OCS EIS/EA
MMS 2007-003

# Outer Continental Shelf Oil & Gas Leasing Program: 2007-2012

## Final Environmental Impact Statement
## April 2007

## Volume II

MMS U.S. Department of the Interior
Minerals Management Service

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# PROPOSED OUTER CONTINENTAL SHELF
# OIL AND GAS LEASING PROGRAM: 2007–2012
# FINAL ENVIRONMENTAL IMPACT STATEMENT

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## APPENDICES

# IV. ENVIRONMENTAL CONSEQUENCES (CONTINUED)

# C. Alternative 2—Exclude North Aleutian Basin

## 1. Description

Under alternative 2, no sales would be held in the North Aleutian Basin Planning Area. There would be no change from alternative 1 in the remaining planning areas. Alternative 2 would result in scheduling 19 sales in 6 planning areas:

- Central Gulf of Mexico—6 annual sales
- Western Gulf of Mexico—5 annual sales
- Beaufort Sea—2 sales
- Chukchi Sea—3 sales
- Cook Inlet—2 sales
- Mid-Atlantic—1 sale

The same means of transporting hydrocarbons to shore from production facilities would be used in all planning areas for alternatives 1 and 2.

## 2. Comparison of Impacts

Excluding the North Aleutian Basin Planning Area would result in one fewer sale in the Alaska Region. All offshore and onshore oil and gas activities and production associated with these sales would not occur. The small amount of oil assumed to be developed under alternative 1 in the North Aleutian Basin would be compensated for by imported oil. It is unlikely that the additional amount of imported oil that could occur under alternative 2 would measurably affect the number of tanker oil spills that occur in other offshore areas in the United States.

Excluding the North Aleutian Basin will forgo the employment and income gains expected from alternative 1 (Table IV-11). Up to 11,500 jobs and $340 million of income were estimated to result from alternative 1 in the North Aleutian Basin area during the life of the 2007-2012 program. Also, alternative 2 will result in forgoing up to 5 Tcf of natural gas estimated to be developed in the North Aleutian Basin and brought to shore via pipeline during the life of the 2007-2012 program. These local gas resources were identified during scoping as being important for the economic development of the area.

Under alternative 1, most impacts to biologic resources in the North Aleutian Basin were evaluated to be short term and localized, and would not result in population-level changes to the species affected under alternative 1. While alternative 2 would result in local or short-term impacts to these resources, population-level impacts to these resources would be essentially the same under both alternative 1 and alternative 2. An exception would occur if under alternative 1 a moderate to large spill resulted in extensive contact along the coast of Bristol Bay where the threatened Steller's eider occurs in large numbers during migration. Another exception would occur if a moderate to large spill occurred and contacted important marine mammal haulout and rookery areas. The endangered Steller sea lion would be particularly vulnerable to this occurrence. Although these population-level impacts are unlikely given the small amount of liquid hydrocarbons that are assumed to be developed and the requirement that the spill, should it occur, contact high concentration areas, such impacts would be eliminated under alternative 2. If a spill did occur under alternative 1 and affected the population of these species, the impacts could affect populations in the Arctic and South Alaska Subregions. During the nonbreeding season, the Steller sea lion disperses widely throughout the Aleutian Islands and Prince William Sound, so impacts to the sea lions in the North Aleutian Basin could affect the population that occurs seasonally in the Cook Inlet area. The breeding range for the Steller's eider in Alaska occurs primarily in the Arctic Coastal Plain between Wainwright and Prudhoe Bay. Impacts to this species in the North Aleutian Basin could affect the breeding population in the Arctic Subregion.

Alternative 2 eliminates all possible effects of OCS activity on subsistence activities. These potential effects include offshore activities interfering with Native hunting patterns and oil spills precluding affected areas from normal hunting activities. While the anticipated small amount of activity in the North Aleutian Basin and associated small volume of liquid hydrocarbons expected to be produced make these occurrences unlikely under alternative 1, alternative 2 removes this risk entirely.

Impacts to air and water quality under alternative 1 in the North Aleutian Basin are expected to be short term and localized because of the small amount of activity anticipated and the largely pristine quality of the air and water environments here. Therefore, alternative 2 would not result in a major difference from alternative 1 for these resources.

The analysis of archaeological resources indicated that existing MMS requirements for archaeological surveys would eliminate most of the possible impacts to historic and prehistoric resources. Impacts could be possible from cleanup operations after an oil spill. However, given the small amount of liquid hydrocarbons expected to be produced under alternative 1, compounded with the requirement that the spill would have to contact areas with historic or prehistoric resources for impacts to occur, alternative 2 is not expected to result in a significant difference from alternative 1 with regard to the potential for archaeological resource impacts.

With the exception to possible impacts to the Steller's eider and the Steller sea lion, the potential impacts of alternative 2 would be the same as those for alternative 1 in all other areas included in alternative 1 (Gulf of Mexico, Beaufort Sea, Chukchi Sea, Cook Inlet, and mid-Atlantic). Impacts to the Steller's eider in the North Aleutian Basin could affect the number of birds that will nest in the Arctic Subregion. Impacts to the Steller sea lion could affect the population in the Cook Inlet area.

# D. Alternative 3—Exclude Cook Inlet

## 1. Description

Under alternative 3, no sales would be held in the Cook Inlet Planning Area. There would be no change from alternative 1 in the remaining areas. Alternative 3 would hold 18 sales in 6 planning areas:

- Central Gulf of Mexico—6 sales
- Western Gulf of Mexico—5 annual sales
- Beaufort Sea—2 sales
- Chukchi Sea—3 sales
- North Aleutian Basin—1 sale
- Mid-Atlantic—1 sale

The same means of transporting hydrocarbons to shore from production facilities would be used in all planning areas for alternatives 1 and 3.

## 2. Comparison of Impacts

Excluding the Cook Inlet Planning Area would result in two fewer sales in the Alaska Region. All offshore and onshore oil and gas activities and production associated with these sales would not occur. The small amount of oil assumed to be developed under alternative 1 in Cook Inlet would be compensated for by imported oil. It is unlikely that the additional amount of imported oil that could occur under alternative 3 will measurably affect the number of tanker oil spills that occur in other offshore areas in the United States.

The analyses of impacts of alternative 1, the proposed action, in Cook Inlet showed in almost all cases temporary and localized impacts. Any disturbance to existing environmental conditions associated with routine operations or an oil spill would be expected to ameliorate on a time scale of days to a year or two Under alternative 3, these short-term localized impacts would not occur. Under alternative 1, no population-level impacts were predicted to biological resources though several endangered and/or threatened bird species would be vulnerable to mortality from oil spills. A moderate to large oil spill could affect a relatively large number of Steller’s eiders that overwinter in Cook Inlet. But because the eider does not breed in Cook Inlet, the breeding populations would not be directly affected, although the number of eiders that arrive in the Arctic for breeding could be reduced. The endangered short-tailed albatross occurs uncommonly in Cook Inlet, so large numbers of birds would not be affected by a spill. Furthermore, the albatross breeds outside Cook Inlet, so the breeding population would not be affected. Kittlitz’s murrelets, a candidate for listing under the Endangered Species Act, also occur in Cook Inlet and would be expected to come in contact with spilled oil while foraging. Impacts to these species under alternative 1 would be contained to the Cook Inlet area and would not extend to other planning areas in Alaska where these species also occur during different life stages or seasons. Under alternative 3, none of these localized impacts to protected species would occur from OCS activity.

While no long-term population-level impacts to terrestrial mammals in the Cook Inlet area are expected under alternative 1, increased mortality of brown and black bears could occur if previously remote areas were converted to industrial use, resulting in increased conflict between bears and humans. A large oil spill that affected intertidal areas could lead to significant mortality of eggs and juvenile fish of pelagic species, such as the salmon, leading to reduced adult survival. The overall fish populations in South Alaska, however, would not be affected. A large spill could temporarily affect fisheries in the area contacted by the spill. While no long-term impacts to the fish populations are expected, economic impacts to commercial and recreational fisheries could result as a result of loss of gear, closings of affected areas, and unavailability of fishing areas during cleanup operations. These temporary and localized impacts in Cook Inlet, which are unlikely given the small amount of activity expected under alternative 1, would be precluded under alternative 3.

Impacts to air and water quality under alternative 1 in Cook Inlet are expected to be short-term and localized because of the small amount of activity anticipated and the largely pristine quality of the air and water environments there. Therefore, alternative 3 will not result in a major difference from alternative 1 for these resources.

The analysis of archaeological resources indicated that existing MMS requirements for archaeological surveys would be expected to eliminate most of the possible impacts to historic and prehistoric resources. Impacts were possible from cleanup operations after an oil spill. Given the small amount of liquid hydrocarbons expected to be produced under alternative 1 in Cook Inlet, compounded with the requirement that the spill would have to contact areas with historic or prehistoric resources for impacts to occur, alternative 3 is not expected to result in a significant difference from alternative 1 with regard to the potential for archaeological resource impacts.

The population, employment and income impacts anticipated under alternative 1 in the Cook Inlet area would not occur under alternative 3. Table IV-11 shows estimates of 5,750 jobs and $170 million in income resulting from alternative 1 in the Cook Inlet area during the life of the 2007-2012 program.

# E. Alternative 4—Exclude Mid-Atlantic

## 1. Description

Under alternative 4, the one lease sale in the Mid-Atlantic Planning Area included in alternative 1 would not occur. There would be no change from alternative 1 in the remaining areas. Alternative 4 would hold 19 sales in 6 planning areas:

- Central Gulf of Mexico—6 sales
- Western Gulf of Mexico—5 annual sales
- Beaufort Sea—2 sales
- Chukchi Sea—3 sales
- Cook Inlet—2 sales
- North Aleutian Basin—1 sale

The same means of transporting hydrocarbons to shore from production facilities would be used in all planning areas for alternatives 1 and 4.

## 2. Comparison of Impacts

Because of the small amount of anticipated activity and production offshore Virginia under alternative 1, in most cases the impacts of alternative 4 are similar to those of alternative 1. Under alternative 4, there would be a slight increase in U.S. imported liquid hydrocarbons to compensate for the oil and condensate that could be developed offshore Virginia. The anticipated amount is too small, however, to result in a statistically significant change in probability of oil spills from import tanker accidents.

In general, no population-level impacts to biological resources would occur under alternative 1. Possible exceptions could occur for the right whale and for sea turtles. The right whale is particularly susceptible to being struck by ocean vessels. A mortality resulting from a service vessel or shuttle tanker/barge collision with a right whale could have population-level impacts to the total right whale population of 300 to 350 individuals. With only one to five service vessel trips per week estimated under alternative 1 (Table IV-3), the risk of collision is very low. This slight risk would be eliminated, however, under alternative 4. However, under alternative 4, the additional tankers needed to import oil and/or liquefied natural gas to compensate for the hydrocarbons not produced offshore Virginia would pose a similar risk to the right whale. Although unlikely, population-level impacts to sea turtles in the mid-Atlantic are possible from oil spills. Alternative 4 would eliminate this possibility.

The small amount of activity offshore Virginia associated with alternative 1 is not expected to result in any measurable impacts to population, infrastructure, employment, income, or environmental justice. The Norfolk/Hampton Roads area, the staging area for onshore support activity and the area that would experience most of the socioeconomic effects, is a diversified economic area with a large existing marine industry. Although the socioeconomic effects of alternative 1 are insignificant, they would not occur under alternative 4. A large spill affecting coastal areas could affect tourism and recreation activities and business for several months to a year under alternative 1. Also, an offshore production structure could be visible from shore depending on its proximity. Because the area is a major port, large ocean-going vessels commonly occur near the coastline. Construction of a single offshore platform would add a fixed structure to the horizon that would remain for decades, which would contrast with the vessels moving in and out of the Hampton Roads area day-to-day. Also, the addition of the platform would have possible positive impacts on recreational fishing and underwater diving near the structure, which could serve as an artificial reef. Both the possible positive and negative impacts to tourism and recreation activities would not occur under alternative 4.

Impacts to air and water quality under alternative 1 in the mid-Atlantic offshore Virginia are expected to be short-term and localized because of the small amount of activity anticipated. Alternative 1 would have a small incremental effect on the existing air and water quality conditions in this industrialized and urbanized area. This incremental effect would not occur under alternative 4.

The analysis of archaeological resources indicated that existing MMS requirements for archaeological surveys would eliminate most of the possible impacts to historic and prehistoric resources. Impacts were possible from cleanup operations after an oil spill. Under alternative 4, most of the small amount of liquid hydrocarbons expected to be produced under alternative 1 in the mid-Atlantic would be replaced by imported oil. Whether the oil is imported or produced offshore, a spill would have to contact areas with historic or prehistoric resources for impacts to occur. Therefore, alternatives 1 and 4 would be similar with respect to the potential for archaeological resource impacts.

The potential impacts of alternative 4 would be the same as for alternative 1 in all other areas included in alternative 1 (Gulf of Mexico, Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet).

# F. Alternative 5—Defer Blocks Within 25 Miles of Virginia and Chukchi Sea Coasts

## 1. Description

This alternative considers the impacts associated with not leasing within 25 miles of the Virginia and Chukchi Sea coasts. The alternative would affect the locations within a planning area that is available for leasing, not the schedule of lease sales.

Alternative 5 would affect the impacts from sales in:

- Chukchi Sea (Alaska) - 3 lease sales scheduled in 2007, 2010, and 2012
- Mid-Atlantic (Virginia) - 1 sale in 2011, which is subject to restrictions

Sale-related activities identified for the proposed action (alternative 1) would have a reduced impact to shore and nearshore communities under this 25-mile buffer alternative. Offshore infrastructure such as rigs and platforms would be located further from shore. This would make the structures essentially beyond the normal visual field of most individuals. Length of pipelines and length of travel by vessels may increase, but coastal water quality effects from discharge of drilling fluids and air and noise emissions from platforms would be partially reduced.

## 2. Comparison of Impacts

### a. Chukchi Sea

A 25-mile buffer zone would reduce, but not entirely eliminate, impacts to water quality from exploration, construction activities, and discharges. Short-term impacts would still be expected to occur from pipeline construction and vessels, and there would remain a slight risk of an oil spill from a pipeline breakage. There would be no gravel island or ice roads constructed in the Chukchi Sea under this alternative, thus eliminating temporary water quality impacts from those sources. However, there would remain coastal water quality impacts from construction of pipeline landfalls, onshore pipelines, and other onshore infrastructure.

Potential onshore air quality impacts for the Chukchi Sea would be lower than those for the proposed action because drilling and production platforms may be located at larger distances from shore. Air quality impacts from pipeline construction, support vessel traffic, and onshore support facilities would remain the same as in alternative 1.

This alternative would reduce potential impacts to marine mammals from noise and discharges compared with the proposed action. However, some risk of impacts from vessels and aircraft would still exist. In the Arctic, vessels, construction of ice roads, on-ice vehicles, and aircraft have been known to affect polar bear behavior (e.g., they may abandon dens, which could reduce cub survival). With a 25-mile buffer in the Chukchi Sea, impacts from ice roads or on-ice vehicles would be eliminated, but possible impacts related to noise from aircraft would be similar to those associated with the proposed action.

Mitigation measures are in place that may subject areas to seasonal drilling restrictions to prevent the endangered bowhead whale from being disrupted during its migration and when it is most likely to be hunted. The endangered fin and humpback whales would also be protected by the same mitigation measures developed to minimize disturbance to bowhead whales. The 25-mile buffer would provide additional protection to the bowhead whales during their spring migration.

Fewer marine and coastal birds would be impacted by seismic surveys, exploratory drilling, and offshore facilities. Any impacts that would arise from offshore gravel islands and ice roads would be eliminated. However, impacts from pipeline landfalls and onshore support facilities would not be reduced.

The potential for adverse impacts from oil spills on water quality, marine mammals, marine and coastal birds, coastal habitats, benthic communities, fish resources and essential fish habitats (EFH), and archaeological resources would be reduced compared with that for the proposed action. This is mainly because the proposed action has the potential to effect both coastal and offshore areas where the 25-mile buffer zone would limit the potential for impacts in nearshore or coastal waters. This alternative would also reduce potential effects of a large oil spill on portions of the Chukchi Sea Unit of the Alaska Maritime National Wildlife Refuge. The establishment of a 25-mile buffer would substantially reduce potential impacts on Native subsistence. Possible adverse health or environmental impacts from changes in subsistence resources and harvest patterns would be reduced. A reduction in the likelihood of an oil spill would make adverse effects on Native subsistence resources and harvests less likely.

The impacts to terrestrial animals, coastal habitats, land use and existing infrastructure, population, employment, regional income, tourism, and recreation would be essentially the same as those for the proposed action since the need for onshore support facilities and pipelines would not change.

## b. Mid-Atlantic

Potential onshore air quality impacts for the mid-Atlantic area would be reduced because drilling and production platforms would be located at greater distances from shore. Air quality impacts from pipeline construction, support vessel traffic, and onshore support facilities would remain the same as those in the proposed action. Portions of the southeastern Virginia coastal area are classified nonattainment for ozone. While the Proposed Program would have very little effect on onshore ozone levels, the 25-mile buffer would further reduce the possibility of any measurable effects on the nonattainment area.

The effects of underwater noise on marine mammals would be largely eliminated within the 25-mile buffer zone. However, the risk of collisions between vessels and marine mammals, including the right whale, would still exist. Impacts from vessel and aircraft traffic would be essentially the same as those in alternative 1.

Under the proposed action, marine and coastal bird populations on the mid-Atlantic would not be measurably affected by routine activities. A 25-mile buffer would lessen any already-minimal impact on both shore and nearshore communities. Impacts from routine activities on water quality, fish resources and EFH, turtles, and seafloor habitats would be lower than those for alternative 1. The 25-mile buffer would eliminate the potential visual impacts from beaches and other recreation sites, and impacts to coastal National Register and National Register-eligible historic properties.

The potential for adverse impacts from oil spills on water quality, marine mammals, marine and coastal birds, sea turtles, benthic communities, fish resources and EFH, and archaeological resources would be reduced. A reduction in the chance of a nearshore oil spill would also reduce possible longer term adverse effects on tourism.  However, a risk of a large spill from tanker transport of oil would still exist.

The impacts to terrestrial animals, coastal habitats, land use and existing infrastructure, population, employment, and regional income, would be essentially the same as those for alternative 1 since the need for onshore support facilities and pipelines would not change.

In summary when compared to alternative 1, this alternative would reduce potential impacts on water quality, air quality, marine mammals, marine and coastal birds, fish resources, seafloor habitats, and archaeological resources in the Chukchi Sea and in the mid-Atlantic area.  Impacts to terrestrial animals, coastal habitats, land use and existing infrastructure, population, employment, and regional income would be essentially the same as those for alternative 1.

Potential impacts on polar bears in the Chukchi Sea would be reduced, and impacts on Native subsistence and hunting patterns would be substantially reduced.  In the mid-Atlantic area, this alternative would eliminate potential visual impacts from beaches.

# G. Alternative 6—Defer Blocks at the Mouth of the Chesapeake Bay

## 1. Description

This alternative would affect the locations within a planning area that is available for leasing, not the schedule of lease sales. Alternative 8 would affect the potential impacts from sales in:

- Mid-Atlantic – 1 sale in 2011

Under alternative 6, the area offered in the mid-Atlantic lease sale would be reduced by eliminating the lease blocks within a wedge-shaped area offshore the entrance to the Chesapeake Bay. There would be no change from alternative 1 in the remaining OCS sale areas. For the purpose of this analysis, it is assumed that the deletion of these lease blocks would not significantly change the resource estimates or the development scenario for the mid-Atlantic sale area. It is also assumed that deletion of these tracts would not significantly change the general geographic location of the one platform assumed under the development scenario for alternative 1.

## 2. Comparison of Impacts

This alternative would affect impact levels only within the mid-Atlantic sale area. In all other OCS areas, there would be no change from the impacts described for alternative 1. Because it is assumed that the deletion of the wedge-shaped area offshore the entrance to the Chesapeake Bay would not significantly change the development scenario for the mid-Atlantic sale area described under alternative 1, in most cases the impacts of alternative 6 are the same as those described for alternative 1.

Under alternative 1, there is a slight potential for population-level impacts for the right whale and for sea turtles. The right whale is particularly susceptible to being struck by ocean vessels. A mortality resulting from a service vessel or shuttle tanker/barge collision with a right whale could have population-level impacts to the total right whale population of 300 to 350 individuals. With only one to five service vessel trips per week estimated under alternative 1 (Table IV-3), the risk of collision is very low. Because the development scenario would not change under alternative 6, this slight risk would remain unchanged. Although unlikely, population-level impacts to sea turtles in the mid-Atlantic sale area are possible from oil spills. The possible oil-spill-related impacts to sea turtles described under alternative 1 would remain unchanged under alternative 6.

The small amount of activity offshore Virginia associated with alternative 1 would result in no measurable impacts to population, infrastructure, employment, income, or environmental justice. The Norfolk/Hampton Roads area, the staging area for onshore support activity and the area that would experience most of the socioeconomic effects, is a diversified economic area with a large existing marine industry. The socioeconomic effects of alternative 1 are insignificant, and they would remain so under alternative 6.

Under alternative 6, both the possible positive and negative impacts to tourism and recreation activities described under alternative 1, would most likely remain unchanged. The one, large, 1,500-bbl oil spill from a tanker or barge assumed under alternative 1 would remain unchanged for this alternative. If such a spill reached the coastal area, it could affect tourism and recreation activities and business for several months to a year. The one production platform assumed for the development scenario could be visible from shore, depending on where it was located within the sale area. For the purpose of this analysis, it is assumed that the general geographic location of the platform projected for the mid-Atlantic sale area under alternative 1 would not significantly change; therefore, the potential visual impacts would remain the same as those described for alternative 1. The placement of the platform within the mid-Atlantic sale area likely would have positive impacts on recreational fishing and diving near the structure, as the platform would serve as an artificial reef.

Impacts to air and water quality under alternative 1 in the mid-Atlantic area offshore Virginia are expected to be short-term and localized because of the small amount of activity anticipated. Alternative 1 would have a small incremental effect on the existing air and water quality conditions in this industrialized and urbanized area. This incremental effect would remain unchanged under alternative 6.

Under alternative 6, deletion of the area offshore the Chesapeake Bay entrance would remove the area of highest archaeological potential from the mid-Atlantic sale area. Both historic shipwrecks and prehistoric archaeological sites tend to be more concentrated in the vicinity of major embayments. Embayments both focused historic shipping activities and were the locations of major river valleys on the prehistoric landscape before they were submerged by rising sea level. Although, as discussed under alternative 1, existing MMS requirements for archaeological surveys would eliminate most of the possible impacts to historic and prehistoric resources; under alternative 6, the low potential for adverse impacts to archaeological resources would be even further reduced. Because the development scenario under alternative 6 is assumed to be the same as for alternative 1, the potential impact to archaeological resources from oil-spill cleanup operations would remain the same.

Based on the assumptions that the development scenario and the location of the one projected platform outlined for alternative 1 would remain unchanged under alternative 6, the potential impacts described for alternative 1 would also remain unchanged under alternative 6, with one minor exception. The low potential for direct physical impacts to archaeological resources from exploration and development activities under alternative 1 would be reduced even further.

# H. Alternative 7—Limit Leasing in North Aleutian Basin Planning Area to Blocks Offered in Sale 92

The alternative would affect the locations within a planning area that is available for leasing, not the schedule of lease sales. Alternative 7 would affect the potential impacts from sales in:

- North Aleutian Basin – 1 sale scheduled in 2011

## 1. Description

Under alternative 7, the area offered in the North Aleutian Basin Planning Area would be reduced to 990 blocks (approximately 2.27 million hectares) forming a wedge-shaped area that ranges from 18 to about 185 km offshore of the Alaska Peninsula, the same area proposed for the earlier North Aleutian Basin Lease Sale 92. This alternative includes the entire geographic area in which program-related offshore oil and gas activities were projected to occur under the alternative 1 development scenario. Therefore, for the purpose of this analysis, it is assumed that this limitation alternative would not significantly change the resource estimates or the development scenario for the North Aleutian Basin sale area, nor change the general geographic location of sale-related activities. The development scenarios under alternative 1 and alternative 7 assume there will be no more than six offshore platforms.

## 2. Comparison of Impacts

This alternative would affect impact levels only within the North Aleutian Basin sale area. In all other OCS areas, there would be no change from the impacts described for alternative 1. Because it is expected that under alternative 1 all offshore sale-related activities would occur within this reduced area, it is assumed that alternative 7 would not substantially change the development scenario for the North Aleutian Basin sale area described under alternative 1. In most cases, the impacts of alternative 7 are the same as those described for alternative 1.

Under alternative 1, no population-level impacts are expected from routine operations on marine mammals, birds, and fish. Because the development scenario would not change under alternative 7, this slight risk would remain unchanged. While a large oil spill is unlikely, should one occur it could have population-level effects on one or more species of marine mammals or birds, including the Steller sea lion and Steller's eider. While the overall risk of an oil spill would not change under alternative 7, the slight risk of adverse impacts to the Steller sea lion and Steller's eider would be reduced still further by limiting oil-related activity to the southern portion of the planning area.

Under alternative 7, as under alternative 1, impacts to population, infrastructure, employment, income, and environmental justice are expected to be small and would be limited further under mitigation measures. Impacts to tourism and recreation activities would also be small in scale and duration. They would be most concentrated during development and limited afterwards to the few locations of onshore industrial infrastructure.

Impacts to air and water quality under alternative 1 in the North Aleutian Basin sale area are expected to be short-term and localized because of the small amount of activity anticipated. These effects would remain unchanged under alternative 7.

As discussed under alternative 1, existing MMS requirements for archaeological surveys would eliminate most of the possible impacts to historic and prehistoric resources; under alternative 7, the low potential for adverse impacts to archaeological resources would be even further reduced by further limiting the geographic area of possible industry activity.

This alternative includes the entire geographic area in which program-related offshore oil and gas activities were projected to occur under the alternative 1 development scenario. Therefore, it is not expected to substantially affect the impact levels that would be expected to occur under alternative 1. However, by limiting oil-related activities to the southern portion of the planning area, it would reduce slightly the already slight risk of adverse impacts to the Steller sea lion and Steller's eider.

# I. Alternative 8—Defer Blocks in the Beaufort Sea Planning Area to Avoid Conflicts with Whaling

The alternative would affect the locations within a planning area that is available for leasing, not the schedule of lease sales. Alternative 8 would affect the potential impacts from sales in:

- Beaufort Sea—2 lease sales scheduled in 2009 and 2011

## 1. Description

This alternative is based on two alternatives that were included in the Beaufort Sea Planning Area EIS to protect subsistence hunting (MMS, 2003). These alternatives are:

- The Barrow Subsistence Whaling Deferral that defers 26 whole or partial blocks located at the western border of the planning area
- The Kaktovik Subsistence Whaling Deferral that defers 28 whole or partial blocks located offshore of Kaktovik.

## 2. Comparison of Impacts

This alternative would affect impact levels only within the Beaufort Sea sale area. In all other OCS areas, there would be no change from the impacts described for alternative 1.

This alternative would include two deferral areas in the Beaufort Sea to reduce potential conflicts between whale subsistence hunters and OCS operations. These deferral areas were identified by the Alaska Eskimo Whaling Commission and the subsistence hunting community based on whale strike data. This alternative would largely eliminate potential subsistence impacts from routine operations in these areas that are known to be important for subsistence whale hunting. The absence of any OCS infrastructure in the deferred areas would also reduce the potential effects of OCS activity on whale behavior. Subsistence hunting and the hunted animals would remain susceptible to affects from an oil spill or other discharges that affect water and/or air quality occurring in blocks outside the deferral areas.

These deferrals would account for 54 of the nearly 2,000 blocks available for leasing in the Beaufort Sea. Based on the small area deferred compared to the total area available for leasing potential impacts to other resources other than subsistence hunting would not be affected.

## J. Alternative 9— Defer Blocks Within 50 Miles of Virginia with Other Possible Restrictions

### 1. Description

This analysis considers the impacts associated with not leasing within 50 miles of the Virginia coast. It also includes the deferral of the wedge-shaped area offshore the mouth of the Chesapeake Bay analyzed in alternative 6. Other restrictions may apply, including exploration-only and gas-only leasing.

Alternative 9 would affect the impacts from one sale in:

- Mid-Atlantic (Virginia) - 1 sale in 2011, which is subject to restrictions

### 2. Comparison of Impacts

The analyses are done for three scenarios: (1) oil and gas exploration and development leasing beyond 50 miles, (2) exploration-only leasing beyond 50 miles, and (3) gas-only exploration and development leasing beyond 50 miles.

#### a. Oil and Gas Exploration and Development beyond 50 Miles

The 50-mile deferral under alternative 9 extends the 25-mile coastal Virginia deferral that was analyzed in alternative 5. Alternative 9 also includes the blocks deferred under Alternative 6 that extend beyond 50 miles. The level of exploration and development activities shown in Table IV-3 are used in the analysis of this alternative because geologic evidence suggests that the greatest resource potential occurs farther offshore (MMS, 2001h). Potential onshore air quality impacts for the mid-Atlantic area would be further reduced, compared to alternative 1, because of greater distances between offshore activities and the shoreline.

The effects of underwater noise on marine mammals would be largely eliminated within the 50-mile buffer zone. However, the risk of collisions between vessels and marine mammals, including the right whale, would still exist, although possibly to a reduced extent because of more usage of helicopters for the long distances offshore. Impacts from vessel and aircraft traffic, however, would be essentially the same as those in alternative 1.

Under the proposed action, marine and coastal bird populations in the mid-Atlantic would not be measurably affected by routine activities. A 50-mile buffer would lessen any already-minimal impact on both shore and nearshore communities. Potential impacts from routine activities on coastal water quality, fish resources and EFH, turtles, and seafloor habitats would be equal to or lower than those for alternative 1. The 50-mile buffer puts all oil and gas structures beyond the coastal view shed. Impacts to coastal National Register and National Register-eligible historic properties would be avoided also.

As discussed in the analysis of alternative 5, which considered a 25-mile coastal deferral off the Virginia coast, the potential for adverse impacts from oil spills from an OCS platform to coastal water quality, marine mammals, marine and coastal birds, sea turtles, benthic communities, fish resources and EFH, and archaeological resources would be reduced. A reduction in the chance of a nearshore oil spill would also reduce possible longer term adverse effects on tourism. However, a risk of a large spill from tanker transport of oil would still exist.

The impacts to coastal habitats, land use and existing infrastructure, population, employment, and regional income, would be essentially the same as those for alternative 1 since the need for onshore support facilities and pipelines would not change.

This alternative reduces potential impacts to coastal water quality, air quality, marine mammals, marine and coastal birds, fish resources, seafloor habitats, and archaeological resources in the mid-Atlantic area. Impacts to coastal habitats would be less than in Alternative 1 that considered development closer to shore. Land use and existing infrastructure, population, employment, and regional income would be essentially the same as those for alternative 1.

## b. Exploration-Only beyond 50 Miles

Under this scenario, there would be no development activity occurring in the Mid-Atlantic Planning Area as a result of the one sale in the 2007-2012 program. We assume that adequate exploration and delineation of potential resources offshore Virginia will likely be achieved through exploration activities resulting from this (2007-2012) and subsequent 5-year programs combined (MMS internal memo). The timeframe for establishing a natural gas production, transportation and processing system in the mid-Atlantic will likely exceed the timeframe of the life of the 2007-2012 program. We therefore assume no development activity will occur as a direct result of the 2007-2012 program.

Compared to the analysis of impacts under alternative 1, this alternative would eliminate potential impacts from pipeline landfalls, processing/terminal facilities, and the large tanker/barge oil spill that was included in the scenario analysis of alternative 1. We assume that the level of exploration activity under this alternative would be less than under alternative 1 because the exploration-only restriction could reduce interest in leasing. This would result in reduced service vessel traffic reducing the already small chance of collisions with marine mammals. Under an exploration-only restriction, industry would outsource much of the offshore work and utilize existing onshore infrastructure to operate from rather than investing in new facilities. This would lessen the occurrence of impacts to local employment, population, infrastructure, or sociocultural systems. An oil spill at an exploratory well is unlikely, particularly if the gas-only clause is in effect. In the Gulf of Mexico, only 25 spills of 50 bbl or greater have occurred at exploration wells. Most of these were diesel and fuel spills from storage tanks; only 5 were crude or condensate spills associated with blowouts. Furthermore, only two of the spills from blowouts have occurred since 1990; one 100-bbl spill and one 200-bbl spill. In the unlikely event that a large oil/condensate or fuel spill should occur at an offshore exploration site, its distance offshore argues against the occurrence of measurable coastal impacts.

## c. Gas-Only Exploration and Development beyond 50 Miles

This scenario adds potential gas development impacts to the exploration-only scenario discussed above. A known sizeable quantity of natural gas would need to be available before development could proceed to justify the large investment required for a pipeline over 50 miles long and production and processing facilities. It is unlikely that the 10 to 15 exploration and delineation wells assumed to be drilled as a result of the one lease sale held during the 2007-2012 program will develop the information about available gas resources to support gas development. As was the case with the exploration-only analysis, we assume that adequate exploration and delineation of potential resources offshore Virginia will likely be achieved through exploration activities resulting from this (2007-2012) and subsequent 5-year programs combined. Furthermore, the technology available to extract, process, and transport gas at the time in the future when gas development occurs may be so different from the technology used today that an analysis of development impacts now would be of little value. In general, however, gas-only development impacts would be similar to the development impacts evaluated for alternatives 1 and 5, other than the fact that there would be no impacts from the transportation of oil. Also, the chances of an oil-spill occurrence at a gas production facility would be less than at an oil platform.

## K. Environmental Impacts of Alternative 10—No Action

The no action alternative corresponds to a situation where the USDOI does not adopt the proposed action in 2007-2012 program or any other active OCS leasing schedule for the 2007-2012 period. Thus, no oil and natural gas would be produced from this program. The amount of oil and natural gas forgone is shown in Tables IV-1, IV-2, and IV-3.

Under the no action alternative, none of the environmental impacts associated with the proposed action would be expected to occur. The proposed action also would not contribute to cumulative effects; however, the effects from other activities would still be expected to occur.

The impacts of the proposed action on employment, regional income, and the sociocultural stability of regions also would not be expected to occur under the no action alternative. However, unlike the natural environment, the human environment might experience direct negative effects from no action. The offshore oil and natural gas industry operates on a continuing stream of new leases that are explored and developed over time. If a 5-year interruption occurs in the leasing process, this interruption will inevitably lead to a disruption in the normal development sequence. It is this type of interruption that is characteristic of the “boom and bust” condition that many local jurisdictions fear. It is very difficult to estimate with any degree of accuracy how a regional economy will react to a loss of employment and income in one sector. Nevertheless, it is safe to say that the net effect of an economic loss of the type represented by the no action alternative would have a measurable impact on the regional economies involved. Substitutes for OCS oil and natural gas will also create regional socioeconomic impacts of varying degrees. Where those impacts are expected to be of consequence, they are addressed in the appropriate sections below.

Failure to implement the proposed action would force the economy to substitute energy from alternative sources for the resulting lower production of OCS oil and natural gas. The next section lists the uses of oil, natural gas, and natural gas liquids. Following that is a section that identifies the most likely sources of alternative energy to meet the demand for those uses. This section includes an analysis of the environmental impacts associated with these alternative energy sources.[1] The succeeding section discusses energy alternatives that government may impose along with the environmental impacts of those alternatives. The final section consists of a short note on the very important topic of conservation.

### 1. Uses for Oil, Natural Gas, and Natural Gas Liquids

The first step in determining which sources of energy will replace lost OCS production is to identify the uses of the oil, natural gas, and natural gas liquids (NGL's) produced on the OCS. The NGL's are liquids removed from streams of natural gas production that are similar to and are used in similar ways to the lighter fractions of crude oil.

#### a. Oil and NGL's

The MMS identified and considered the following uses for oil and NGL's in the U.S. economy:

[1]The discussion of energy alternatives under the no action alternative is based on material in *Energy Alternatives and the Environment* (TKC Communications, 2007a), available from the MMS Environmental Division, Herndon, VA.

- Transportation vehicle and machinery fuel
  - gasoline powered cars, light trucks and buses, boats, aircraft, tractors, and small engines
  - diesel powered cars, trucks, buses, trains, boats, tractors, and machinery
  - jet aircraft
  - steam powered ships
  - propane powered industrial vehicles
- Industrial sector uses
  - industrial process heat and steam
  - drying and interior space heating and cooling
  - cogeneration
- Residential and commercial sector uses
  - interior space heating and cooling
  - hot water
  - appliances
- Electricity generation
  - steam boilers
  - diesel generators
- Nonenergy uses
  - chemical feedstock
  - solvents, lubricants, asphalts, and waxes

Table IV-25 provides statistics on quantities and percentages of oil-based products used in each energy category or sector. As the table shows, oil provides about 39 percent of our energy on a British thermal unit (Btu) basis. It dominates transportation to such an extent that it can be said that U.S. transportation runs on oil. Oil is an important, but not dominant, source of energy to industry. It makes a modest contribution to the residential and commercial sector and only a minor contribution in electricity generation.

## b. Natural Gas

The MMS identified and considered the following uses for natural gas in the U.S. economy:

- Electricity generation
  - steam boilers
  - turbines
  - combined cycle
- Industrial sector uses
  - industrial process heat and steam
  - drying and interior space heating and cooling
  - cogeneration
- residential and commercial sector uses
  - interior space heating and cooling
  - hot water
  - appliances
- Transportation vehicle fuel
- Chemical feedstock

As Table IV-26 shows, the industrial sector is the number one consumer of natural gas followed closely by the residential and commercial sectors. Electricity generation uses less gas than the preceding sectors; however, it is the fastest growing major use of natural gas. The figure shown for transportation refers only to the use of natural gas in pipeline transportation.

## 2. Most Likely Alternative Energy Mix and Its Impacts

Table IV-27 identifies the "most likely" set of energy alternatives that the economy would adopt in response to the no action alternative. The estimates in this table were generated using MarketSim, a model developed to analyze energy alternatives and other economic aspects of the 5-year program. The model and the estimates in the table assume that basic economic decisions in the U.S. economy will continue to be made through the free market system. The Federal Government might also impose certain energy alternatives on the economy to accomplish various political and environmental goals. Alternatives that might be imposed by the Federal Government are discussed below and at greater length in TKC Communications (2007a).

In Table IV-27, all of the numbers are in relation to the production assumed to occur as a result of the proposed action but lost in the no action alternative. Focusing first on oil production, the overwhelming percentage (88%) of lost OCS production will be made up by importing oil. Smaller percentages will be substituted by conservation (5% on an energy equivalent basis), increased onshore production (3%), and switching to natural gas (4% on an energy equivalent basis).

The market will substitute about 28 percent of lost OCS gas production with onshore gas, about 39 or 40 percent on an energy equivalent basis by switching to oil, about 16 percent on an energy equivalent basis with conservation, and about 16 percent with imports. In assessing the process of substituting oil for lost OCS gas, the MMS assumes that the percent of additional oil the economy obtains through imports is the same as the percentage calculated for the case of lost OCS oil (88%). As a result, the switch from natural gas to oil will induce additional imports of between 1.3 and 2.3 billion barrels of oil (BBO) over 40 years.

As stated in the introduction to this section, none of the negative environmental impacts and risks associated with the proposed action (including incremental contributions to the cumulative case) would be expected to occur under the no action alternative. However, the energy alternatives substituted for the lost OCS production would have negative impacts of their own.

### a. Replacements for OCS Oil and NGL's

#### (1) Increased Oil Imports

Table IV-27 shows a significant increase in U.S. imports of crude oil as a result of the no action alternative. These additional imports both replace a portion of the decreased OCS oil production and respond to fuel switching to oil occasioned by the decrease in OCS natural gas production. An insignificant amount of additional employment related to additional imports would probably occur in and around ports and in the transportation sector as imported oil moves to refineries. Available models probably could not measure the overall effect on regional economies and regional social stability from additional imports.

The additional crude oil imports associated with the no action alternative increase the risk of large oil spills. Table IV-28 shows the estimated additional spills greater than 1,000 bbl, along with their probabilities, associated with the no action alternative. These spills are expected to lead to the most significant negative environmental impacts associated with the no action alternative. Other significant environmental impacts associated with the expanded importation of oil include:

- generation of greenhouse gases and regulated air pollutants from both transport and dockside activities (emissions of $NO_x$, $SO_x$, and VOC's having an impact on acid rain, tropospheric ozone formation, and stratospheric ozone depletion);
- degradation of water quality in the instances of oil spills from either accidental or intentional discharges or tanker casualties;
- possible destruction of flora and fauna and recreational and scenic land and water areas in the instance of oil spills; and
- public fear of the increased likelihood of oil spills.

Citizens are concerned about the oil spills associated with imports. Imported oil is the single largest component in the replacement mix, consisting of 88 percent of the lost oil and about 35 percent of the lost natural gas on an energy equivalent basis. Therefore, the environmental impact analysis of the no action alternative focuses on oil importation.

Large oil spills resulting from additional imports associated with the no action alternative are expected to lead to the Region-specific impacts described below.

**Gulf of Mexico Region:** The no action alternative will eliminate all lease sales (11) in the Gulf of Mexico proposed for the 2007-2012 program. The elimination of lease sales in the Gulf of Mexico would eliminate all impacts, positive and negative, associated with the proposed action. The incremental contribution of the proposed action to cumulative effects would also be eliminated, but such effects from other activities, including past lease sales and potential future OCS program activities, would remain. It is assumed that most of the replacement energy would be from imported oil. Table IV-28 presents the number of large spills associated with the no action alternative and the probability of occurrence. It is estimated that about one-fourth of the number of large oil spills estimated for the proposed action would be expected to occur in the Gulf of Mexico if the no action alternative were adopted. The source of large spills changes considerably. For the proposed action, the primary spill source would be pipelines (50%) followed by platform spills (38%), with tanker spills playing a minor role (12%). All spills, as a result of the no action alternative, would result from tankers since almost all replacement oil would be imported.

The source of spills is important when considering the risk to coastal areas within the Gulf of Mexico. The size of the spills and the most likely locations of the spills are important factors as well. Based on recent leasing and development trends in the Gulf of Mexico. The MMS estimates that up to 75 percent of the activity associated with the 2007-2012 program will occur in deep or ultradeep water in the Gulf of Mexico. These deepwater areas are typically located at substantial distances from the coast so that platform spills would likely not affect coastal and nearshore resources. Spills from OCS pipelines have occurred more frequently closer to the shoreline where anchor damage can occur more easily. However, the average tanker spill is twice the size of the average OCS pipeline spill. Several very large tanker spills have occurred in the Gulf area (the *Mega Borg*, 93,000 bbl; *Burmah Agate*, 248,000 bbl; and the Ocean 255 barge, 231,000 bbl), two of which were similar to the *Exxon Valdez* (241,000 bbl) in size.

If the no action alternative were adopted, the principal cause of impacts would be from coastal tanker spills. The increased risk of large spills would increase somewhat the severity of impacts on the following resources:

- marine or coastal birds,
- marine turtles,
- estuarine-dependent fish species,
- commercial and recreational fishing, and
- beach recreation and related tourism.

Furthermore, wetland losses could be twice the amount estimated for the proposed action. The employment estimated to result from the proposal would not be expected to occur, nor would the resulting in-migration. On the other hand, the no action alternative would result in a decreased risk to topographic features and live bottoms from oil spills and installation of drilling rigs, platforms, and pipelines.

**Alaska Region:** The proposed action includes sales in four Alaska planning areas: Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet. It is assumed that tankers to west coast ports would transport any oil produced from the Beaufort Sea and Chukchi Sea areas. North Aleutian Basin's small expected production will be transported to shore via pipeline. Gas will be converted to Liquefied Natural Gas (LNG) at a new LNG facility on the Alaska peninsula and then transported to the U.S. west coast. About one-third of the oil produced in Cook Inlet would be refined at Nikiski; the rest would be tankered to the west coast.

If the no action alternative is adopted, most of the oil that would have been produced from sales in the Alaska planning areas will be replaced by foreign imports. It is assumed that tankers would transport these imports to west coast ports. Therefore, the no action alternative would eliminate the potential impacts from the proposal that could occur in the Alaska planning areas other than Cook Inlet. Specifically, none of the impacts of exploration, development, and production activities described for the proposal would be expected to occur in Alaska waters or in Alaska coastal areas (except Cook Inlet). No wells would be drilled, and no oil or gas would be produced and transported; therefore, no oil spills could occur from proposal-related OCS activities that could adversely affect environmental resources.

Oil that would have been produced from the Cook Inlet sale and refined in Nikiski would most likely be replaced by additional oil from the Port of Valdez if the no action alternative were adopted. There is a 4 to 9 percent probability that an oil spill of 1,000 bbl or more would be expected to occur from these additional tankers (Table IV-28).

**Pacific Region:** Because no sales are proposed in the Pacific Region, the only impacts that could occur on the west coast would be the result of oil spills from tankers transporting oil from the Alaska Region to west coast ports. It is estimated that as many as two tanker spills of 1,000 bbl or more could occur anywhere along the tanker route from the Port of Valdez to west coast ports. It is assumed that these spills would occur in Alaskan waters or in the Pacific Region.

The risk of these tanker spills is eliminated if the no action alternative is adopted. However, it is estimated that some of the oil that would have been produced from the sales proposed for the Alaska OCS will be replaced by imported oil. Based on the estimated amount of additional oil that would be imported, up to two tanker spills of 1,000 bbl or more could occur in the Pacific Region (Table IV-28). Therefore, the risk of a tanker spill occurring in the Pacific Region is about the same for the no action alternative as for the proposed action.

## (2) Domestic Onshore Oil Production

The greatest potential for significantly increasing the domestic crude oil supply lies with the successful application of enhanced oil recovery (EOR) processes to known reservoirs, and by additional drilling in existing fields (infill drilling). The EOR processes include chemical flooding, miscible flooding, and thermal recovery methods. A key feature common to all three methods is the need to inject liquids or gases to mobilize and displace otherwise unrecoverable oil. The EOR activities do not usually impose significant additional negative impacts in areas where primary and secondary recovery have already occurred.

The major environmental impacts associated with expanded domestic onshore oil production using EOR techniques include potential degradation of local ambient air quality from atmospheric emissions of dust, engine exhaust, off-well gases, gas flaring products, particulates, $SO_2$, CO, $NO_x$, $H_2S$, and hydrocarbons. These releases can lead to acid deposition, an increase in tropospheric ozone, depletion of stratospheric ozone, and potential degradation of local and national air quality due to emissions of greenhouse gases, especially $CO_2$ used in miscible flooding. Additional impacts could include:

- possible degradation of both surface water and groundwater quality from spills or leaks of process chemicals during handling, mixing, or injection;
- increased potential for chemical contamination of drinking water by injected fluids left in the reservoir; and
- expanded land use through more intensive field development, (i.e., more wells, roads, injection lines, and facilities).

Finally, workers may face health risks from the handling of the toxic chemicals used in thermal and chemical recovery processes.

Additional domestic onshore oil exploration, development, and production occasioned by the decrease in OCS activity would employ some of the workers displaced from the offshore industry. This would tend to ameliorate some of the negative impacts on regional employment, income, and social stability. However, much of the additional employment would be expected to occur outside the normal OCS service areas. This would mean that either job opportunities would be unavailable to the displaced workers, or it would tend to lead to community instability as families are uprooted or torn apart as workers leave their homes for employment opportunities in other regions.

## (3) Conservation

Oil conservation efforts would likely focus on the transportation and industrial sectors. Transportation sector conservation may take the form of increased fuel economy (e.g., driving more fuel efficient vehicles, driving smaller and lighter cars, driving at slower speeds, and replacing gasoline engines with hybrids and diesel engines) or reduced miles traveled by private vehicles through use of public transportation. These transportation-related measures should have positive net impacts on the environment.

A major industrial end use of oil and NGL's is as a feedstock for plastics. Thus, reduced consumption of plastics is an alternative to oil (or NGL) production. However, other impacts may be associated with production and use of the substitute materials. For example, substituting steel for some plastic parts in automobiles could lead to greater energy consumption and possibly greater attendant environmental impacts (steel production requires coal production; steel adds weight to a vehicle, thus making it less fuel efficient and leading to increased oil production or imports). Thus, reducing plastic consumption may not lead to reduced environmental impacts.

Oil conservation is unlikely to have any measurable effect on regional employment, income, or social stability.

#### (4) Switching to Gas

Environmental impacts associated with increased domestic onshore gas production are discussed below.

### b. Replacements for OCS Natural Gas

#### (1) Domestic Onshore Gas Production

Increased domestic onshore gas production represents 28 percent of the replacement for OCS natural gas produced under the proposed action. Following are the major negative environmental impacts associated with increased domestic onshore gas production:

- Noise and regulated pollutant emissions result from support equipment and from venting and flaring of natural gas during excavation and initial production. These emissions contribute to greenhouse gases, potentially add to acid rain and tropospheric ozone, and may have a negative impact on stratospheric ozone.
- Discharge of produced water, which often has elevated levels of salts, trace metals, solids, etc., can degrade surface and groundwater quality and uses. Hydraulic fracturing may result in disruption and potential contamination of aquifers.
- Land disturbance occurs from site preparation at drilling locations (typically 3 acres are cleared, graded, and leveled per deep-well location) and establishment of holding ponds for wastes like drilling muds and cuttings. These activities result in soil erosion, vegetation destruction, ecosystem disturbance, and potential effects on wetlands.
- For the most part, economic and social impacts from additional onshore gas production will add to, but be indistinguishable from, those associated with additional onshore oil production. However, workers will face increased risk of exposure to toxic chemicals in the fracturing fluids that are used more extensively in gas production.
- Onshore gas development could result in the direct physical contact between the construction of new gas facilities or pipelines and previously unidentified archaeological resources. State and Federal laws require consideration of archaeological resources if any State or Federal funding or permits are required for construction. Therefore, impacts to historic or prehistoric sites from onshore gas development are unlikely.

#### (2) Switching to Oil

Almost all the additional oil consumed because of switching from natural gas to oil would come from imports. Environmental impacts associated with oil imports were discussed above in Section IV.I.2.a(1).

### (3) Conservation

Reduced gas consumption would not produce air, water, or land impacts or generate any solid waste and, thus, would have zero negative environmental impacts.

### (4) Gas Imports

Most additional gas imports would come via pipelines from Canada. New pipelines would be needed, and these would have impacts on the lands through which they passed. Additional gas imports also may come by ship in the form of LNG. The only major environmental impacts associated with expanded LNG importation might occur if a LNG carrying tank punctures or leaks during unloading. Because LNG readily vaporizes but does not disperse quickly and remains near ground level, accidental ignition of the vapor clouds would have tremendous explosive power. Regulated pollutant emissions during transport and unloading are not a significant problem due to the ships' special combustion system, the use of natural gas as fuel in the process, and the special unloading process.

## 3. Government Imposed Alternatives and Their Impacts

The U.S. Government or the governments of States like California or those in the Northeast might choose to encourage or mandate use of one or more energy alternatives different from those chosen by the market. Mechanisms that might be used are taxes like a carbon tax or vehicle fuel tax, an integrated energy conservation program, or more specific mandated energy saving measures. Among the energy saving measures that governments might mandate are automobile fuel economy standards and the requirement in California and portions of the Northeast that a certain percentage of new vehicles sold after a given date be zero emission vehicles. TKC Communications (2007a) discusses mechanisms for imposing alternatives at greater length; however, regardless of the mechanism chosen, it must operate through an energy alternative such as those examined below.

The most-likely targets for government action would be vehicle fuels and fuel consumption and electricity generation plants, their fuels, and electricity consumption. Narrowly focused measures are more likely than broad measures, and the choice of target probably will be tied in to environmental considerations, especially air pollution minimization.

The phrase "energy conservation" can be useful in certain contexts. Unfortunately, as the discussion becomes more specific in terms of energy alternatives, energy conservation can come to mean many different things. For instance, energy conservation has been used to describe each of the following types of alternatives:

- saving a fuel like gasoline by switching to an alternative like ethanol or methanol,
- improving the use of a fuel through more efficient production of the energy product such as improving automobile fuel economy or power plant efficiency,
- enhancing the efficiency of an energy-related transportation system by means such as providing more mass transit or improving electricity transmission, and
- encouraging consumers to use less of the energy product through actions such as work-at-home or turning down thermostats.

This section will follow the convention that fuel switching is not energy conservation. The other three categories above can be classed as conservation; however, most of the remainder of this section will keep the three types of alternatives separate. In addition, the major focus of the rest of this section will be on vehicle fuels and electricity generation with only passing reference to industrial, residential, and commercial energy alternatives.

## a. Transportation Vehicle Fuels

### (1) Fuel Switching

**Ethanol:** Ethanol as an alternative to gasoline or diesel fuel will require additional production of some biological product. Corn is the feedstock most widely used for ethanol production in North America. Energy experts expect corn to serve as the feedstock of choice for additional future ethanol production. Additional corn will probably be grown principally on land now considered marginal for crop production. This will mean taking land out of less intense uses to devote to this intensively cultivated row crop. The practice could result in significant increases in soil erosion, fertilizer runoff, and systemic effects through expanded uses of pesticides and herbicides in the case of no-till cultivation. The net effect could be deteriorated water quality through siltation, eutrophication, and chemical toxicity. Upland wildlife habitat could be diminished through loss of cover and the effects of chemical toxicity. Wildlife will also be adversely affected by the additional rural activity associated with the more intense agriculture. Traditional forms of ethanol production use great quantities of water and can lead to releases of large quantities of oxygen depleting materials into streams and rivers. The net effect can be significant further deterioration of water quality. Ethanol production can also have deleterious impacts on local air quality through releases of hydrocarbons and on greenhouse gases through release of large quantities of $CO_2$. Increased ethanol production would have positive impacts on the economies of corn producing areas, but these might be somewhat offset by the negative impacts on non-corn producing areas where food prices would increase marginally.

**Natural Gas:** Natural gas vehicles have the potential to replace a large percentage of the urban fleet vehicles currently operating on gasoline. The environmental impacts of domestic onshore production of natural gas are discussed in Section IV.I.2.b(1).

**Hydrogen:** Hydrogen powered fuel cells could be used in a new generation of vehicles designed to minimize final-use air pollution in urban areas. However, this technology faces three major impediments:

- hydrogen is expensive to produce,
- no distribution network exists for hydrogen, and
- efficient, effective fuel cells for powering vehicles have yet to be perfected.

If the U.S. Government decided to pursue hydrogen fuel cell vehicles on a large scale, major additions to the electricity production infrastructure would have to be developed. The impacts of this development are discussed in Section IV.I.3.b. Hydrogen is an entirely new fuel, and the development of the new industry would undoubtedly provide employment opportunities and increased income to the regional economies in locations where the new industry was located. The MMS is studying the potential for hydrogen production as a means of transporting energy produced from advanced technologies on the OCS.

**Electricity:** Substantial adoption of electric vehicles would greatly increase the demand for electricity. Meeting increased demand for electricity would lead to the kinds of environmental impacts noted in Section IV.I.3.b.

### (2) More Efficient Vehicles

**More Efficient Engines and Transmission:** The automotive industry faces a formidable challenge in trying to maintain performance standards with engines and transmissions that use less fuel without greatly increasing the cost of these major vehicle components. Assuming the automotive firms can find a solution acceptable to the government and consumers, the environmental impacts associated with the production of such machinery would probably be indistinguishable from those associated with less-fuel-efficient components.

**Lighter, More Streamlined Bodies:** The other way to produce more efficient vehicles besides more efficient engines and transmissions is to build them with lighter, more streamlined bodies. Once again, the industry is faced with maintaining safety standards and holding down costs while improving the efficiency of vehicle bodies. Lighter bodies may entail more use of plastic composites in place of steel, although the steel industry has recently unveiled a newly designed lighter prototype car body. Regardless of what materials are used, the environmental impacts associated with their production will probably be comparable with similar quantities of present auto body parts.

### (3) More Efficient Transportation Systems

**More Mass Transit:** If governments could get people out of their cars and into mass transit, including car pools, that action would ameliorate a significant array of the problems associated with our urban transportation systems. The environmental impacts of such a behavioral shift would be very positive. Air, water, land, noise, and visual aesthetics would all be improved.

**More Rail:** Rail transportation of goods is much more fuel-efficient than movement by truck. A significant switch from truck to rail would also lead to environmental improvement. Impacts to air, water, land, and noise would all decline.

### (4) Less Motorized Transportation

Telecommuting and the use of nonmotorized transportation, such as bicycles and walking, would have similar but greater positive impacts on the environment compared to mass transit.

## b. Electricity Generation

### (1) Alternative Sources of Electricity

**Coal:** Coal extraction is almost synonymous with negative environmental impacts. It causes especially severe impacts on water resources, which are degraded by acidic drainage from active and abandoned mines and by silt from earth movement which is especially serious in strip and auger mining. Ground water is often polluted or disrupted by coal extraction because coal seams serve as the aquifer in many locations. Coal mining also is associated with air pollution from dust and machinery exhaust. The machinery also produces noise pollution. The impact of coal extraction on visual aesthetics is especially severe because the surface scars from strip mining and the mountainside cuts from auger mining have an especially significant effect on scenic mountain areas. Additional demand for coal would provide employment opportunities in many traditionally underemployed coal mining areas.

**Nuclear:** Compared with other forms of large-scale electricity generation, nuclear power has relatively minor environmental impacts. Mine tailings from uranium mining have caused radioactive water pollution in the West, but this is more a result of formerly inadequate regulation or lax enforcement than it is a problem with present production. The tremendous cooling needs of nuclear reactors can lead to abnormal temperature increases in bodies of water used for plant cooling. The size of the containment vessels can also cause visual aesthetic degradation. Without a doubt, the main environmental problem associated with nuclear power is finding socially acceptable, long-term repositories for the spent fuel rods that are removed from these plants.

**Hydroelectric:** Most attractive hydroelectric sites in the United States have already been utilized or set aside for aesthetic reasons. It is unlikely that hydroelectric power, with the exception of pump storage, can make much of an additional contribution to domestic electricity generation. Pump storage, which is a method for storing less expensive, base-load power from off-peak hours for meeting peak demand, could substitute for some natural gas-fired turbines used for peaking power. Environmental impacts from pump storage facilities tend to be localized and to consist of destruction of wildlife habitat and, in open systems, disruption of stream flows.

**Geothermal:** Geothermal electricity generation is limited by the availability of geothermal resources. Geothermal generating stations create negative air pollution, water pollution, noise, and aesthetic consequences.

**Wind:** The amount of electricity generated by wind power has expanded greatly over the last decade. In addition, vastly expanded wind-powered electric generation facilities have been proposed for several locations in the West and offshore New England and New York. In order to produce a measurable amount of electricity, wind powered generators must be located in groups called farms. Wind farms can occupy large tracts of ground and modify the natural land environment. When wind farms are located in arid, mountainous country, construction of the pads and access roads can lead to disturbance of large areas of sensitive land. The result can be greatly increased soil erosion compared with what it would be from more traditional land uses. The increased erosion can lead to siltation in nearby streams, depending on the location of the wind farm.

Wind generation in shallow waters offshore entails similar technology to that used onshore except that a structure must be built to raise the generating equipment above the level of the water. However, unlike parts of Western Europe, 90 percent of U.S. offshore wind resources lie in deep water. Deep water entails much more elaborate and expensive structures to protect the generators. Estimates of shallow-water cost lie in the range of $.08 to $.15 per kilowatt hour (kwh). Deepwater costs are expected to be double those figures, although technological improvements and economies of scale could lower that number significantly. Offshore environmental impacts include visual impacts; noise and vibrations; collisions, habitat dislocation, and navigational disorientation for birds; alterations of natural underwater environments; and impacts on fisheries and marine traffic. Potential siting constraints include water depth, migration routes, shipping lanes, pipelines, and military operations.

**Solar:** Solar generating technologies are expensive. However, photovoltaic cells are finding increased use to power facilities far from existing power lines. In recent years, the cost of photovoltaic cells has declined while their reliability has improved. Now, in many cases, it is cheaper to install photovoltaic cells than run a power line many miles over difficult terrain. The recent development of photovoltaic film should significantly expand the range of applications for photovoltaic power. Nevertheless, solar-powered electricity will remain a high-cost alternative for the foreseeable future and will not make a major contribution to electricity generation because of its cost.

Solar-powered electricity generation on a small scale has relatively minor environmental impacts. However, if solar power were ever to make a measurable contribution to national electricity generation, vast areas of land would have to be given over to this technology. Although the areas best suited to solar energy tend to be arid and thus fragile, many areas might be flat or on gentle slopes and not as susceptible to wholesale erosion as wind farms. Nevertheless, large-scale losses of vegetation and wildlife habitat, soil erosion, and resulting water pollution can be expected from large-scale solar generating facilities. Such facilities would also be aesthetically displeasing to some observers. The MMS is investigating the use of solar energy to produce electricity on the OCS.

**Advanced Technologies:** There are several types of advanced technologies for electricity generation being studied.

**Ocean Currents**—Submerged turbines similar to wind turbines can extract energy from ocean currents. The system for producing energy from ocean currents would consist of the rotor blade turbine, a generator for converting the rotational energy into electricity, and a means of transporting the electrical current to shore for incorporation into the electrical grid. Problems attendant on this technology include the necessity of maintaining corrosion resistance and prevention of marine growth buildup. Marine current energy is likely to have minimal negative environmental impacts; however, fish, marine mammals, shipping routes, and recreational fishing and diving will need to be considered. Risks may also be encountered from slowing the current flow by extracting energy.

**Wave Action**—The energy from waves can be captured using a variety of technologies. The cost of energy produced by wave action depends on technological, physical, and economic factors. One study found the cost in areas with relatively high wave energy was in the range of $0.09 to $0.11/kh after tax incentives. However, expanded production volume can significantly reduce equipment costs. The eventual cost of wave-generated electricity with mature technologies has been estimated to be competitive with wind-generated electricity. Wave energy may have environmental impacts on marine habitat, lead to releases of toxic hydraulic fluids, cause visual disturbances and noise pollution, and conflict with commercial shipping and recreational boating.

**Other**—Tidal energy and ocean thermal gradients are other potential sources of generating capacity. These sources often rely on relatively unique circumstances to justify their construction. For the most part, these exotic sources lack the potential to make a serious contribution to U.S. electricity supply. In most situations, these alternatives are too expensive, lack feasible technology, or both. It is extremely unlikely that any exotic form of electricity generation will make even a 1 percent contribution to the U.S. electricity supply during the planning period for this program.

The MMS is preparing a separate programmatic EIS for OCS renewable energy. This document will include an assessment of hydrogen production, solar, wind, current, and wave energy sources. It will assess the technical status, economic viability, and potential environmental impacts of each of these sources on the OCS.

## (2) More Efficient Generation and Transmission

Using more efficient generating equipment to produce the same amount of electricity as now could save an unknown, but large, amount of oil and natural gas. For instance, combined cycle systems are much more fuel efficient than straight turbines. The problem is that modern, efficient generating plants are very expensive. Power companies may have trouble justifying the expenditures to their stockholders on a financial basis. Furthermore, State regulatory agencies may be unwilling to allow additions to rates for plant construction while they allow standard rate adjustments for fuel costs. Saving oil and natural gas through more efficient generation would reduce the incidence and risk of all the environmental impacts associated with the oil and natural gas production saved, some of which would come from the OCS.

### (3) More Efficient Use and Less Use

More efficient use and less use of electricity by the industrial, commercial, and residential sectors could save the oil and natural gas (and other fuels) used to generate that electricity. These types of savings will be discussed below.

## c. Industrial Sector Uses

### (1) Alternative Fuels

The trend in the industrial sector is to switch to natural gas or electricity produced from natural gas. It is unlikely that any significant savings of oil and natural gas will be made by the industrial sector switching to alternative fuels.

### (2) More Efficient Energy Use

Although the industrial sector, as a whole, spends a considerable amount of time and money developing methods for using energy more efficiently, there remain opportunities for saving vast quantities of energy in the industrial sector. Many consulting firms make it their business to help firms use energy more efficiently, but they tend to help only those firms with high enough levels of inefficiency to pay a portion of efficiency savings to a consultant. Many smaller opportunities for improvements go unaddressed. This is true for the use of natural gas, oil, electricity, and even other energy inputs such as coal.

One way firms in the industrial sector can improve their energy efficiency is by adopting state-of-the-art equipment. In many cases, new processes or space heating and cooling equipment can save enough in energy costs to pay for itself in a reasonably short payback period. Choosing equipment that is the right size in terms of energy efficiency for the task at hand can reap related savings.

Another way firms can save energy is through improving the energy efficiency of their industrial processes. Although most "reengineering" activities in industry are aimed at using labor more efficiently, the same kind of thought can be used to save on the use of energy. Combinations of new processes with new, properly sized equipment can lead to especially significant energy savings.

Although some negative environmental impacts may be associated with the production of materials or equipment implemented in the process of achieving greater energy efficiency, these impacts tend to be negligible. Thus, improvements in the efficiency with which the industrial sector uses energy are almost entirely beneficial to the environment.

## d. Residential and Commercial Sector Uses

### (1) Alternative Fuels

Just as in the industrial sector, the trend in the residential and commercial sectors is to switch to natural gas, when it is available, or electricity produced from natural gas. It is unlikely that any significant savings of oil and natural gas will be made by the residential and commercial sectors switching to alternative fuels.

### (2) More Efficient Energy Use

Once again, the residential and commercial sectors can use correctly sized state-of-the-art equipment to increase their efficiency of energy use. However, in terms of more efficient use, these sectors have some specific steps open to them that have broad application across the sectors. Potentially most important is the use of better designs and materials. Better designs take advantage of passive solar energy, minimize the openings to the outside, and take into account airflow as well as temperature to maximize comfort. Better materials include multipaned glass and insulating sheathing.

Insulation and weatherization can be especially effective in the residential sector. Programs to subsidize insulation and weatherization sponsored by electric utilities have cost-effectively spared utilities from having to install expensive new generating plants. In more sophisticated applications, zoning and time-of-day controls can be used to hold down unnecessary energy use in large residences and commercial establishments. More efficient appliances and appliance use can also add to the efficiency of the residential sector.

As was true in the industrial sector, any negative environmental impacts from increased production of more energy efficient heating and cooling equipment and appliances would be only marginal. Therefore, almost all the improvements in energy efficiency in the residential and commercial sectors would have positive impacts on the natural environment.

### (3) Less Energy Use

In the industrial sector, any decrease in energy use not associated with increased energy efficiency would lead directly to a decrease in production. In the residential sector, less energy use might lead to lower utility; however, the tradeoff might be a reasonable one. For instance, less heating and cooling might lead people to change their dress habits without causing much inconvenience. Everyday decisions like this could lead to positive impacts on the environment.

## 4. A Note on "Conservation"

The three types of conservation, improving the energy efficiency of production, increasing the efficiency of transport, and using less, all have two characteristics in common:

- There may be some negative environmental impacts associated with any new equipment required to achieve the efficiency, but these impacts will tend to be marginal.
- The net effect of these measures will generally be positive from an environmental point of view.

In addition, most energy conservation measures tend to substitute capital and labor for some sort of fuel. This substitution tends to create somewhat more employment although, in general, the increase in employment is marginal and any regional impacts would be immeasurable. Furthermore, there is ample opportunity in our society to provide cost-effective subsidies to entice people to implement various conservation measures. Unfortunately, the opportunities are not unlimited. Enticement to conserve will have to be constant; absent technological change, each additional unit of conservation after an initial period of success will become incrementally more expensive. In other words, conservation has an upward sloping supply curve just as most other goods and services do. Eventually, saving more energy would become too expensive to continue, unless breakthrough technology can come to the rescue.

Some energy analysts believe that society has within its power the ability to implement technological improvements that could change the nature of our energy system. The Rocky Mountain Institute has published a volume titled, *Winning the Oil Endgame*, in which the authors detail just such a system of change based partially on already available technology and partially on technological improvements that they believe are well within the capabilities of modern science and engineering. Their focus is on substituting conservation and other fuel sources for the vast quantity of oil imported by the United States from unstable foreign sources. They offer the possibility of achieving these goals in the not too distant future.

# L. Environmental Impacts of the Cumulative Case

## 1. Scenario

Cumulative effects are the impacts on the environment that result from the incremental impact of the proposed action when added to other past, present and reasonably foreseeable future actions regardless of what agency, industry, or person undertakes the other actions. The cumulative analyses evaluate OCS activities associated with the 2007-2012 Outer Continental Shelf (OCS) Oil and Gas Leasing Program (proposed action), as well as activities resulting from other past and future OCS 5-year OCS programs that could occur during the 40-year life of the proposed action. The cumulative analyses also evaluate impacts from activities and processes that are not related to OCS development. These activities and processes will be identified in the following analyses where they apply. There are some activities and processes, however, that either are pandemic (state oil and gas and imported oil), are emerging trends effecting multiple-use issues on the OCS (alternate energy and liquefied natural gas facilities and transportation), or affect the global geophysical environment (climate change). Because of their widespread importance as potential cumulative impact factors, we describe these phenomena in this section to provide a framework for their inclusion in the appropriate cumulative analyses.

## a. OCS Oil and Gas Activities

Tables IV-14 through IV-16 show numeric estimates of the amount of activities that could occur from all OCS activities during the life of the proposed action. These estimates include activities that will be part of the 2007-2012 program, as well as those from previous and later programs. Transportation and other scenario assumptions that were used in the proposed action scenario and analyses (Section IV.B.1) apply to the cumulative analyses.

Table IV-17 shows estimates of the assumed numbers of large and small oil spills that could result from cumulative OCS hydrocarbon development. The source and number of assumed OCS spills were based on the volume of anticipated oil production, the assumed mode of transportation (pipeline and/or tanker), and the spill rates for large spills. Assumptions regarding the number of large oil spills from import tankers were based on the estimated level of crude oil imports and worldwide tanker spill rates. We assume that these spills would occur with uniform frequency over the life of the proposed action.

## b. Non-OCS Oil and Gas Activities

### (1) Onshore and Coastal Oil and Gas

#### Gulf of Mexico

All the Gulf States except Florida have active oil and gas programs. These oil and gas activities take place in both offshore State waters and on coastal lands. State oil and gas activity levels are highest in Texas and Louisiana, a long-established trend that will likely continue through the life of the 2007-2012 program.

Louisiana is the nation’s third largest producer of natural gas and the fourth largest producer of oil. The State also has a large offshore and coastal infrastructure to support, transport, and process petroleum. This infrastructure includes 19 active refineries, accounting for 15 percent of the national refining capacity; thousands of miles of pipelines; and numerous support and supply bases. Oil and gas development in Texas has a long history. In recent years, oil and gas production has declined from approximately 1 billion barrels (Bbbl) in 1978 to 0.5 Bbbl in 1998.

Although Mississippi ranks eleventh in the nation in crude oil production, the State does not currently have an offshore program. Coastal and offshore Alabama supports an active, mainly gas, development program. There are 44 fixed structures and platforms in coastal Alabama producing 220 billion cubic feet of gas annually

## Alaska

**State:** The State of Alaska has more than a million offshore acres under lease in State waters. The majority of the leases are on the North Slope and in coastal waters of the Beaufort Sea. About 98 percent of the State of Alaska's oil production comes from North Slope fields. We assume that the North Slope fields will continue to account for most Alaskan State production during the life of the proposed action, although projections from the State of Alaska anticipate a 60-percent production decline by 2021 (Alaska Department of Natural Resources [ADNR], 2000). Oil produced from the North Slope and Beaufort Sea is transported in the Trans-Alaska Pipeline System to Valdez, Alaska, where it is loaded onto tankers and exported. Only 3.7 trillion cubic feet (Tcf) of the greater than 35 Tcf of natural gas that have been produced on the North Slope have been used as a fuel for facilities. The remainder has been reinjected into the hydrocarbon reservoir to enhance oil recovery.

There are also some leases in the Cook Inlet Planning Area. The majority of gas produced in Cook Inlet is exported either as urea fertilizer or liquefied natural gas. The oil and gas fields in the Cook Inlet are nearing the end of their economic lives.

**Other Federal Oil and Gas Activity:** The National Petroleum Reserve in Alaska (NPR-A) is a 23-million acre site on the North Slope of Alaska that is managed by the Bureau of Land Management (BLM). The U.S. Geological Survey (USGS) has estimated that there is between 1.3 and 5.6 Bbbl and 39.1 and 83.2 Tcf of natural gas on federal lands within the NPR-A. Integrated activity plans have been developed by BLM (2004, 2006a) that identify the lands within the NPR-A available for leasing as well as those restricted from leasing, and identify stipulations and restrictions on surface activities in the lease areas of the NPRA. To date, there have been 4 lease sales in the NPR-A (1999, 2002, 2004, and 2006), and as a result of these sales, the BLM currently administers 381 Federal oil and gas leases on the NPR-A. To date, no production wells have been established in the NPR-A, although 23 exploration wells have been drilled within the reserve since 2000, and as many as an additional 11 exploration wells may be established by 2011 (BLM, 2006b). It is uncertain at this time whether or not production facilities will be established within the NPR-A during the life of the 2007-2012 program

**Canadian Oil and Gas:** Northern Canada contains about one quarter of Canada's remaining discovered resources of conventional petroleum and one third to one half of the country's estimated potential (Northern Oil and Gas Directorate, 2007). This resource is distributed throughout northern Canada as follows:

- Mackenzie Valley and onshore Yukon: 26 significant discoveries and 3 producing fields: the Norman Wells oil field produces oil at rates of 30,000 barrels of oil per day (6.294 = 1 $m^3$)with initial recoverable reserves of 235 million barrels (MMbbl); the Kotaneelee and Pointed Mountain fields close to the British Columbia-Alberta border have produced 417 billion cubic feet (35.3 cubic feet = 1 $m^3$) of gas by the end of 1997.

- Arctic Islands: 19 significant discoveries after fewer than 200 exploration wells; the Bent Horn field in the Arctic Islands, which produced high-quality light oil for many years on a seasonal basis, has only recently been abandoned.
- Mackenzie Delta/Beaufort Sea: discovered resources of in excess of 1 billion barrels (Bbbl) of oil and nine trillion cubic feet (Tcf) of gas in 53 significant discoveries. Four trillion cubic feet of marketable gas have been discovered in three onshore discoveries, and offshore discoveries include over 200 MMbbl in the Amauligak field. On the Mackenzie Delta, the Ikhil gas discovery is being developed to supply natural gas to the town of Inuvik where it will replace imported diesel oil for power generation and domestic use.

**Additional Mining Activity:** Because mining is such a large component of the Alaskan economy (McDowell Group, Inc., 2006) and activity could occur in the future in areas potentially affected by OCS oil and gas activity, we have included a description of other mining activities. Alaska's mining industry includes exploration, mine development, and mineral production, and produces zinc, lead, gold, silver, and coal, as well as construction minerals such as sand, gravel, and rock (Research Development Council, 2007). Approximately 73 open-pit, underground, mechanical placer, and suction dredge mines were in production in Alaska in 2005. In addition, there are at least 37 rock quarries and 71 active sand and gravel operations in the State (Research Development Council, 2007). Two large mines, the Kensington Gold Project and the Pogo Gold Project, are expected to begin operation in 2007. The three largest mines in Alaska are the Red Dog, Ft. Knox, and Greens Creek mines. The Red Dog Mine, located in the Northwest Arctic Borough, is the world's largest zinc producer.

Among the large active mines currently operating in the State, only the Red Dog Mine is located adjacent to any of the Alaska OCS planning areas addressed in this EIS. This mine, located in the DeLong Mountains approximately 55 miles east of the Chukchi Sea, discharges treated water into Red Dog Creek, whose waters eventually feed into the Wulik River and drain into the Chukchi Sea.

In addition to the active and planned mine sites in the State, there are numerous exploration projects for gold, copper, nickel, silver, lead, zinc and coal. In July 2006 Billiton Energy Coals signed an exploration and development agreement with the Arctic Slope Regional Corporation (ASRC) to conduct a five-year coal exploration program and concept-level project evaluation on corporation lands in northwestern Alaska. This project is at a very early stage. During the next 3-5 years, the potential reserves and the options for moving the project to market will be investigated. The exploration area is located in bituminous coal beds west of the NPR-A, approximately 35 miles south of the Inupiat community of Point Lay. Point Lay is situated on the coast of the Chukchi Sea north of the Bering Strait. While bituminous and sub-bituminous coal occurs across a large section of the Western Arctic Slope, the current project is restricted to the bituminous showing on ASRC lands, where the corporation holds both the surface and sub-surface rights.

Key activities during the exploration program include:

- Community and stakeholder consultation;
- Regional geologic exploration to extend the exploration and test mining conducted by ASRC and the old U.S. Bureau of Mines in the early 1990's;
- A concept-level feasibility study on a railroad transportation corridor to move coal south to a port with a reasonable ice-free season;

- A concept-level feasibility study on a terminal and port site for shipping coal to the Asian market; and
- Baseline environmental research necessary to support the environmental assessment and permitting of the project, should a production decision be made.

It is too early in the project to predict whether or not coal mining will be implemented during the life of the 2007-21012 program, if at all. Should development occur, impacts from coal mining would affect cumulative water, air quality, biological, and socioeconomic conditions in the Arctic.

### Atlantic

No coastal or offshore oil and gas exploration or production is occurring within the State of Virginia. Between 1976 and 1983, the MMS held 10 oil and gas lease sales along the Atlantic coast. Forty-seven wells were drilled on the OCS; one well being drilled in the Mid-Atlantic Planning Area. None of these wells discovered commercial quantities of hydrocarbons and were abandoned.

## (2) Imported Oil

Foreign crude oil imports have increased every year from 1991 to 1998, with a slight dip in 1999 to 8.59 million barrels per day (MMbbl/day) (U.S. Department of Energy [USDOE], 2000b). The USDOE estimates that crude oil imports will increase at an average annual growth rate of 1.1 percent from 2004 to 2030, resulting in 13.53 MMbbl/day being imported by 2030. Canadian oil imports, representing about 16 percent of the total, are delivered by pipeline. The remaining oil arrives in the United States on tankers. Table IV-17 shows assumed numbers of oil spills greater than 1,000 bbl associated with tanker imports in the geographic areas included in the Proposed Program. The numbers are based on the historic tanker spill rate of 0.73 spills per billion barrels of oil and the historic percentages of tanker imports to different coastal areas (Anderson and LaBelle, 2000).

# c. Climate Change

Because a growing body of evidence shows that climate change is occurring, we have included it as an impact factor in the cumulative analysis of some resources. The resources that include climate change as a cumulative impact factor meet one or both of the following two criteria.

- The resource is already experiencing impacts from climate change so the effects are observable and not speculative. In Alaska, for example, the effects of climate change in recent decades have resulted in decreased extent and thickness of sea ice and other changes that could impact biological resources and subsistence.
- The resource will be directly affected by warming temperatures. An example of direct impacts of warming is increased melting of continental ice that leads to accelerated sea-level rise and inundation of coastal wetlands and beaches in the Gulf of Mexico.

We do not analyze, however, impacts from climatic and hydrologic changes that are the indirect result of temperature change because these indirect impacts are too uncertain to predict. For example, it is reasonable to expect changes in precipitation regimes as a result of climate change. Furthermore, it is also likely that precipitation changes would, in turn, affect the coastal salinity balance between freshwater flow and tidal influence in some areas, and that these changes would affect fisheries and fish populations in some way. Both the magnitude and direction of each factor in this sequence of occurrences, however, are uncertain. While we acknowledge that continuing climate change could result in changing regional ecological and socioeconomic patterns and distributions, at this stage of our understanding of underlying processes, the rates and directions of many of these changes are too speculative to include in the cumulative analyses that follow.

## d. Alternate Energy

On August 8, 2005, the Energy Policy Act of 2005 was passed into law. This act gives MMS the authority to:

- grant leases easements or right-of-ways for renewable energy-related uses on the Federal OCS;
- act as the lead agency for coordinating the permitting process with other Federal agencies;
- monitor and regulate those facilities used for renewable energy production; and
- explore opportunities for alternate uses of existing OCS oil and gas facilities for non-OCS purposes.

While it is too early to predict the number and types of alternate uses and renewable energy projects that could be developed during the life of the 2007-2012 program, at the current time several OCS renewable energy projects are being considered or have been proposed. Most of these are wind energy projects. Wind energy will probably be the first type of OCS renewable energy project to be implemented. Other alternate energy projects being considered at this time include harnessing wave and ocean current energy and generating hydrogen from seawater. The MMS will be preparing a programmatic EIS on OCS renewable energy and alternate uses; it is scheduled to be completed in November 2007. This EIS will assess various marine energy technologies such as wind, hydrogen, waves, and currents and possible conflicts among these technologies. The EIS will also consider existing uses of the OCS, such as oil and gas developments, shipping, and fishing and conflicts that these existing uses may have with emerging uses. Multiple-use strategies will need to be employed in order to avoid conflicts and ensure safe management of the OCS.

## e. Liquefied Natural Gas (LNG)

Natural gas is liquefied to concentrate a much greater volume of product in a given space to facilitate storage and/or transportation. Use of LNG reduces the volume that natural gas occupies more than 600 times, making the transportation of gas in tankers economical. With an expected doubling of the amount of imported natural gas in the United States during the next 20 years, it is reasonable to anticipate more LNG facility construction in the United States (USDOE, 2003).

During the life of the proposed 5-year program, we expect increased use of the OCS to install, maintain and use LNG terminals and facilities. Currently in the Gulf of Mexico, more than 10 of these facilities are at the planning or permitting stages. One, the Gulf Gateway facility, began operation 214 kilometers (116 miles) off the coast of Louisiana in 2005. These facilities will offload vaporized LNG from tankers into the existing offshore natural gas pipeline system. Although MMS does not permit or regulate these facilities, their increased presence and use on the OCS will create space-use issues and will add to the existing mix of potential offshore cumulative impacts.

Onshore LNG facilities may also be used in the development of gas in Alaska because of their economic advantage compared to pipeline construction. We include an LNG facility in the scenario for the development of gas resources in the North Aleutian Basin Planning Area. More detailed environmental analyses of the facilities will be done during the leasing, development, and construction stages by MMS and other Federal and State Agencies.

Environmental effects specific to LNG transportation and facilities are associated with explosions and fires and with the cryogenic and cooling effects of either an accidental release of LNG or the release of cooled water during the vaporization process. In the Gulf of Mexico, most, if not all, LNG facilities are expected to use an open-loop vaporization process that uses a throughput of approximately 130-250 million gallons per day of seawater to raise the temperature of the LNG from minus 260 $^{o}$F to 40 $^{o}$F. This process produces a discharge of seawater that has been cooled by as much as 20 $^{o}$F. These discharges are expected to occur in water depths ranging from 18 meters (m) to 55m (60 to 280 feet). This large volume of cool, dense water could create an impact to the surrounding environment, rendering the area uninhabitable by local species of invertebrates and fish, especially in the Gulf of Mexico. The magnitude of this impact is still unknown since there is only one facility (the Gulf Gateway facility) currently operating. The potential cumulative effect of multiple facilities also needs consideration. In addition to the thermal discharge, biocides are added to prevent fouling of the flow through system. The chemicals currently proposed for use are copper and sodium hypochlorite.

## 2. Gulf of Mexico Region

## a. Air Quality

The cumulative analysis considers the impacts from all future Outer Continental Shelf (OCS) oil and gas development, OCS emission sources not related to oil and gas activities, and onshore emissions.

Onshore emission sources include power generation, industrial processing, manufacturing, refineries, commercial and home heating, and motor vehicles. Nationwide, nitrogen oxide ($NO_x$) emissions have decreased about 12 percent in the period 1993-2002, while sulfur dioxide ($SO_2$) emissions have decreased about 31 percent (U.S. Environmental Protection Agency [USEPA], 2003b). Emissions of volatile organic compounds (VOC) have decreased 25 percent in the period 1993-2002 and particulate matter ($PM_{10}$) emissions have decreased by 22 percent. However, the changes vary by region and in the last decade, some Gulf Coast States have observed an increase in $SO_2$ or $NO_x$ emissions, while others have seen a decrease (emission tabulations by State may be found at http://www.epa.gov/air/data/geosel.html).

In the ozone ($O_3$) nonattainment areas, which include the Houston area in southeast Texas and the Baton Rouge area in Louisiana, emissions of $NO_x$ and VOC are being reduced through the State Implementation Plan (SIP) process in order for those areas to achieve compliance with the national $O_3$ standard. Prior to the revocation of the 1-hour $O_3$ standard in 2004, Houston-Galveston-Brazoria and Baton Rouge were classified severe nonattainment, while the Beaumont-Port Arthur nonattainment classification was serious. While the 1-hour $O_3$ standard no longer applies, the same emission controls will remain in effect while the State is developing their plan to reach compliance with the new 8-hour standard. The Houston-Galveston-Brazoria area is classified moderate nonattainment for the 8-hour standard, while Beaumont-Port Arthur and Baton Rouge are marginal nonattainment. Moderate nonattainment areas are required to comply with the 8-hour standard by the year 2010, while marginal areas have to meet the standard by 2007.

Ozone levels in the southeast Texas have been in a steady downward trend during 1995 through 2005. The maximum observed fourth highest 8-hour $O_3$ concentration in the Galveston-Houston area has decreased from about 0.140 ppm in 1995 to around 0.100 parts per million (ppm) in 2005. Yearly summaries of air pollutant values by geographic area may be obtained at http://www.epa.gov/air/data/reports.html. Ozone levels in the Baton Rouge area have remained steady over the 1995-2005 period, while the number of exceedances of the $O_3$ standard have been in a general downward trend. This shows that emission reduction measures have been effective in reducing $O_3$ levels.

The USEPA has promulgated a series of measures to reduce regional and nationwide emissions. In 1999, the USEPA established emission rules for commercial marine engines. That same year emission standards were promulgated for small engines such as leaf blowers, lawn mowers, and tractors. In 2002, the USEPA established regulations for large industrial engines, offroad recreational vehicles, and diesel marine engines for recreational boats. In May 2004, the USEPA promulgated the Clean Air Nonroad Diesel Rule, which sets new emission limits on nonroad diesel engines. This rule will phase in standards for $NO_x$, $PM_{10}$, and $SO_2$. Along with this rule, the USEPA issued a Notice of Intent to propose more stringent emission standards for marine vessels and locomotives.

In the year 2000, Phase 2 of the Acid Rain Rule (Title IV) went into effect. Under this rule, emissions of SO2 and $NO_x$ from power plants in the eastern half of the United States are projected to continue a downward trend over the next decade. In 2005, the USEPA finalized the Clean Air Interstate Rule that applies to 28 States (including all of the Gulf Coast States) and the District of Columbia. This rule will place additional limitations on $NO_x$ and $SO_2$ emissions from power plants. The USEPA projections indicate that by 2015 the total $SO_x$ emissions from power plants in the five Gulf Coast States will decrease by over 40 percent compared to 2003 levels, while $NO_x$ emissions will decrease by over 50 percent.

The effects of these various regulations and standards would tend to result in a steady, downward trend in future air emissions. This trend should be realized in spite of continued industrial and population growth. The States are required to implement SIP's to reduce emissions in the $O_3$ nonattainment areas. The Houston-Galveston-Brazoria area is classified moderate nonattainment for $O_3$ and is required to achieve the $O_3$ standard by June 2010. The Beaumont-Port Arthur area is classified marginal $O_3$ nonattainment and has to achieve the standard by June 2007. In Louisiana, the Baton Rouge area is marginal nonattainment for $O_3$ and is required to meet the $O_3$ standard by June 2007.

Table IV-19 lists the yearly average emissions associated with all future OCS oil and gas activities in the Gulf of Mexico. The table also presents the emissions calculated from an inventory of all OCS activities collected in the year 2000 by Wilson et al., 2004. When we compare the future projected OCS emissions with the year 2000 emissions, there is a small increase in $NO_x$ emissions, a slight decrease in $SO_2$ and $PM_{10}$ emissions, and a significant increase in CO and VOC emissions. There are other emissions on the OCS that are not associated with oil/gas activities, and these include emissions from commercial marine vessels, commercial and recreational fishing, tanker lightering, military vessels, and natural sources such as oil or gas seeps. These activities are likely to increase in the future, but new USEPA emission standards for marine vessels would, to some extent, counteract the associated emissions increase.

The MMS performed a cumulative air quality modeling analysis of platform emissions in a portion of the Gulf of Mexico in 1992 (MMS, 1997b). The modeling incorporated a 40-percent increase in emissions above the 1992 levels to account for growth in oil and gas development. Predicted concentrations were well within the national ambient air quality standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Class II maximum allowable increases. It is still not known whether the PSD increments have been exceeded in the Breton Class I area as one needs to consider the cumulative effect of all other emission sources in the area with respect to the baseline year. In an attempt to address this question, the MMS has a modeling study underway to estimate the contribution of OCS emissions to concentrations of $NO_2$ and $SO_2$ in the Breton Class I area. This study is scheduled to be completed in 2006. In addition, the MMS consults with the U.S. Fish and Wildlife Service (FWS), which is the Federal land manager of the Breton Class I area, for plans within 100 kilometers (km) of Breton that exceed a certain emission threshold.

Ozone modeling was performed using a preliminary Gulfwide emissions inventory for the year 2000 to examine the $O_3$ impacts with respect to the 8-hour $O_3$ standard of 80 parts per billion (ppb). One modeling study focused on the coastal areas of Louisiana extending eastward to Florida (Haney et al., 2004). This study showed that the impacts of OCS emissions on onshore $O_3$ levels were very small, with the maximum contribution at locations where the standard was exceeded of 1 ppb or less. The other modeling effort dealt with $O_3$ levels in southeast Texas (Yarwood et al., 2004). The results of this study indicated a maximum contribution to areas exceeding the standard of 0.2 ppb or less. The projected emissions for the cumulative case would be about the same as the emissions used in the modeling. The contributions to $O_3$ levels would therefore be similar. As emissions within the nonattainment areas are expected to decrease further in the future, the cumulative impacts from the OCS oil/gas program on $O_3$ levels would likely be reduced.

Gaseous and fine particulate matter in the atmosphere can potentially degrade atmospheric visibility. Existing visibility in the eastern United States, including the Gulf States, is impaired due to fine particulate matter containing primarily sulfates and carbonaceous material. High humidity is an important factor in visibility impairment in the Gulf coastal areas. The absorption of water by the particulate matter makes them grow to a size that enhances their ability to scatter light and, hence, aggravate visibility reduction. The estimated natural mean visibility in the eastern United States is 60-80 miles (97-129 km) (Malm, 1999). Based on data presented by Malm (2000), the observed mean visual range is about 24-30 miles (38-48 km) in coastal Louisiana, Mississippi, and Alabama. In the Texas coastal areas, the average visibility is about 30-40 miles (48-64 km). In the Gulf Coast States, about 60-70 percent of the human-induced visibility degradation is attributed to sulfate particles, while about 20 percent of the visibility degradation is from organic or elemental carbon particles. About 8 percent of the visibility impairment is attributed to nitrate particles (Malm, 2000; USEPA, 2001c).

Visibility degradation in large urban areas, such as Houston, can be especially pronounced during air pollution episodes. In some severe cases, it may hinder navigation by boats and aircraft. Degraded visibility also adds to the perception by the observer of bad air quality even when monitors do not record unhealthful pollutant levels.

A study of visibility from platforms off Louisiana revealed that significant reductions in Louisiana coastal and offshore visibility are almost entirely due to transient occurrences of fog (Hsu and Blanchard, 2005). Episodes of haze are short-lived and affect visibility much less. Offshore haze often appears to result from plume drift generated from coastal sources. The application of visibility screening models to individual OCS facilities has shown that the emissions from a single facility are not large enough to significantly impair visibility. It is not known to what extent aggregate OCS sources contribute to visibility reductions; however, the effects from OCS sources are likely to be very minor because offshore emissions are substantially smaller than the onshore emissions.

In July 1999, the USEPA published final Regional Haze Regulations to address visibility impairment in the Nation's national parks and wilderness areas (64 FR 35714). These regulations established goals for improving visibility in Class I areas through long-term strategies for reducing emissions of air pollutants that cause visibility impairment. The rule requires States to establish goals for each affected Class I area to improve visibility on the haziest days and to ensure no degradation occurs on the clearest days. Since visibility impairment involves considerable cross-boundary transport of air pollutants, States are encouraged to coordinate their efforts through regional planning organizations. Texas and Louisiana are part of the Central States Regional Air Planning Association. Mississippi, Alabama, and Florida are members of the Visibility Improvement State and Tribal Association of the Southeast. The regional planning organizations are required to submit their first implementation plan in 2008. Subsequent plans are to be submitted at 10-year intervals.

The Regional Haze Regulations along with the rules on $O_3$ and acid rain should result in a lowering of regional emissions and improvement in visibility. Projected emissions from all cumulative OCS activities are not expected to be substantially different from year 2000 emissions. The contribution of OCS emissions to visibility impairment would be very minor.

Impacts from oil spills for the cumulative case would be similar to those for the proposed 2007-2012 program. Since impacts from individual spills would be localized and temporary, the magnitude of impacts would be no different from those associated with the proposed action.

### Conclusion

The OCS program contributes slightly to onshore levels of $NO_2$, $SO_2$, and $PM_{10}$, but concentrations are well within the national standards and PSD increments. The effects from the future OCS program would remain about the same. Portions of the Gulf Coast have $O_3$ levels that exceed the Federal standard, but the contribution from all OCS activities to $O_3$ levels is very small. Ozone levels are on a declining trend due to air pollution control measures that have been implemented by the States. This trend is expected to continue as a result of local as well as nationwide control efforts. The contribution of the 2007-2012 program on onshore ozone would remain very small. The Gulf Coast has significant visibility impairment from anthropogenic emission sources. Visibility is expected to improve somewhat as a result of regional and national programs to reduce emissions. The contribution from OCS sources to visibility impairment is expected to remain very small.

## b. Water Quality

As discussed in Section IV.B.2.b, impacts from the proposed action could affect water quality in coastal waters, continental shelf waters, and deep marine waters in the Gulf of Mexico. There are also a number of existing and future OCS activities that are not part of the proposed action and non-OCS activities that are ongoing or reasonably expected to take place in the Gulf in the foreseeable future that could affect water quality. Activities of the proposed action would, therefore, incrementally add to the overall cumulative impact to water quality.

Routine ongoing and future OCS activities that are not part of the proposed action could affect water quality in the Gulf of Mexico. These activities include the discharge of drilling fluids, cuttings, and produced waters to continental shelf or deep waters and structure removal activities. In almost all cases, the OCS activities under the proposed action represent a small portion (about 15%) of the ongoing and future activities that would occur within the Gulf for the period of the proposed action (2007-2012), and thus would likely produce a relatively small increase in the overall adverse water quality impacts. Approximately 100 structures are removed annually. These structures have completed their production life and are generally significant contributors of produced water. These removals could balance the overall contributions of produced water from the placement of new structures.

Existing and future non-OCS activities occurring in the Gulf of Mexico that would affect water quality include the transportation of oil, gas, and commodities (e.g., domestic transport and the transport of foreign imports); the installation of liquefied natural gas (LNG) facilities; and National Aeronautics and Space Administration (NASA), U.S. Department of Defense (USDOD), and U.S. Department of Transportation (USDOT) activities (Section IV.L.1.b). Discharges from domestic and foreign commercial and military vessels (e.g., bilge water, waste, incidental spills, and leaching from anti-fouling paints – MMS, 2001d) would adversely affect the quality of water in the Gulf of Mexico.

Although vessel trips that are part of the proposed action (up to about 500 trips per week) would add to the adverse impacts to water quality, they would about 10 percent of the number of current and future OCS activities that are not part of the proposed action (up to approximately 4,000 per week). In addition to OCS vessel activities, extensive commercial cargo traffic and commercial and recreational fishing traffic occurs in the Gulf of Mexico, one of the world's most concentrated shipping areas (U.S. Army Corps of Engineers [COE], 2003a). Operation of these vessels would adversely impact water quality in the Gulf. For example, in 2003, the Port of New Orleans handled over 255,000 domestic and foreign container vessels (approximately 4,300 vessels per week), while the port at Gulfport, Mississippi, handled more than 161,000 foreign container vessels (COE, 2003b) (approximately 3,100 vessels per week). The Gulf also supports extensive commercial fisheries as well as recreational boating. For example, there were 2 million recreational small watercraft registered in the Gulf States, many of which are used in Gulf waters (USCG, undated). Cruise ships depart weekly from major Gulf coast cities, carry up to 3,000 passengers, and generate associated wastes (Copeland, 2005). The number of vessel trips anticipated under the proposed action would, therefore, represents a small fraction of the total vessel traffic in the Gulf, and the additional vessel trips that would occur under the proposed action would be expected to produce little incremental increase in adverse impacts to water quality.

Dredging, discharge of treated municipal and industrial wastes, urban runoff, discharges of biocides in the cooling water from offshore LNG terminals, and agricultural runoff (animal waste and residual fertilizer, in particular nitrogen and phosphorous compounds) would also adversely affect water quality in the Gulf of Mexico during the period of the proposed action. More than 3,700 point sources of contamination discharge material into the Gulf. Municipalities, refineries, and petrochemical plants account for the majority of these sources (MMS, 2001d). For example, the City of Matamoros, Mexico, discharges an estimated 0.7 million barrels (MMbbl) a day of completely untreated wastewater into a canal that flows into the Gulf, about 37 kilometers (km) south of the international border (Texas Center, 1995). Similarly, inflows from such rivers as the Mississippi would impact water quality in the Gulf (Rabalais, 2005) during the period of the proposed action. In an average year, the Mississippi River discharges nearly 1.6 million metric tons (t) of nitrogen to the Gulf. The principal sources of inputs of nitrogen to the Mississippi River system are soil mineralization, fertilizer application, and animal manure. Such discharges have influenced the development of an extensive hypoxic zone during periods of water column stratification, mainly during the summer. In comparison to the input from the Mississippi and Atchafalaya Rivers, it is estimated that produced water contributes from 0.02 to 0.2 percent of the nitrogen to the hypoxic zone (Rabalais, 2005; Veil, 2005) The proposed action is not expected to have a large incremental effect on the hypoxic zone and water quality in the Gulf. Inflows of contaminants to the Gulf of Mexico from rivers such as the Mississippi are, by comparison, very much larger.

The OCS operations under the proposed action would produce additional adverse impacts to water and sediment quality that would add to those derived from these non-OCS activities. The impacts would be related to increased water turbidity in the vicinity of the operations and the addition of soluble contaminants to the water column and alterations to sediment composition. The additional impact to water and sediment quality from the proposed action would be expected to be small compared to those derived from non-OCS extraction activities because the non-OCS activities are much more extensive.

Oil spills in the Gulf of Mexico also adversely affect water quality. Nearly 85 percent of the 0.7 MMbbl of the petroleum that enter North American ocean waters each year as a result of human activities comes from land-based runoff, polluted rivers, airplanes, and small boats and jet skis; less than 8 percent comes from tanker or pipeline spills. Oil exploration and extraction are responsible for only 3 percent of the petroleum that enters the sea. Another 1.1 MMbbl are introduced into the ocean from naturally occurring seeps on the seafloor (NRC, 2003a). As witnessed during the 2005 hurricane season, the region is in a cycle of increased storm activity. Damage from hurricanes during the active and destructive 2005 season resulted in over 500 small spills in 2005, but no large spills occurred due to the shut-in of wells prior to the storms. Numerous small spills would be expected in the future, should similar storms cross the Gulf.

Up to 45 large oil spills could occur from all OCS activities, including the Proposed Program, in the Gulf of Mexico Planning: up to 5 pipeline spills (4,600 bbl each), up to 30 platform spills (1,500 bbl each), and up to 10 tanker spill (5,300 bbl) (Table IV-17). For a time period of 40 years, as many as 42 large tanker spills could be expected to occur in the Gulf of Mexico from import tankers (Table IV-17) involved in non-OCS activities. This would translate to about 4 tanker spills averaged over a 5-year period. Some of these spills could occur some distance from shore and would affect continental shelf or deep marine water or sediment quality. These spills would temporarily reduce the water quality in the vicinity of the spill and would introduce associated contaminants into the water column and sediments. Accident locations are unknown and cannot be accurately predicted, given the possibility of accidental oil release from a vessel collision (anywhere on the OCS or in State waters) or transfer/lightering operations at the Louisiana Offshore Oil Port or other ports. The incremental increase in water quality impacts from these spills is difficult to predict because water quality impacts would depend on the location of the spills, existing weather conditions, spill volumes, and the type of product spilled.

In addition, the volume of oil spilled would represent a small fraction of the total oil released to the Gulf from other sources such as naturally occurring oil seeps. Gulf of Mexico seeps release about 4,000 tons of oil/year to Gulf waters (Kvenvolden and Cooper, 2003). For a specific gravity of 0.8, the rate of oil seepage is about 0.03 MMbbl/year, or 0.12 MMbbl for the 40-year life of the Proposed Program. Potential spills associated with the proposed action would be about 0.08 MMbbl, equal to an increase over natural seepage of about 7 percent over this time period. The incremental adverse impact to water quality from predicted spills would be correspondingly small.

As discussed in Section IV.A.2, global warming could produce an increase in sea level, warmer water temperatures, increases or decreases in river discharges to the Gulf of Mexico, and possible changes in the number and intensity of hurricanes. Such changes could affect water circulation, salinity, dissolved oxygen content, and the extent of the Gulf of Mexico hypoxic zone. Because the magnitudes of these changes are not known with certainty, incremental increases derived from the proposed action cannot be accurately predicted.

### Conclusion

Normal operational activities under the proposed action would adversely impact water quality in the Gulf of Mexico. However, the incremental increase of such activities relative to impacts derived from existing and future OCS activities that are not part of the proposed action and from non-OCS activities would be minimal and, in general, expected to be less than 10 percent. The number of large spills in Gulf waters for most activities associated with the proposed action would represent only small increases over the number of expected spills from ongoing OCS and non-OCS activities, and a small increase relative to releases from naturally occurring oil seeps. The incremental increase in water quality impacts from these spills would depend on existing weather conditions at the location of the spills, their volumes, and the type of product spilled.

## c. Marine Mammals

Two activities have been identified as the primary causes of anthropogenic injury or morality of marine mammals in the northern Gulf of Mexico: fisheries and vessel traffic (NOAA, 2004b). Marine mammals may incur injury or mortality as a result of entanglement with fishing equipment (such as nets and longlines) or as a result of vessel collisions. Entanglement with fishing gear has been observed for larger cetacean species, while the incidence of fishery-associated injury or morality is unknown for many of the cetacean species (such as the pantropical spotted dolphin) that inhabit the northern Gulf of Mexico. Among the cetaceans, most ship-strike data are associated with larger species, such as the sperm and pygmy sperm whales (NOAA, 2004b).

A number of anthropogenic causes of injury or mortality have been reported for the West Indian manatee. These include vessel collisions, crushing by barges and water-control structures (such as lock gates), entanglement in fisheries equipment, poaching, and ingestion of debris (NOAA, 2004b).

There are a number of non-OCS activities that are occurring in the Gulf of Mexico that could result in collisions between marine mammals and ships. These activities include dredging and marine disposal, the domestic transportation of oil and gas, State oil and gas development, foreign crude oil imports, commercial shipping and recreational boating, commercial fisheries, and military training and testing activities (Section IV.L.1.b). Vessel traffic associated with these activities may also disturb normal behaviors with unknown long-term consequences. With all of these activities, the Gulf of Mexico is one of the world's most concentrated shipping areas (COE, 2003a,b). The Gulf of Mexico also supports an extensive commercial fishery, as well as recreational boating. Because of the very large number of vessels typically present in the Gulf of Mexico, the potential for vessel-marine mammal collisions is high, and may be expected to increase for the foreseeable future. The amount of OCS-related vessel traffic anticipated as a result of the 2007-2012 program and as a result of cumulative OCS activities are shown in Tables IV-1 and IV-14.

There are a number of non-OCS facilities or activities that discharge wastes to Gulf waters, and thus may expose marine mammals to potentially toxic materials or solid debris that could become entangled or ingested. These facilities or activities include sewage treatment plants, industrial manufacturing or processing facilities, electric generating plants, cargo and tanker shipping, cruise ships, commercial fishing, and recreational pleasure craft. In addition, the Mississippi River (and to a lesser extent, other rivers and streams that discharge to the northern Gulf of Mexico) discharges waters containing suspended sediments, fertilizers, herbicides, and urban runoff (Rabalais et al., 2001; 2002). While marine mammals are exposed to a variety of contaminants from these discharges, little is known about the levels of contaminants at which lethal or sublethal effects may be incurred. These discharges may also affect habitat quality in the vicinity of the discharges.

The role of exposure to toxins to marine mammal mortality is unknown. Elevated levels of chemicals such as polychlorinated biphenyls (PCB's) and pesticides have been measured in individuals sampled from waters that receive municipal, industrial, and agricultural inputs and have high concentrations of contaminants (such as in the immediate vicinity of Tampa Bay) (NOAA, 2004b). There is little information, however, regarding the level at which tissue concentrations of contaminants may result in lethal or sublethal effects.

A number of OCS-related activities could affect marine mammals or their habitats. These activities include seismic exploration, offshore construction (including pipeline trenching and platform removal), the discharge of operational wastes (such as produced water and ship wastes), and vessel traffic. Impacts to marine mammals associated with these activities may include physical injury or death, behavioral disturbances, lethal or sublethal toxic effects, and loss of reproductive, nursery, and feeding habitats (Section IV.B.2.c).

Discharges from currently operating OCS-related vessels and platforms are strongly regulated and would continue to be so under the proposed action. Thus, the potential for exposure to discharges from OCS vessels or facilities may be expected to be small. Operational discharges associated with the OCS activities are expected to contribute little to the cumulative risk of toxic exposure or ingestion/entanglement due to other discharge sources present in the Gulf of Mexico.

Noise generated during seismic surveys conducted in support of the OCS development has the potential to disturb or injure marine mammals in the immediate vicinity of the survey (Section IV.B.2.c). In addition, noise from normal operations may disturb marine mammals in the vicinity of the operation, causing a short-term change in normal behavior. Other noise-generating activities in the Gulf of Mexico unrelated to OCS activities include seismic surveys, construction and/or operation of offshore structures for State oil and gas development or nonenergy minerals extraction, dredging, commercial and recreational vessel traffic, and military training and testing activities. These may be expected to continue or increase in the foreseeable future.

It is unknown to what extent noises from seismic surveys or other activities may be affecting marine mammals. Noises that would be associated with normal OCS operations may be expected to add little to the overall noise levels in the Gulf of Mexico, although locally they may represent the dominant long-term noise in the environment. In these areas, seismic noise from OCS activities represents the dominant source of this type of noise in the environment. However, these noise events would be short-term in nature. Noise from activities associated with the proposed 2007-2012 program will add incrementally to this noise.

Marine mammals could be exposed to oil accidentally released from platforms, pipelines, and vessels (see Section IV.B.2.c). Most OCS spills associated with the proposed action would be relatively small ($\geq$ 1 bbl and < 50 bbl), and most would be expected to occur in waters of depths of 200 m or more (Table IV-4).

Storms, operator error, and mechanical failures may result in accidental oil releases from a variety of non-OCS related activities, such as the domestic transportation of oil, the import of foreign crude oil, and State development of oil. Crude oil may also enter the environment of the northern Gulf of Mexico from naturally occurring seeps (MacDonald et al., 1996; MacDonald, 1998b; Mitchell et al., 1999).

Accidental oil releases from these activities and from naturally occurring seeps could expose marine mammals to oil by direct contact or through the inhalation or ingestion of oil or tar deposits. The magnitude and duration of exposure will be a function of the location, timing, duration, and size of the spill; the proximity of the spill to feeding habitats; and the timing and nature of spill containment. Depending on their location, as well as the location of such spills from other sources and natural seeps, accidental spills associated with OCS activities could contribute to the overall exposure of marine mammals in the Gulf of Mexico OCS planning areas. Locally, OCS spills may represent the principal source of exposure for some species; especially in deepwater areas where most accidental spills will be from OCS sources.

Marine mammal populations throughout the Gulf may be adversely affected by climate change and, to a lesser extent, by hurricane events. As previously discussed (Section IV.L.1.c), there is growing evidence that climate change is occurring, and potential effects in the Gulf may include a change (i.e., rise) in sea level or a change in water temperatures. Such changes could affect the distribution, availability, and quality of feeding habitats and the abundance of food resources. It is not possible at this time to identify the likelihood, direction, or magnitude of any changes in the environment of the Gulf of Mexico due to changes in the climate, so it is too speculative to further discuss climate change impacts on marine mammals.

Severe storm events such as hurricanes may result in direct or indirect mortality of manatees and have the potential to impact their nearshore habitats (Langtimm and Beck, 2003). Heightened wave action and intensity could alter nearshore channels affecting the abundance and distribution of shallow-water habitats such as lagoons and bays, while sediments deposited into foraging habitats by storm waves may alter the thermal environment and affect aquatic vegetation in feeding habitats. Because hurricanes are annual events that are an inherent component of the overall Gulf ecosystem, it may be assumed that marine mammals of the Gulf have experienced hurricane impacts in the past and may be expected to continue to experience future hurricane events.

### Conclusion

Impacts to marine mammals in the Gulf of Mexico OCS Region may occur in the future as a result of normal activities related to the proposed action, as a result of current and future leasing (and associated activities) in the OCS, and as a result of non-OCS related activities. Marine mammals in the Gulf of Mexico may also be potentially affected by exposure to oil from naturally occurring seeps, by changes in habitat quality and distribution resulting from climate change, and by change in habitat or direct injury or mortality from hurricanes. The overall contribution to these cumulative impacts resulting directly from new leasing under the proposed action is expected to be small.

## c. Marine Mammals

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There are a number of non-OCS activities that are occurring in the Gulf of Mexico that could result in collisions between marine mammals and ships. These activities include dredging and marine disposal, the domestic transportation of oil and gas, State oil and gas development, foreign crude oil imports, commercial shipping and recreational boating, commercial fisheries, and military training and testing activities (Section IV.L.1.b). Vessel traffic associated with these activities may also disturb normal behaviors with unknown long-term consequences. With all of these activities, the Gulf of Mexico is one of the world's most concentrated shipping areas (COE, 2003a,b). The Gulf of Mexico also supports an extensive commercial fishery, as well as recreational boating. Because of the very large number of vessels typically present in the Gulf of Mexico, the potential for vessel-marine mammal collisions is high, and may be expected to increase for the foreseeable future. The amount of OCS-related vessel traffic anticipated as a result of the 2007-2012 program and as a result of cumulative OCS activities are shown in Tables IV-1 and IV-14.

There are a number of non-OCS facilities or activities that discharge wastes to Gulf waters, and thus may expose marine mammals to potentially toxic materials or solid debris that could become entangled or ingested. These facilities or activities include sewage treatment plants, industrial manufacturing or processing facilities, electric generating plants, cargo and tanker shipping, cruise ships, commercial fishing, and recreational pleasure craft. In addition, the Mississippi River (and to a lesser extent, other rivers and streams that discharge to the northern Gulf of Mexico) discharges waters containing suspended sediments, fertilizers, herbicides, and urban runoff (Rabalais et al., 2001; 2002). While marine mammals are exposed to a variety of contaminants from these discharges, little is known about the levels of contaminants at which lethal or sublethal effects may be incurred. These discharges may also affect habitat quality in the vicinity of the discharges.

The role of exposure to toxins to marine mammal mortality is unknown. Elevated levels of chemicals such as polychlorinated biphenyls (PCB's) and pesticides have been measured in individuals sampled from waters that receive municipal, industrial, and agricultural inputs and have high concentrations of contaminants (such as in the immediate vicinity of Tampa Bay) (NOAA, 2004b). There is little information, however, regarding the level at which tissue concentrations of contaminants may result in lethal or sublethal effects.

A number of OCS-related activities could affect marine mammals or their habitats. These activities include seismic exploration, offshore construction (including pipeline trenching and platform removal), the discharge of operational wastes (such as produced water and ship wastes), and vessel traffic. Impacts to marine mammals associated with these activities may include physical injury or death, behavioral disturbances, lethal or sublethal toxic effects, and loss of reproductive, nursery, and feeding habitats (Section IV.B.2.c).

Discharges from currently operating OCS-related vessels and platforms are strongly regulated and would continue to be so under the proposed action. Thus, the potential for exposure to discharges from OCS vessels or facilities may be expected to be small. Operational discharges associated with the OCS activities are expected to contribute little to the cumulative risk of toxic exposure or ingestion/entanglement due to other discharge sources present in the Gulf of Mexico.

Noise generated during seismic surveys conducted in support of the OCS development has the potential to disturb or injure marine mammals in the immediate vicinity of the survey (Section IV.B.2.c). In addition, noise from normal operations may disturb marine mammals in the vicinity of the operation, causing a short-term change in normal behavior. Other noise-generating activities in the Gulf of Mexico unrelated to OCS activities include seismic surveys, construction and/or operation of offshore structures for State oil and gas development or nonenergy minerals extraction, dredging, commercial and recreational vessel traffic, and military training and testing activities. These may be expected to continue or increase in the foreseeable future.

It is unknown to what extent noises from seismic surveys or other activities may be affecting marine mammals. Noises that would be associated with normal OCS operations may be expected to add little to the overall noise levels in the Gulf of Mexico, although locally they may represent the dominant long-term noise in the environment. In these areas, seismic noise from OCS activities represents the dominant source of this type of noise in the environment. However, these noise events would be short-term in nature. Noise from activities associated with the proposed 2007-2012 program will add incrementally to this noise.

Marine mammals could be exposed to oil accidentally released from platforms, pipelines, and vessels (see Section IV.B.2.c). Most OCS spills associated with the proposed action would be relatively small ($\geq$ 1 bbl and < 50 bbl), and most would be expected to occur in waters of depths of 200 m or more (Table IV-4).

Storms, operator error, and mechanical failures may result in accidental oil releases from a variety of non-OCS related activities, such as the domestic transportation of oil, the import of foreign crude oil, and State development of oil. Crude oil may also enter the environment of the northern Gulf of Mexico from naturally occurring seeps (MacDonald et al., 1996; MacDonald, 1998b; Mitchell et al., 1999).

Accidental oil releases from these activities and from naturally occurring seeps could expose marine mammals to oil by direct contact or through the inhalation or ingestion of oil or tar deposits. The magnitude and duration of exposure will be a function of the location, timing, duration, and size of the spill; the proximity of the spill to feeding habitats; and the timing and nature of spill containment. Depending on their location, as well as the location of such spills from other sources and natural seeps, accidental spills associated with OCS activities could contribute to the overall exposure of marine mammals in the Gulf of Mexico OCS planning areas. Locally, OCS spills may represent the principal source of exposure for some species; especially in deepwater areas where most accidental spills will be from OCS sources.

Marine mammal populations throughout the Gulf may be adversely affected by climate change and, to a lesser extent, by hurricane events. As previously discussed (Section IV.L.1.c), there is growing evidence that climate change is occurring, and potential effects in the Gulf may include a change (i.e., rise) in sea level or a change in water temperatures. Such changes could affect the distribution, availability, and quality of feeding habitats and the abundance of food resources. It is not possible at this time to identify the likelihood, direction, or magnitude of any changes in the environment of the Gulf of Mexico due to changes in the climate, so it is too speculative to further discuss climate change impacts on marine mammals.

Severe storm events such as hurricanes may result in direct or indirect mortality of manatees and have the potential to impact their nearshore habitats (Langtimm and Beck, 2003). Heightened wave action and intensity could alter nearshore channels affecting the abundance and distribution of shallow-water habitats such as lagoons and bays, while sediments deposited into foraging habitats by storm waves may alter the thermal environment and affect aquatic vegetation in feeding habitats. Because hurricanes are annual events that are an inherent component of the overall Gulf ecosystem, it may be assumed that marine mammals of the Gulf have experienced hurricane impacts in the past and may be expected to continue to experience future hurricane events.

### Conclusion

Impacts to marine mammals in the Gulf of Mexico OCS Region may occur in the future as a result of normal activities related to the proposed action, as a result of current and future leasing (and associated activities) in the OCS, and as a result of non-OCS related activities. Marine mammals in the Gulf of Mexico may also be potentially affected by exposure to oil from naturally occurring seeps, by changes in habitat quality and distribution resulting from climate change, and by change in habitat or direct injury or mortality from hurricanes. The overall contribution to these cumulative impacts resulting directly from new leasing under the proposed action is expected to be small.

## e. Terrestrial Mammals

Under the proposed action, terrestrial mammals in the Gulf of Mexico are not expected to be affected by normal OCS-related activities (see Section IV.B.2.e). The terrestrial mammals considered in the impact analysis for the proposed action are four federally endangered Gulf Coast beach mouse species and the federally endangered Florida salt marsh vole. Because of the listing of these species under the ESA as well as their occurrence in protected areas, the siting and construction of any onshore facilities associated with the proposed action would be required to take into account these species and their habitats, and construction activities would not be allowed in the habitats of these species. However, these species and their habitats could be affected by an accidental offshore or coastal oil spill.

Activities in the Gulf of Mexico not related to the proposed action that could result in the accidental release of oil and may affect terrestrial mammals and their habitats include oil production from prior and future OCS sales, domestic transportation of oil, State oil development, foreign crude oil imports, and military training activities involving open-water ship refueling. If spills from these activities occur in the vicinity of, or are transported by Gulf currents to, the habitats of the beach mice or the salt marsh vole, potential impacts would be similar in nature to those identified for the proposed action. Impacts associated with an oil spill may include loss of thermoregulatory ability from oiling of fur, lethal and sublethal toxic effects from inhalation of ingestion of oil or oil-contaminated foods, a decrease in food supply due to oiled vegetation, a decrease in habitat quantity and quality due to oiling of beach sands, and the fouling of burrows and nests. In addition, spill response activities could further impact habitats due to beach cleanup activities and vehicle and pedestrian traffic.

Given the relatively small number of spills that are expected under the proposed action and during the life of the 2007-2012 program (see Table IV-17), the requirement under the Oil Pollution Act of 1990 to prevent contact of protected or sensitive habitats (such as the habitats of the beach mice and the salt marsh vole) with spilled oil, and the need of a spill to be associated with environmental conditions (such as a storm surge sufficient to transport the spilled oil over foredunes) that could favor exposure of the species and their habitats, relatively few cumulative impacts may be expected from accidental oil spills from all potential sources, and the contribution of spills associated with the proposed action is expected to be limited.

Present beach mice habitat is no longer of optimal quality because of historical beach erosion, construction, and tropical storm damage. Coastal construction can be expected to threaten beach mouse populations on a continual basis. Beach mice have existed in an environment subject to recurring hurricanes, but tropical storms and hurricanes are now considered to be a primary factor in the beach mouse’s decline. It is only within the last 20-30 years that the combination of habitat loss due to beachfront development, isolation of remaining beach mouse habitat blocks and populations, and the destruction of remaining habitat by hurricanes have increased the threat of extinction of several subspecies of beach mice. Natural catastrophes including storms, floods, droughts, and hurricanes may substantially reduce or eliminate beach mice habitat. Some of these are expected to occur and periodically contact beach mouse habitat with direct and indirect effects on beach mice. Predation from both feral and domestic cats and dogs, and competition with common house mice may also reduce and disturb their populations, but estimates of mortality are unreliable (FWS, 1987; Humphrey and Frank, 1992).

Trash and debris may be mistakenly consumed by beach mice or entangle them. This problem may have increased following Hurricanes Ivan and Katrina because the storms washed large amounts of debris into the dune habitats. In addition, the reduction of food sources due to storm stress could lead animals to consume items not normally in their diet. Cleanup efforts to remove storm debris could result in serious negative impacts to beach mouse habitat if not properly regulated.

The habitats of these species could be affected by climate change, especially if there is an increase in sea level. The habitats of these species are also susceptible to hurricane events. Heightened wave action and associated storm surge could greatly reduce or eliminate the habitats for these species.

### Conclusion

A number of non-OCS activities (such as coastal development and transportation of domestic and foreign oil), and oil spills associated with many of these activities, could affect the habitats of the four federally endangered Gulf Coast beach mice species and the federally endangered Florida salt marsh vole. Under the proposed action, no impacts to these species are expected from normal OCS activities. While these species may be affected by accidental oil spills that could occur in association with the proposed action, it is unlikely that a spill associated with the proposed action would impact them. Thus, the proposed action is expected to contribute little, if any, incremental impact to the four beach mouse species or to the salt marsh vole.

## f. Fish Resources and Essential Fish Habitat

Section IV.B.2.f(1) and (2) identify potential effects of the proposed action on fish resources in the Gulf of Mexico. This section identifies other activities that could affect fish resources in the Gulf of Mexico, including non-OCS activities and current and planned OCS activities that would occur during the life of the 2007-2012 program, and the potential incremental effects of implementing the proposed action.

As identified in Section IV.B.2.f(3), essential fish habitat (EFH) in the Gulf of Mexico could be affected by any activity that degrades coastal or marine environments. Cumulative effects on EFH in the Gulf of Mexico could occur from a variety of OCS and non-OCS activities that have a potential to directly kill managed fish species, disturb ocean bottom habitats, increase sediment suspension, degrade water quality, or affect the food supply for fishery resources.

### (1) Gulf Sturgeon (Threatened Species)

As identified in Section IV.B.2.f(1), impacts to Gulf sturgeon could occur if routine activities or operational releases were to take place in or affect habitats utilized by this species. Placement and removal of structures, discharges of operational wastes, and accidental spills of oil were identified as activities of particular concern because of a potential to physically harm or disturb individual Gulf sturgeon or their habitat, cause sedimentation of areas that provide food, or elicit lethal or sublethal toxic effects. The level of such activities in the Gulf of Mexico planning areas under the proposed action (Table IV-1) would represent an incremental increase in the overall level of similar activities associated with ongoing and planned OCS activities that would occur during the life of the 2007-2012 program (see Table IV-14).

Bottom area disturbed by construction of platforms and pipelines in the Central Gulf of Mexico Planning Area could either directly affect individual fish or could affect the Gulf sturgeon’s estuarine and coastal benthic prey. Under ongoing and future OCS activities that would occur during the life of the 2007-2012 program, a total of approximately 12,000-17,000 ha of bottom area could be disturbed by such construction activities in the Central Planning Area (Table IV-14). It is anticipated that the majority (over 75%) of the areas disturbed by such construction activities would occur in waters over 300 m in depth.

Drill cuttings, muds, and associated fluids could smother potential benthic food sources for adult Gulf sturgeon as well as change the sediment particle size in small areas surrounding release locations; this could reduce the amount of desirable habitat for some benthic invertebrates that serve as prey for Gulf sturgeon. Under ongoing and future OCS activities that would occur during the life of the 2007-2012 program, up to 90 million barrels (MMbbl) of drill cuttings and about 236.9 MMbbl could be produced as a result of activities in the Gulf of Mexico (Table IV-14). However, it is anticipated the releases of most of these fluids would occur in areas that are over 300 m in depth.

Short-term increases in turbidity from bottom disturbances and increases in noise levels from platform and pipeline installation and drilling activities may disrupt feeding behavior and drive some of the adult Gulf sturgeon away. Platform removals with explosives may kill some adult Gulf sturgeon.

As described in Section IV.B.2.f(1), the majority of the areas in which construction, drilling, and removal activities would occur as a result of ongoing and planned OCS activities and as a result of the proposed action would be outside the normal habitat areas used by Gulf sturgeon (67 FR 39106-39199). Consequently, it is anticipated that effects on Gulf sturgeon from OCS activities would be limited.

In addition to potential effects from oil and gas activities identified above, Gulf sturgeon could be affected by commercial fishing, water quality degradation, coastal and upland development, dredge and fill activities, and damming of major spawning rivers (FWS and Gulf States Marine Commission, 1995). The increasing presence of offshore LNG facilities could lead to impacts associated with discharges of water used in the vaporization process. Each facility could produce up to 250 million gallons per day of water cooled by as much as 20 $^{o}$C. In addition to the thermal discharge, biocides are also discharged from the facilities. Even though it is illegal to fish for Gulf sturgeon, some individuals may be harmed or killed when captured as bycatch during commercial fishing activities. Dredging and fill activities in rivers used for spawning have the potential to smother the benthic eggs of the Gulf sturgeon. Increased barriers (e.g., locks or dams) to major spawning sites may result in fish reproducing in less desirable locations. The eggs and fry are susceptible to other fish and invertebrate predators as well as anthropogenic effects, such as artificially increased water temperatures due to the release of cooling water from power plants and exposure to pesticides and heavy metals.

Other events, including hurricanes, turbidity plumes, and hypoxia, could also affect Gulf sturgeon or their habitat, although the species as a whole should be adapted to such events. Regardless, a severe event could cause localized damage to important habitat areas and could result in the introduction of contaminants via surface water runoff. Therefore, such events could affect individual Gulf sturgeon or population levels for some period of time.

Oil spills in the Gulf of Mexico have the greatest potential to impact Gulf sturgeon populations. Western Gulf of Mexico Planning Area spills are less likely to reach estuarine and shelf habitat of the adult sturgeon. Under the cumulative scenario, approximately 2,500 small spills, 200 intermediate-sized spills, and 45 larger spills are assumed to occur in the Central Planning Area (Table IV-17), although most of these spills would be limited to deeper areas of the Central Planning Area where Gulf sturgeon are less likely to be present (67 FR 39106-39199). Spills in shallow areas have the greatest potential to affect Gulf sturgeon. As identified in Section IV.B.2.f(1), eggs and larvae of Gulf sturgeon are typically located in freshwater areas, and oil from OCS-related spills are unlikely to come into contact with these life stages. Because adult sturgeons are benthic feeders, they are relatively unlikely to come into contact with surface oil.

Non-OCS spills in the Gulf of Mexico (Table IV.17) could have similar impacts to those mentioned in the previous paragraph and in Section IV.B.2.f(1). Crude oil may also enter the environment of the northern Gulf of Mexico from naturally occurring seeps. At least 63 seeps have been identified in the northern Gulf of Mexico (mostly off the coast of Louisiana) (MacDonald et al., 1996), and more than 350 naturally occurring and constant oil seeps that produce perennial slicks of oil at consistent locations may be present in the Gulf (MacDonald and Leifer, 2002, as cited in Kvenvolden and Cooper, 2003). Seeps in the northern Gulf have been estimated to discharge more than 28,000 bbl of crude oil annually to overlying Gulf waters (MacDonald, 1998).

Most non-OCS spills and oil released from seeps are likely to occur in deep water and will not come into contact with the estuarine and coastal habitat during the approximately 4 months (November-February) when the adult sturgeon are present and feeding. Gulf sturgeon eggs, juveniles, and adults may be more likely to come in contact with oil or other contaminants that are released into upstream areas of freshwater rivers used as spawning and nursery areas either as a result of accidental spills, permitted discharges, or from nonpoint runoff from commercial and residential areas.

### Conclusions

Although Gulf sturgeon may be affected by a variety of OCS and non-OCS activities, most OCS activities occur in deeper areas that are outside of the normal habitat areas used by Gulf sturgeon. Consequently, it is anticipated that the cumulative effects of OCS and non-OCS activities on Gulf sturgeon would be similar to the effects of non-OCS activities alone, and the proposed action is expected to contribute little to any overall incremental impacts on the Gulf sturgeon.

## (2) Other Fish Resources

As discussed in Section III.A.9, there are numerous fish and marine invertebrate species that inhabit different niches throughout the surface waters, water column, and benthic environments of the Gulf of Mexico. Cumulative routine activities will have varied effects on these fish populations depending on their habitat and life history. Activities that temporarily disturb sediments and increase turbidity include installation of new pipelines and platforms and discharges of drill cuttings and associated fluids. This could cause soft-bottom fish such as Atlantic croaker, sand sea trout, Atlantic bumper, sea robins, and sand perch to temporarily move from the area. Fish species that are normally associated with reefs, such as snappers, groupers, grunts, and squirrelfishes, may also move from areas of increased turbidity. Sedimentation could smother demersal eggs and benthic prey of some of these fish species (Gulf of Mexico Fishery Management Council [GMFMC], 1998). Some habitat such as seagrasses could also be damaged because of sedimentation from these routine activities.

Many reef species as well as highly migratory species use platforms as habitat. Removal of platforms will reduce available substrate and structures for these fish and some of their prey species. Some fish will be killed in the process of these platform removals, especially when explosives are used to accomplish the removals. It is anticipated that 4,000 platforms could be removed with explosives under ongoing and future OCS activities during the life of the 2007-2012 program.

Highly migratory species such as tunas and billfish may be affected by several routine activities. Elevated noise levels from increased vessel traffic and drilling activities may cause these fish to avoid particular areas. It is estimated that ongoing and planned OCS activities result in 4,500 to 6,000 vessel trips per week. The addition of new platforms may act as fish attracting devices (FAD’s), and there has been some speculation that an increase in FAD’s could impact the migration patterns of highly migratory species. An additional 3,000 platforms would be constructed under ongoing and future OCS activities.

Non-OCS routine activities are similar to those discussed in Section IV.L.2.f(1) above. These impact-producing factors may negatively influence fish resources in various life stages and habitats. In addition to those previously discussed, 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 Gulf of Mexico fish resources.

Natural events, including hurricanes, turbidity plumes, and hypoxia, could also affect various fish species or their habitat, although the Gulf fish community as a whole should be adapted to such natural events. Severe natural events could cause localized damage to important habitat areas and could affect individuals or populations, although the level of effects is not predictable. In 2005, Hurricanes Katrina and Rita occurred sequentially as category 4/5 storms that traversed much of the offshore and coastal areas of the Gulf of Mexico. The storms caused substantial platform damage and destruction offshore that had served as fish reef habitat. The 113 destroyed platforms from both storms is similar to the number of structures decommissioned in a single year so the impact of the storms on this habitat was slight. Much of the material from the destroyed platforms remains in various conditions as functional fish habitat. Much of this debris will eventually be removed, but the habitat loss will be spread out over time.

Oil spills caused by Hurricane Katrina sent more than 8 million gallons of crude into southeast Louisiana bayous and rivers. In addition 224 billion gallons of floodwaters were pumped out of New Orleans following Hurricanes Katrina and Rita. The most extensive loss to fisheries and EFH was in shallow-water habitats. Significant areas of fish nursery grounds were lost due to physical disturbance of marsh edge habitat and general wave destruction. Total wetlands loss has been conservatively estimated to be over 100 $mi^2$ in eastern Louisiana alone as a result of these storms. The USGS (2006b) reported estimates that the effects of Hurricane Katrina transformed more than 30 $mi^2$ of marsh around the upper portion of Breton Sound to open water, or 20-26 percent of this 133-$mi^2$ area. Results of fisheries surveys conducted by NOAA in November 2005 indicate that offshore shrimp and bottom fish abundance was the same or higher than in the fall of 2004, with shrimp and other valuable species relatively abundant and widely distributed (NOAA, 2005d). The surveys show some species, such as the commercially valuable and overfished red snapper, had a higher population in 2005 than in 2004. They also found that the Atlantic croaker population doubled in 2005. Collected samples were tested for toxins that might have been released into the marine ecosystem after hurricane flooding, such as PCB's, pesticides, and fire retardants. All samples show the levels of these compounds are well below Federal guidelines for safe seafood consumption. The samples also were tested for potential bacteria such as *E. coli*, which is associated with human fecal contamination. None of the samples harbored the bacteria, although other vibrio bacteria that normally inhabit the marine environment were found.

Studies conducted after Hurricanes Katrina/Rita in Barataria Bay, Louisiana, showed shrimp and fish abundance at near normal levels. The greatest impact has occurred to oyster populations. According to Mississippi Department of Marine Resources estimates, approximately 90 percent of Mississippi's oyster beds were damaged and disrupted by Hurricane Katrina (Hogarth, 2005). Through early 2006, 100 percent of Mississippi's oyster fleet was out of work because of Hurricane Katrina. Oyster populations were similarly affected in parts of Louisiana.

A shallow pipeline spill could occur in the eastern part of the Gulf of Mexico area being offered in the 2007-2012 program in the vicinity of pink shrimp assemblages (Section III.A.9), which include fish species such as Atlantic bumper, sand perch, and pigfish. However, adults of these species are demersal and would either not come into contact with the oil once it reached the surface or would move away from it at the spill site.

Spills could affect fish in the brown shrimp assemblage. Some of the fish species in this assemblage include the longspine porgy, sea robins, and the dwarf goatfish. These fish are primarily demersal and, because they spend their time primarily near the bottom, would be unlikely to be exposed to the higher concentrations of hydrocarbons at the water surface. Further, it is generally believed (but not confirmed) that most adult fish in marine environments are capable of avoiding surface oil to a great extent (Birtwell and McAllister, 2002). The cumulative oil spill scenario for ongoing and future OCS activities estimates that 45 large pipeline spills could occur in the Gulf of Mexico from OCS operations during the life of the 2007-2012 program (Table IV-17).

Any oil spills reaching shallow seagrass, estuarine, or coastal marine habitats could affect fish species that use affected areas as spawning or juvenile nursery habitat. Coastal pelagic fish throughout the Gulf of Mexico could come into contact with surface oil, but would most likely move away from affected areas.

Highly migratory species could come into contact with deepwater surface spills. However, they would likely move away and avoid these areas (Birtwell and McAllister, 2002). If they were to occur, deepwater surface spills could also impact invertebrate eggs and larvae, neuston communities such as jellyfish species, and Sargassum together with any associated vertebrate and its invertebrate organisms. Such organisms could not move away from spilled oil and could be injured or killed.

The potential effects of spills from non-OCS activities would be similar to those described for OCS activities. More large spills are likely to occur from tankers carrying imported oil in the Gulf of Mexico than from OCS activities. As described in Section IV.L.2.f(1), crude oil may also enter the environment from naturally occurring seeps. Although such releases typically occur in deeper water, the released oil should rise to the surface relatively quickly. Although it is anticipated that most adult fish would be able to avoid the resulting plumes of oil, larvae or eggs of some fish species could be affected. Although some individual fish in various life stages could be affected, it is anticipated that such releases would not result in adverse overall effects on fish populations or communities in the Gulf of Mexico.

## Conclusion

It is anticipated that the proposed action would represent a small increment to the potential for overall cumulative effects on fishery resources in the Gulf of Mexico. Routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population- or community-level effects on fish resources because of the limited time frame over which most individual activities would occur and the small proportion of available habitats that could be affected during a given period.

The magnitude and severity of potential effects to fish resources from oil spills would be a function of the location, timing, duration, and size of spills, the proximity of spills to particular fish habitats, and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall community-level effects on fish resources because of the relatively small proportion of important fish habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in the shallow portions of the eastern Gulf have the potential to be of greatest significance to fish communities, due to the more extensive availability of seagrass and estuarine habitat along that coastline.

## (3) Essential Fish Habitat

Routine OCS activities could disturb bottom areas due to the installation of platforms and pipelines and the anchoring of vessels and structures. It is estimated that installation of platforms and pipelines could affect 12,000-17,000 ha of bottom area, respectively, under current and future OCS activities during the life of the 2007-2012 program. It is also estimated that cumulative OCS activities could result in 3,000-4,000 vessel trips per week (Tables IV-1 and IV-14). It should be noted, however, most of these vessel trips would not require anchoring to bottom substrates.

As discussed in Section IV.B.2.f(3), deposition of drilling fluids and cuttings could potentially affect EFH by altering grain-size distributions, and chemical characteristics of sediments such that benthic prey of some managed fish species would be affected in the immediate area surrounding drill sites. It is estimated that approximately 240 MMbbl of drilling muds and 70 MMbbl of drill cuttings would be produced as a result of cumulative OCS activities during the life of the 2007-2012 program. However, the most sensitive benthic habitats, such as those associated with hard bottoms and topographic features, should not be affected by the deposition of drilling muds and cuttings because of existing lease stipulations.

Platform removals using explosives will likely kill some fish, including managed species for which EFH has been established, and would remove platform-associated fouling communities that serve as prey for managed species. Approximately 4,000 platforms would be removed using explosives as a result of cumulative OCS activities during the life of the 2007-2012 program. If large numbers of fish are killed as the result of removal of platforms using explosives, there could be effects on managed species and their prey in the immediate vicinity of the removed platforms. Once a platform is removed, the fouling community that serves as a food source for some managed and prey fish species in the vicinity would no longer be available, and the associated fishes would be forced to relocate to other foraging areas. However, given the relatively small area that would be affected by such removals, Gulfwide effects on managed species are not anticipated.

There are also State oil and gas activities that can affect EFH. Louisiana and Texas have experienced substantial oil and gas development within their coastal areas including exploratory drilling, production platform installation, and pipeline installation. Factors that could affect EFH from these activities would be similar to those described above for OCS activities. However, the effects from non-OCS oil and gas activities could possibly be more severe than the effects from routine OCS activities because the activities are closer to shore and in shallower environments. As a consequence, more benthic EFH may be damaged, and resulting changes in sedimentation and turbidity could affect a greater proportion of the water column.

Other non-OCS activities that influence EFH may include commercial fishing, commercial shipping (tanker transportation), land development, water quality degradation, dredge and fill and dredge disposal operations, and marine mining (other non-oil and gas extraction minerals). Additionally, excavation and maintenance of channels, construction and operation of ports, moorings, cargo handling facilities, construction and operation of ship repair facilities, and construction of channel stabilization structures such as jetties could affect EFH (GMFMC, 1998).

There is one deepwater port (Louisiana Offshore Oil Port) in the Gulf of Mexico, which is located in Grand Isle Block 59, approximately 19 miles from shore. A concentration of vessel traffic in this area requires various fixed and mobile structures for anchoring. Fixed structures can permanently affect EFH associated with some benthic areas, although the anchoring structures themselves also provide substrate for sessile organisms. Location of anchoring structures away from topographic features and outside hard-bottom areas would limit effects because the softer sediments in other areas of the Gulf are relatively widespread and more common.

Barges carrying cargo arrive and depart through ports and travel through the Gulf Intracoastal Water Way, which serves as a major route for needed goods and supplies. Discharges of treated wastes or hazardous chemicals could negatively affect water quality (Section IV.L.2.b), a component of EFH, as well as aquatic vegetation. Pollutants generated from boat maintenance activities on land and water could also negatively impact water quality. Oil and grease are commonly found in bilge water, especially in vessels with inboard engines, and these products may be discharged during vessel pump out (USEPA, 1993).

Routine dredging operations for channel construction and maintenance, pipeline emplacement, and creation of harbor and docking areas can affect EFH by suspending sediments and affecting water quality. As suspended sediments settle to the bottom, the benthic prey of some managed fish species could be smothered. In most cases, benthic organisms would recolonize such areas unless maintenance dredging operations are repeated frequently. Dumping sites for dredge spoils in the Gulf of Mexico, most of which are located within State waters, could also alter water quality and affect benthic organisms that serve as prey for some managed fish species.

Loss of wetland habitat is a loss of important EFH for many larval and juvenile stages of managed species. Wetland loss could be caused by several factors including erosion, sea level rise, discharging nutrient-laden waters to the environment, reduced sediment load of the Mississippi River, and human-induced subsidence from groundwater withdrawals, among others. Cumulative effects on wetlands are discussed in Section IV.L.2.h.

Commercial and recreational fisheries in the Gulf of Mexico also impact EFH. For example, most of the wild shrimp caught are harvested using bottom trawls. The nets are held open with bottom sled devices made from wood or steel. In addition to capturing and killing some nontarget fish and invertebrate species, the sleds, or “doors,” drag along the bottom, potentially digging up sediments and hard substrate. Such activities could disrupt the benthic community and increase the turbidity of the water (Jones, 1992). Similarly, use of spiny lobster and stone crab traps may also damage bottom substrate such as seagrasses and corals. Strings of traps deployed without buoys are sometimes retrieved by dragging 40-pound grapnels and chains across the bottom until the trap string is hooked, potentially damaging bottom habitats in the process.

Other events, including hurricanes, turbidity plumes, and hypoxia, could also affect various managed fish or their habitat, although the Gulf fish community as a whole should be adapted to such events. For example, a hurricane or a series of hurricanes could temporarily degrade the quality of large areas of wetlands that serve as nursery and feeding areas for a variety of managed fish and invertebrate species. Severe natural events could cause localized damage to important habitat areas and could affect individuals or populations, although the level of effects is not predictable.

Oil spills from OCS and non-OCS activities may cumulatively affect several resources that contribute to EFH, including sediments, water quality, fish resources, coastal habitats, and seafloor habitats and benthic communities (see Sections IV.L.2.b, f, g, and h, respectively).

Oil from shallow-water spills could impact life stages of managed fish species that use surface waters as part of their life cycle, especially those that release pelagic eggs and have pelagic larvae. Unlike adult fish that can move away from oiled waters, pelagic eggs and larvae are largely transported by wind and water currents. Those that come into contact with surface oil could be injured or killed through smothering or an accumulation of oil on the gills. Thus, oiled surface waters would temporarily reduce the amount of EFH available for these life stages.

As described in Section IV.L.2.f(1), crude oil may also enter the environment from naturally occurring seeps. Although such releases typically occur in deeper water, the released oil should rise to the surface relatively quickly. Although it is anticipated that most adult fish would be able to avoid the resulting plumes of oil, larvae or eggs of some managed fish species could be affected. Although individual fish in various life stages could be affected, it is anticipated that such releases would not result in adverse overall effects on fish populations or communities in the Gulf of Mexico.

Habitat areas of particular concern include intertidal and estuarine habitats with emergent and submerged vegetation, sand and mud flats, and shell and oyster reefs that may provide food and rearing for managed juvenile fish and shellfish. Shallow-water spills may reach these coastal EFH areas and have negative impacts. During a spill, aquatic vegetation, which provides habitat for juveniles and for prey of some managed species, could become coated with oil. In such cases, organisms that are sessile or that have limited ability to avoid spills could be killed. These areas represent important nursery areas for fishes and invertebrates that contribute to estuarine, coastal, and shelf food webs. Surface spills would temporarily affect the quality of surface water EFH areas used by the eggs, larvae, and prey species of some managed fish species.

Seagrasses and macroalgae that provide nursery grounds for many fish species and habitat for many larval and adult invertebrates critical to nearshore food chains may also be affected by oil spills that enter shallow-water habitats. One study in a tropical marine environment (Panama) found that the abundance of seagrasses and associated invertebrates declined in areas contaminated with crude oil, although these areas had recovered within 3 years of the spill (Keller and Jackson, 1993). Similarly, a controlled experiment that evaluated the effects of a controlled release of oil in a tropical marine environment over a 10-year period found short-term (1- to 2-year) effects on seagrasses and invertebrates in oiled areas, followed by recovery of these communities to levels comparable to non-oiled reference sites (Baca et al., 1996).

Shallow-water wave action could increase entrainment of oil and tar balls in the water column. This could temporarily diminish the quality and quantity of benthic EFH. Settled tar balls may be ingested by bottom-feeding fishes and may harm or prove fatal to them.

Potential effects of spills related to OCS activities on fish resources are discussed above. Under the cumulative spill scenario, it is assumed that OCS activities (ongoing, future, and proposed actions combined) could result in 45 spills with volumes greater than 1,000 bbl in the Gulf of Mexico occurring during the life of the 2007-2012 program. Other potential sources of large oil spills that could affect EFH include non-OCS oil development activities and non-OCS tankering activities. Spills from import tankers (Table IV-17) could occur offshore in shipping lanes or in coastal waters as tankers prepare to make landfall.

The actual locations of the spills will determine the degree to which EFH would be affected. Spills have the greatest potential to harm EFH resources if they occur in shallow waters, where benthic habitats or wetlands can be affected, or if they occur when large numbers of pelagic eggs and larvae of managed species are present. If the location of a spill coincided with the location of eggs and larvae, large numbers of these organisms would be injured or killed. Oil reaching the surface from deep water pipeline spills and deepwater tanker spills could affect EFH for the eggs and larvae of federally managed pelagic fish species, neuston prey species, and Sargassum and its associated fauna. Pelagic eggs and larvae contacting the spilled oil would be smothered, and Sargassum within affected areas would be fouled and potentially killed.

### Conclusion

Considering the small proportion of EFH area that would likely be affected, potential impacts on EFH due to cumulative routine OCS operations alone is expected to be limited. The magnitude of impacts would be limited by specific lease stipulations. Additional impacts to EFH could occur as the result of a wide variety of non-OCS activities, including non-OCS oil and gas development, coastline development, commercial shipping, commercial and recreational fishing, dredging, and disposal of dredge spoils. Thus, it is anticipated that routine operations under the proposed action will not contribute substantially to cumulative impacts on EFH. Accidents such as petroleum spills and subsurface blowouts from OCS and non-OCS facilities could also have effects on EFH, especially if the spills occur in shallower nearshore areas or if deepwater spills reach surface areas at the same time that substantial numbers of eggs or larvae of managed species are present. While most accidents related to OCS activities assumed under the cumulative spill scenario would be small and would have relatively small incremental impacts on EFH, large spills that reach coastal wetlands could have more persistent impacts and could require remediation.

## g. Sea Turtles

Impacts to sea turtles from OCS activities may include physical injury or death, lethal or sublethal toxic effects, and loss of reproductive, nursery, and feeding habitats (Section IV.B.2.g). These activities include onshore and offshore construction (including pipeline trenching and removal of offshore structures), the discharge of operational wastes (such as produced water and ship wastes), and vessel traffic. The amount of these activities that would occur in the cumulative scenario during the life of the 2007-2012 program are shown in Table IV-14.

There are a number of non-OCS activities that are currently ongoing or reasonably expected to take place in the Gulf of Mexico in the foreseeable future that could affect sea turtles. These activities include offshore construction (e.g., dredging and marine disposal, extraction of nonenergy minerals, 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 vessel traffic (e.g., commercial shipping, recreational boating, and military training and testing activities).

Anthropogenic mortality in sea turtles has been attributed to a number of sources (NRC, 1990; NOAA, 2003). The human activities responsible for mortality of sea turtle eggs and hatchlings include (in descending order of relative importance) beach development, beach lighting, beach use, entanglement in trash and debris, and beach replenishment. Each of these activities is associated, either exclusively or to a large degree, with coastal development. In addition, the contributions of exposure of eggs and hatchlings to toxins and of the ingestion of plastics and debris by hatchlings are unknown (NRC, 1990; NOAA, 2003). Human activities responsible for mortality of juvenile and adult turtles include shrimp trawling and other fisheries, beach lighting, beach use, vessel collisions, dredging, entanglement, power plant entrainment, and oil platform removal (NRC, 1999; NOAA, 2003). The role of exposure to toxins to overall sea turtle mortality is unknown.

Non-OCS offshore (deepwater and nearshore) construction activities in the Gulf of Mexico that could affect sea turtles include channel construction and maintenance activities (including dredging) conducted by Federal, State, and local governments and the public; the offshore extraction of nonenergy minerals; State oil and gas development; and the transport of domestic and foreign oil and gas (requiring loading and offloading facilities). In addition, the increasing presence of LNG terminals on the OCS could result in increasing discharges of water used in the vaporization process that is cooled by as much as 20 $^{o}$C. Each facility could discharge up to 250 million gallons per day. These facilities would also discharge biocides used to prevent fouling of the flow through system. While sea turtles would likely avoid areas with unusually cool temperatures, the impacts of numerous LNG facilities on sea turtles is not currently known. Potential impacts to sea turtles from these activities may include physical injury or death of individuals present in the immediate construction area. In addition, construction or removal of offshore OCS facilities may result in a relatively small incremental increase in the potential for adverse impacts to sea turtles within the Gulf of Mexico planning areas. However, the mitigation measures established by MMS for construction and platform removal activities may be expected to reduce the contribution of these proposed activities to cumulative impacts to sea turtles from all offshore construction activities throughout the Gulf of Mexico planning areas.

Onshore construction in coastal areas can impact sea turtle nesting habitat. Coastal development is an ongoing activity throughout the Gulf of Mexico and may be expected to continue or increase for the foreseeable future. Residential (i.e., housing developments) and commercial (i.e., casinos) development near nesting beaches may disrupt nesting adults and disorient emerging hatchlings, while increasing the potential for recreational human activities on nesting beaches. Compliance with regulatory requirements and the implementation of appropriate mitigation measures may be expected to reduce the potential for the siting, construction, and operation of onshore facilities.

There are a number of types of facilities or activities that discharge wastes to Gulf waters and thus expose sea turtles to potentially toxic materials or solid debris that could entangle or be ingested by sea turtles. These facilities or activities include sewage treatment plants, industrial manufacturing or processing facilities, electric generating plants, cargo and tanker shipping, cruise ships, commercial fishing, pleasure craft, and vessel traffic associated with the 2007-2012 program. In addition, the Mississippi River (and to a lesser extent other rivers and streams that discharge to the northern Gulf of Mexico) annually discharges waters containing suspended sediments, agricultural fertilizers and herbicides, and urban runoff (Rabalais et al., 2001, 2002). The exposure of sea turtles to these discharges may result in physical injury or death, or a variety of lethal or sublethal toxic effects to adults, juveniles, and hatchlings. These discharges may also affect habitat quality in the vicinity of the discharges.

Operational discharges and wastes associated with OCS activities could adversely affect sea turtles, especially those in the immediate vicinity of discharging platforms and vessels (Section IV.B.2.g). However, discharges from OCS-related vessels and platforms would be strongly regulated under the proposed action (as they are for current OCS-related discharges). Thus, the potential for sea turtles to be exposed to discharges under the proposed action may be expected to be much less than the potential of exposure to many of the nonpoint and non-OCS related discharge sources. Similarly, because of existing U.S. Coast Guard (USCG) and USEPA regulations, the nature of the OCS discharges that could occur are expected to be less toxic or less likely to cause entanglement than discharges from non-OCS sources.

The Gulf of Mexico is one of the world's most concentrated shipping areas, with extensive commercial traffic transporting a variety of materials ranging from agricultural products to domestic and foreign oil (COE, 2003a). For example, in 2003, the Port of New Orleans handled over 255,000 domestic and foreign container vessels, while the port at Gulfport, Mississippi, handled more than 161,000 foreign container vessels (COE, 2003b). The Gulf of Mexico also supports extensive commercial fisheries as well as recreational boating. For example, there were 2 million recreational watercraft between 12 and 64 feet in length registered in the Gulf States, many of which are used in Gulf waters (USCG, undated). The Gulf of Mexico also supports training by U.S. Navy vessels as well as routine USCG activities. Because of the very large number of vessels typically present in the Gulf of Mexico, the potential for sea turtles colliding with watercraft is high, and may be expected to continue and increase into the foreseeable future. In comparison with the overall level of vessel traffic in the Gulf, the additional numbers of vessel trips that would occur to support OCS activities is expected to result in an incremental increase to the overall potential for sea turtle-vessel collisions in the Gulf of Mexico planning areas.

It is largely unknown how sea turtles may be affected by noise (see Section IV.B.2.g). Current noise generating activities in the Gulf of Mexico unrelated to OCS activities or the proposed action include the construction of offshore structures (such as those supporting State oil and gas development or nonenergy minerals extraction), dredging, commercial and recreational vessel traffic, and military training and testing activities. These may be expected to continue or increase in the foreseeable future.

Sea turtles could be exposed to OCS oil spills that could occur from platform, pipeline, and/or vessel accidents (see Section IV.B.2.g). Most spills associated with the proposed action would be relatively small ($\geq$ 1 bbl and < 50 bbl), and most would be expected to occur in water depths of 300 m or more (Table IV-17).

Storms, operator error, and mechanical failures may result in accidental oil releases from a variety of non-OCS related activities, such as the domestic transportation of oil, the import of foreign crude oil, and State development of oil. Crude oil may also enter the environment of the northern Gulf of Mexico from naturally occurring seeps. At least 63 seeps have been identified in the northern Gulf of Mexico (mostly off the coast of Louisiana) (MacDonald et al., 1996), and more than 350 naturally occurring and constant oil seeps that produce perennial slicks of oil at consistent locations may be present in the Gulf (MacDonald and Leifer, 2002, as cited in Kvenvolden and Cooper, 2003). Seeps in the northern Gulf have been estimated to discharge more than 1.2 million gallons of crude oil annually to overlying Gulf waters (MacDonald, 1998). Using remotely sensed satellite data, Mitchell et al. (1999) identified approximately 1,000 $km^2$ of floating oil in the northern Gulf of Mexico, presumably from natural seeps.

Accidental oil releases from these activities and from naturally occurring seeps could impact sea turtles by oiling (fouling) nesting beaches and nest sites and hatchlings, and through the inhalation or ingestion of oil or tar deposits. The magnitude and severity of potential effects to sea turtles from such exposure will be a function of the location, timing, duration, and size of the spill; the proximity of the spill to nesting beaches and feeding habitats; and the timing and nature of spill containment and cleanup activities. Depending on their location, as well as the location of spills from other sources and releases from natural seeps, accidental spills associated with the proposed action could contribute to the overall exposure of nest beaches, eggs, and hatchlings to oil, and subsequent lethal and sublethal effects, in the Gulf of Mexico planning areas.

Sea turtles populations throughout the Gulf may be adversely affected by climate change or hurricane events. As previously discussed (Section IV.L.1.c), there is growing evidence that climate change is occurring, and potential effects in the Gulf may include a change (i.e., rise) in sea level or a change in water temperatures. Climate change could affect the availability or quality of nesting beaches, the location and duration of current convergence areas utilized by hatchlings in the open waters of the Gulf, and the distribution, availability, and quality of feeding habitats. It is not possible at this time to identify the likelihood, direction, or magnitude of any changes in the environment of the Gulf of Mexico due to changes in the climate, and thus it is too speculative to include climate change impacts in this cumulative analysis.

Severe storm events such as hurricanes have the potential to impact nesting beaches if they result in a change in beach topography or in the composition of beach materials. Heightened wave action and intensity could erode nesting beach sites, storm surges could flood beaches and drown eggs and hatchlings, and sediments deposited onto beach surfaces by storm waves may alter the thermal and structural environment of nest sites, potentially decreasing the availability and/or quality of the nesting areas (Milton et al. 1994; Hays et al. 2001; Holloman and Godfrey 2005). Hurricanes Katrina and Rita adversely affected sea turtle habitats in 2005. Approximately 50 Kemp's ridley sea turtle nesting sites were destroyed along the Alabama coast (Congressional Research Service, 2005; FWS, 2006). The loss of beaches through the affected coastal areas has probably affected other existing nests and nesting habitats of this species as well as the loggerhead turtle. Similarly, impacts to seagrass beds may affect the local distribution and abundance species that use these habitats, such as the green sea turtle and Kemp's ridley sea turtle. The Breton National Wildlife Refuge, part of the Chandeleur Islands off of Louisiana and an important loggerhead turtle nesting area, lost approximately 50 percent of its land mass to Hurricane Katrina (Di Silvestro, 2006). Similar habitat loss is expected for the chain of islets. In addition, increased trash and debris in both offshore and inshore habitats have direct affects on sea turtles. About 200 loggerhead hatchlings could not get across the accumulated seagrass and debris washed ashore at Hutchinson Island, Florida, days after Hurricane Katrina hit, although most of the hatchlings were recovered and later released in the ocean (CBS News, 2005).

Although hurricanes are annual events that are an inherent component of the overall Gulf ecosystem, including sea turtle nesting beaches, if hurricanes similar in magnitude to Katrina and Rita occur during the life of the 2077-2012 program, population-level impacts to sea turtles could occur, particularly since the availability of other nearby beaches for turtles to nest on has become limited because of coastal residential and commercial development.

## Conclusion

Impacts to sea turtles may occur in the future as a result of normal activities related to the proposed action, as a result of activities related to ongoing and expected OCS leasing, and as a result of non-OCS related activities. The potential impacts associated from normal OCS operations represent a relatively small incremental increase in the impacts incurred by sea turtles from non-OCS related activities in the Gulf of Mexico. Similarly, accidental oil spills under the proposed action would result in a comparatively small incremental increase in the overall impact of exposure to oil from other anthropogenic activities (such as spills from foreign tankers). Additional impacts to sea turtles may occur as a result of habitat loss or alteration due to climate change and hurricanes, and from exposure to oil from naturally occurring seeps.

## h. Coastal Habitats

A number of activities associated with the proposed action could result in impacts to coastal habitats (Section IV.B.2.h). These activities include construction of pipelines, canals, and shoreline facilities; maintenance dredging of inlets and channels; and vessel traffic. Impacts associated with these activities could include (1) losses of beach and dune habitat and indirect effects that contribute to reductions in beach habitat in areas of ongoing shoreline degradation and (2) elimination of wetland habitat and indirect effects that contribute to reductions in wetland habitat. Similar activities will be occurring from previous and future OCS sales during the life of the 2007-2012 5-year program (see Table IV-14). Excluding the estimated number of offshore pipelines installed, which is not relevant to this analysis, the activities associated with the proposed action will be about 10 percent of the total amount of OCS activity that will be occurring during the life of the 2007-2102 program.

### (1) Barrier Beaches and Dunes

Impacts to barrier beaches and dunes primarily result from factors that reduce sediment input to downdrift areas or that directly contribute to increased erosion of beaches and dunes. Construction projects may reduce the sediment contribution to the Gulf barrier landforms from inflowing rivers or may restrict the movement of sediments to downdrift areas and natural replenishment of barrier beaches. Other activities may disturb barrier dune vegetation, thereby promoting dune erosion, or directly disturb beach and dune substrates, resulting in increased erosion of beaches and dunes. Increases in wave action can also contribute to beach erosion.

Ongoing non-OCS activities that could affect barrier beaches and dunes include those related to State oil development, commercial shipping, coastal development, and recreation. These activities can be reasonably expected to continue into the future. A number of activities reduce the sediment supply to barrier beaches and dunes. Past activities that have contributed to sediment deprivation and submergence of coastal lands have contributed to erosion and land losses, particularly along the Louisiana coast, and are expected to continue into the foreseeable future. Channelization and diversion of Mississippi River flows, as well as the construction of Mississippi River dams and reservoirs, and subsequent reductions in sediment supply to deltaic areas to the west have resulted in the continued extensive erosion of coastal habitats. Past construction of dams on rivers discharging to the western Gulf of Mexico has also resulted in a reduction in sediments delivered to the coast, which, along with natural causes of sediment supply reductions, have resulted in ongoing land loss along the Texas coast. The emplacement of groins, jetties, and seawalls for beach stabilization in much of the Gulf contributes to the reduction of sediment inputs and the acceleration of coastal erosion in downdrift areas. Maintenance dredging of barrier inlets and bar channels, in combination with channel jetties, has resulted in impacts to adjacent barrier beaches down-current due to sediment deprivation, especially on the sediment-starved coastal areas of Louisiana. Maintenance dredging is an ongoing practice and is expected to continue to be an impacting factor into the future, including, for example, efforts to accommodate larger cargo vessels. The past construction of canals for pipelines and navigation has resulted in losses of coastal barrier habitat. Although new navigation canals from the Gulf to inland areas are unlikely to be needed and current pipeline construction methods result in little, if any, impacts to barrier landforms, existing pipeline canals are expected to continue to be sediment sinks and to promote the reduction of adjacent barrier island dunes and beaches. However, the replenishment of barrier beaches with sand obtained from OCS sources and the beneficial use of dredged material are expected to continue to aid in the restoration of barrier islands. The impacts to barrier beaches and dunes from sediment removal activities associated with maintenance dredging under the proposed action would represent a very small contribution to the past, ongoing, and expected future degradation of barrier beaches and dunes from non-OCS activities.

Although coastal barrier islands in most of the Central Gulf Planning Area generally receive minimal recreational use, most barrier beaches in Texas, Alabama, and Florida are accessible and extensively used for recreation. Pedestrian and vehicular traffic on beaches and dunes can destabilize substrates, either by reducing vegetation density—and thus increasing erosion by wind, waves, and traffic—or by directly disturbing or displacing substrates. In addition, considerable private and commercial development has occurred on many barrier islands in the Gulf, resulting in losses of beach and dune habitat. The impacts to barrier beaches and dunes from substrate-disturbance activities associated with pipeline construction under the proposed action are expected to be greatly minimized by non-intrusive construction techniques and would not be expected to appreciably add to the cumulative effects of other substrate-disturbing activities.

Activities that increase wave action along barrier beaches and dunes can contribute to their erosion. The construction of seawalls, groins, and jetties in Texas and Louisiana has contributed to coastal erosion in part by increasing or redirecting the erosional energy of waves. Vessel traffic related to shipping and transportation can result in wake erosion of channels between barrier islands. A large number of vessels use the navigation channels near the Gulf coast. A portion of the impacts related to vessel traffic would be associated with the proposed action; however, activities conducted under the proposed action would contribute a relatively small number of vessel trips to the total.

Barrier beaches and dunes could be impacted by accidental spills of oil or petroleum products resulting from cumulative OCS activities (Section IV.L.1). The majority of these spills would be small ($\geq$ 1 bbl and < 50 bbl) and the majority will occur in deep or ultradeep water located mostly far from shore. Non-OCS activities, such as the domestic transportation of oil, foreign crude oil imports, and State oil development may also result in accidental spills that could potentially impact coastal barrier beaches and dunes. The amount of oil contacting barrier islands from a spill would depend on a number of factors such as the location and size of the spill, waves and water currents, and containment actions. Naturally occurring seeps may also be a source of crude oil introduced into Gulf of Mexico waters (Kvenvolden and Cooper, 2003). The magnitude of resulting impacts and the persistence of oil would depend on factors such as the amount of oil deposited, remediation efforts, substrate grain size, and localized erosion and deposition patterns. In areas of barrier beach erosion, such as Louisiana, it is likely that cleanup operations would be required to greatly minimize sand removal or replace the sand that was removed. The impacts of potential oil spills associated with the proposed action would be expected to add a small contribution to the impacts of other sources of oil spilled at locations closer to the Gulf shoreline.

Indirect effects to coastal barrier beaches and dunes could result from global climate change. Potential thermal expansion of ocean water and melting of glaciers and ice caps could result in a global rise in mean sea level (Section IV.A.2). Sea-level rise could result in increased inundation of barrier beaches and increases in losses of beach habitat.

Hurricanes and other severe storm events can impact coastal barrier beaches and dunes. Increased wave action and intensity on barrier habitats may result in increased erosion and changes in beach and dune topography or losses of habitat. Hurricanes and tropical storms are inherent components of the Gulf ecosystem that have long influenced coastal habitats and are expected to continue to be sources of impacts. Anthropogenic impacts to barrier beaches and dunes may be greatly exacerbated by severe storm events such as hurricanes. Hurricane Katrina in August 2005 caused severe erosion and landloss for the coastal barrier islands and beaches along the Mississippi River Deltaic Plain. The eye of Hurricane Katrina passed directly over the 50-mile Chandeleur Island chain. Aerial surveys conducted by the USGS on September 1, 2005, show that these islands were heavily damaged by the storm (USGS, 2006a). Initial assessments suggest that Katrina reduced the Chandeleur Islands to one-half of their pre-storm land area. Although barrier islands and shorelines have some capacity to regenerate over time, the process is very slow and often incomplete, particularly in an area that already experiencee landloss and coastal erosion. Hurricane Katrina was the fifth hurricane to impact the Chandeleur Island chain in the past 8 years following Hurricanes Georges (1998), Lili (2002), Ivan (2004), and Dennis (2005). While it is not known at this time the extent to which these environments will recover or how long the recovery process will take could result in relatively permanent change to these habitats, particularly in areas that are already experiencing erosion and retreat as a result of sediment deprivation, sea level rise, and coastal development.

## (2) Wetlands

Factors that impact coastal wetlands include the direct elimination of wetland habitat by excavation or filling, the reduction of sediment inputs, the erosion of wetland substrates, and the degradation of wetland communities by reduced water or air quality or hydrologic changes. Construction projects may fill wetlands for facility siting or excavate wetlands for the construction of canals or pipelines. Other projects may reduce the sediment delivered to coastal wetlands from inflowing rivers. A number of activities may degrade wetlands or promote wetland losses indirectly by causing changes to wetland hydrology or introducing contaminants.

Ongoing non-OCS activities that could affect coastal wetlands include those related to State oil and gas development, commercial shipping, coastal development, dredging operations, discharge of municipal wastes and other effluents, domestic transportation of oil and gas, and foreign crude oil imports. These activities can be reasonably expected to continue into the future. A number of these activities result in the localized destruction of wetlands. The construction of pipelines and navigation channels would result in direct losses of wetlands that are crossed, due to excavation. In addition, the creation of spoil banks along canals would bury wetland habitat. Large areas of coastal wetlands are also lost by drainage and filling, due to urban development and agricultural use (Gosselink et al., 1979, Bahr and Wascom, 1984). Although activities that impact wetlands are regulated by State and Federal Agencies, construction of industrial facilities, commercial sites, and residential developments would be expected to result in continued wetland losses. Pipeline installation and vessel traffic outside of established traffic routes could have short-term impacts to seagrass communities, which are primarily located in the eastern Gulf of Mexico. The direct impacts to coastal wetlands from pipeline, navigation canal, or facility construction under the proposed action would represent a small contribution to the past, ongoing, and expected future losses of wetlands from non-OCS activities.

Indirect impacts to wetlands from non-OCS activities are expected to continue to contribute to wetland degradation and conversion of wetlands to open water. A major factor that has contributed to the ongoing loss of coastal wetlands, particularly in the Mississippi River Delta region of Louisiana, is the reduction in sediments provided to coastal marshes. Reductions in sediment supply, in combination with natural subsidence, have contributed significantly to the conversion of coastal marsh to open water. The construction of dams and levees and channelization along the Mississippi River restrict the sediment supply and overbank flow of floodwaters, limiting the release of sediments and fresh water to coastal marshes (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF], 1998, 2003; Corps of Engineers [COE] 2004). Coastal wetlands are also lost due to the effects of large storm events, and the continuing erosion of barrier islands reduces their capacity to act as buffers for coastal wetlands (LCWCRTF 2001). Construction of canals for pipelines and navigation would result in future continuing progressive losses from canal widening and failure of mitigation structures, which would contribute to the conversion of wetlands to open water. Canal construction and maintenance dredging of navigation canals result in hydrologic changes, primarily high levels of tidal and storm flushing and draining potential of interior wetland areas. Such alterations of water movement can result in erosion of marsh substrates and increase inundation levels, and can result in substantial impacts to the hydrologic basin. Construction and maintenance of canals through coastal wetlands can increase the impacts of coastal storms, such as hurricanes, in the conversion of wetlands to open water. Saltwater intrusion results from canal construction and reduced freshwater inputs due to river channelization, and causes considerable deterioration of coastal wetlands. Wetland losses due to subsidence have also been attributed to extraction of oil in some portions of the Mississippi River Delta or the withdrawal of groundwater along the Texas coast. Changes in wetland hydrology, as well as increases in turbidity and sedimentation, as a result of construction projects can impact wetlands. Degradation of wetlands can result from water quality impacts due to storm water discharges and discharges of waste water from vessels, municipal treatment plants, and industrial facilities. Water quality may also be impacted by waste storage and disposal sites. Impacts to air quality near construction sites or industrial facilities can result in local effects to wetland vegetation, and may include sources such as fugitive dust, off-gassing from processing facilities, or exhaust emissions. The indirect impacts to coastal wetlands from pipeline, navigation canal, or facility construction under the proposed action would represent a very small contribution to the past, ongoing, and expected future impacts to wetlands from non-OCS activities.

Accidental spills of oil or petroleum products from cumulative OCS activities (Section IV.L.1) could impact coastal wetlands or seagrass communities. The majority of these spills would be small ($\geq$ 1 and < 50 bbl) and would occur in deep or ultradeep water located mostly far from shore. Should spills occur in shallow water from vessel accidents and pipelines, they could contact and affect coastal wetlands. Spills that occur in deep water would be very unlikely to contact and impact wetlands. Non-OCS activities, such as State oil development, the domestic transportation of oil, and foreign crude oil imports, may also result in accidental spills that could potentially impact coastal wetlands. Naturally occurring seeps may also be a source of crude oil that could potentially affect coastal wetlands. The amount of oil contacting wetlands, the magnitude of resulting impacts, and the length of time for recovery would depend on a number of factors such as the location and size of the spill, containment actions, waves and water currents, type of oil, types of remediation efforts, amount of oil deposition, duration of exposure, season, substrate type, and extent of oil penetration. Impacts from oil spills would be expected to range from short-term effects on vegetation growth to permanent loss of wetlands and conversion to open water. The impacts of potential oil spills associated with the proposed action would be expected to constitute a small addition to the impacts of all other sources of oil in the Gulf.

Global climate change could result in indirect effects to coastal wetlands. Potential thermal expansion of ocean water and melting of glaciers and ice caps could result in a global rise in mean sea level (Section IV.A.2). Sea level rise would result in greater inundation of coastal wetlands and likely result in an acceleration of coastal wetland losses, particularly in Louisiana, as wetlands are converted to open water. In addition, large changes in river flows into the Gulf could affect salinity and water circulation in estuaries, which, in turn, could impact estuarine wetland communities.

Hurricanes and other severe storm events impact coastal wetlands through increased wave action and intensity, resulting in increased erosion of wetland substrates and conversion of coastal wetlands to open water. Hurricanes and tropical storms are inherent components of the Gulf ecosystem that have long influenced coastal habitats and are expected to be continuing sources of impacts. However, impacts to wetlands as a result of human activities, such as those that create marsh openings which enhance tidal and storm-driven water movements, may be amplified by severe storm events such as hurricanes. In 2005, Hurricanes Katrina and Rita caused extensive impacts to wetlands in the Central and Western Gulf. For example, up to 100 square miles of coastal wetlands in Louisiana may have been converted to open water as a result of the storms, and up to 150,000 acres of coastal wetlands and bottomland forests were damaged in national wildlife refuges along the Gulf coast (FWS, 2006). It is not known at this time the extent to which these environments will recover or how long the recovery process will take. It is possible that extreme storms such as these could result in relatively permanent change to these habitats, particularly in areas that are already experiencing erosion and conversion of wetlands to open water as a result of sediment deprivation, sea-level rise, channelization, and coastal development.

### Conclusion

The cumulative impacts of past activities have resulted is considerable losses of coastal habitats in the Gulf of Mexico. The proposed action would be expected to result in direct as well as indirect impacts to coastal habitats which would contribute to the past, ongoing, and future impacts of other activities within the Gulf, including naturally occurring events that affect those habitats. The impacts of the proposed action would be expected to represent a relatively small contribution to other impacts to coastal habitats, with excavation for pipelines and canals and oil spills providing the greatest contribution to cumulative impacts.

## i. Seafloor Habitats

Under the proposed action, a number of activities could directly or indirectly affect seafloor habitats. As identified in Section IV.B.2.i, impacts to seafloor habitats may include direct physical damage, sedimentation, and lethal or sublethal toxic effects resulting from placement and removal of structures, discharges of operational wastes, and accidental spills of oil. The level of such activities in the Gulf of Mexico planning areas under the proposed action (Table IV-4) would represent an incremental increase in the overall level of similar activities associated with previous and future OCS sales that would occur during the life of the 2007-2012 program (see Table IV-14).

### (1) Topographic Features

As identified in Section IV.B.2.i(1), a Topographic Features Stipulation has been in effect for specific lease blocks since 1973. The potential for cumulative impacts to these features resulting from OCS activities, including those that may occur as a result of the proposed action, has been greatly reduced or eliminated by this stipulation and by the establishment of No Activity Zones around these features (Rezak et al., 1983, 1985). As a consequence, there should be no significant incremental increase in direct physical impacts to topographic feature communities from OCS-related platform placement and removal, pipeline construction, and vessel anchoring under the proposed action.

The volumes of drilling muds, cuttings, and produced waters expected from the OCS cumulative scenario are presented in Table IV-14. While the more toxic oil-based drilling muds cannot be discharged under the conditions of the USEPA's National Pollutant Discharge Elimination System (NPDES) permit, there is potential for enrichment of some contaminants in sediments exposed to discharges of water-based muds, especially for discharges in water depths of less than 400 m. If drilling effluents were discharged at the surface in close proximity to a topographic feature, they could impact bank biota; however, the Topographic Features Stipulation precludes these activities in No Activity Zones and requires shunting of these discharges to near the sea floor in areas near topographic features. This greatly limits the potential for impacts from drilling effluents to biota associated with topographic features, and there would be little to no incremental increase in impacts to these features from the proposed action.

Produced waters also have the potential to impact the biota of the topographic features. Produced water discharges from the OCS cumulative scenario are detailed in Table IV-14. The Topographic Features Stipulation described previously would also prevent the discharges of produced waters within No Activity Zones, almost totally eliminating the potential for produced waters to reach and impact the biota of important topographic features.

Non-OCS activities with a potential to impact topographic features include anchoring, fishing/trawling, offshore marine transportation, diving, and tankering of imported oil. Anchoring of non-OCS activity vessels on these features could cause significant damage to the hard-bottom fauna. Anchoring could involve boats used for recreational and commercial fishing or scuba diving, and commercial ship traffic. The amount of damage that could result from anchoring activity would depend upon vessel size, the size of the anchor and chain, sea conditions at the time of anchoring, and the location or position of the anchor on the feature. Areas damaged by anchors may take more than 10 years to recover, depending upon the severity of the damage. Due to a lack of regulation of non-OCS activities on these features, there is a likelihood of damages increasing due to heavier usage of the resources in the future. Fishing activities could result in reduced fish abundance at various features, depending upon fishing intensity. Scuba divers may also cause a slight depletion in resources due to collecting activities. Because anchoring and collection activities by scuba divers on the living reef areas of the Flower Garden Banks, which is designated as a national marine sanctuary, are prohibited, biota associated with the Flower Garden Banks are unlikely to be significantly affected by these activities.

Impacts could also occur due to discharges from other non-OCS activities, including tankers or other marine traffic passing in the vicinity of the banks. Because water depths are typically greater than 20 m at the tops of most of the banks, dilution of discharges would greatly reduce concentrations of potentially toxic components before they could come in contact with topographic features; consequently, it is assumed that discharges from such activities would not be concentrated enough to affect the bank communities.

Hurricanes can occasionally damage the biota of the topographic features. When Hurricane Rita passed 95 km (60 miles) east of the East Flower Garden Bank, coral colonies were toppled, sponges and fields of finger coral (*Madracis mirabilis*) were broken, coral tissues were damaged by suspended sand and rocks, and large-scale shifts occurred in sand patches. Sixteen other banks were closer to the storm track and likely experienced severe effects. Hurricane Katrina may have caused similar damage on topographic features farther east.

Of the oil spills assumed to occur in the cumulative action scenario, only the large pipeline spills, which could occur in deeper waters of the Central and Western Gulf of Mexico Planning Areas, could affect topographic features. Other assumed large spills are either at the surface or in shallow water. Oil from surface spills could penetrate the water column to documented depths of 20 m; however, at these depths, concentrations would likely be several orders of magnitude lower than those demonstrated to have an effect on marine organisms. Due to the water depths of the topographic features, it is unlikely that any significant amounts of oil from surface spills would reach the sensitive communities.

Oil spills from pipeline ruptures or blowouts would be more likely to impact the topographic feature communities, as discussed in Section IV.B.2.i(1), and it is assumed that up to 20 incidences of such spills could occur as a result of current and planned OCS activities (not including the proposed action). Analyses of the potential effects of oil spills near banks indicated that, under worst-case conditions, crude oil reaching the biota of banks would be unlikely to be directly lethal to corals or to most of the other biota present on the bank (Continental Shelf Associates, Inc., 1992c, 1994b). Any effects associated with a spill reaching sensitive biota would most likely be sublethal, with recovery of those organisms likely occurring within an estimated 2 years. The use of dispersants on oil spills in the vicinity of the topographic features could cause these compounds to reach the deeper water reef areas; however, studies indicate the effect of chemically dispersed oil on corals is no different from the effect of oil alone, as noted in Section IV.B.2.i(1).

It is possible that oil spills from pipelines outside the No Activity Zones could reach the vicinity of the topographic features. However, because of the depth of the banks, the bank biota would probably not be affected by the subsurface oil. With the crests of all the banks being at least 15 m below the surface, the concentrations of any oil driven to at least this depth would be far below that capable of causing an impact. Subsurface oil spills would have to come into contact with a bank feature almost immediately to have any detrimental impact, due to the rapid dilution of the spill. Because the topographic features are distributed over a wide area of the shelf edge, the likelihood of any one subsurface spill reaching more than one feature would be minimal. Furthermore, water currents moving around the banks would tend to carry the spill components around the banks rather than directly over the features, thereby lessening the severity of the impact (Rezak et al., 1983).

Under the proposed action, it is assumed that up to 4 additional pipeline spills could occur within the Gulf of Mexico planning areas (Table IV-4). The number of oil spills assumed for all OCS activities is shown in Table IV-17. The increased potential of the activities resulting from the 2007-2012 program for affecting topographic features or bank communities would be small. The Topographic Features Stipulation described above would prevent drilling in the No Activity Zones, thereby avoiding the potential for most of the adverse effects from platform-associated oil spills. Oil spills outside the No Activity Zones should not impact sensitive bank biota due to the distance from the spills to the banks. If impacts to bank features were to occur, in most cases the effects to sensitive biota would be sublethal, with recovery occurring within a 2-year period. In the extremely unlikely event that oil from a subsurface spill were to reach a coral reef community (e.g., Flower Garden Banks) in lethal concentrations, a limited area would be impacted, but recovery could take considerably longer.

Storms, operator error, and mechanical failures may result in accidental oil releases from a variety of non-OCS related activities, such as the domestic transportation of oil, the import of foreign crude oil, and State development of oil. Crude oil may also enter the environment of the northern Gulf of Mexico from naturally occurring seeps. At least 63 seeps have been identified in the northern Gulf of Mexico (mostly off the coast of Louisiana) (MacDonald et al., 1996), and more than 350 naturally occurring and constant oil seeps that produce perennial slicks of oil at consistent locations may be present in the Gulf (MacDonald and Leifer, 2002, as cited in Kvenvolden and Cooper, 2003). Seeps in the northern Gulf have been estimated to discharge more than 28,000 bbl of crude oil annually to overlying Gulf waters (MacDonald, 1998b).

It is assumed that accidental oil releases from most non-OCS activities would be at the surface or located sufficiently far from topographic features that they would be unlikely to greatly affect communities associated with the topographic features. The magnitude and severity of potential effects to biota associated with topographic features from such exposure would be a function of the location, timing, duration, and size of the spill; the proximity of the spill to the features; and the timing and nature of spill containment and cleanup activities. Depending upon location, spills from non-OCS sources and releases from natural seeps could contribute to the overall exposure of communities associated with topographic features in the Gulf of Mexico OCS planning areas to oil, with corresponding lethal or sublethal effects.

## (2) Live Bottoms and Pinnacle Trend

Live bottom areas of concern are found in the north-central to eastern Gulf of Mexico off Mississippi, Alabama, and Florida, from the inner shelf out to the shelf break. Impacts to these areas from the proposed action were discussed in Section IV.B.2.i(2).

Due to the sensitive nature of live bottom and pinnacle communities, specific lease stipulations have been instituted for blocks that MMS has identified as having a high probability for the occurrence of these features. The cumulative analysis for live bottom habitat includes potential impacts from the proposed action together with impacts from activities associated with previous and future OCS sales and from non-OCS activities. The OCS-related factors could include platform placement and removal, pipeline construction, platform discharges, and anchoring. Non-OCS activities that have a potential to impact live bottom communities include commercial and recreational fishing, boating, tanker and shipping operations, and natural events.

The installation of drilling rigs or production platforms on the seafloor and associated anchoring activities would crush any organisms under the legs supporting the structure. As identified in Table IV-14, it is estimated that a total area of 3,000-5,000 ha would be affected by rig or platform placement as a consequence of cumulative OCS activities. However, Live Bottom Stipulations were established that prohibit oil and gas activities in the immediate area of live bottom or hard-bottom communities. Stipulations and regulations are updated based on data gathered from investigations funded by the MMS Environmental Studies Program and from the biological interpretations of geophysical surveys that are done by operators prior to commencing seafloor disturbing activities. These requirements and procedures should prevent physical disturbances to these communities from platforms and anchoring.

Pipeline placement and removal could impact live bottom communities by suspending sediments and burying organisms, as discussed in Section IV.B.2.i(2). The pipeline and support ship anchoring activities could also cause physical damage to the hard-bottom structure in live bottom communities. It is estimated that pipeline installation resulting from cumulative OCS activities would disturb approximately 9,000-12,000 ha of bottom area (Table IV-14). Live Bottom Stipulations should prevent direct physical disturbance of live bottom communities by such OCS activities, thereby limiting impacts to those that would occur as a result of suspending sediments. The majority of the pipelines are situated in the central Gulf, where existing live bottom communities have evolved under periodic conditions of relatively high near-bottom turbidity. It is anticipated that the suspension of sediments during pipeline placement or removal would be of short duration and that affected live bottom areas would recover within several years.

Removal of structures with or without explosives disturbs the seafloor and could potentially impact nearby live bottom communities by suspending sediments, as noted in Section IV.B.2.i(2). The cumulative scenario assumess that 4,000 platforms would be removed with explosives (Table IV-14). Impacts to hard-bottom areas from the explosive removals are not expected to be substantial, primarily because the Live Bottom Stipulations require that platforms be constructed away from live bottom communities and because suspension of sediments during platform removal would be of relatively short duration.

The discharge of drilling muds and cuttings could cause increased turbidity and localized deposition of sediments on the seafloor, as discussed in Section IV.B.2.i(2). Volumes of discharged drilling muds and cuttings from cumulative OCS activities are presented in (Table IV-14). Overall, impacts to live bottom communities by cumulative drilling mud and cutting discharges should be minimized as a consequence of the Live Bottom Stipulations that restrict OCS oil and gas activities in the immediate vicinity of live bottom or hard-bottom communities.

The anticipated volumes of produced water that would be released from each well under the OCS cumulative scenario are identified in Table IV-14. Impacts to live bottom communities should be minimized by limitations in the NPDES permits for discharges from platforms, as well as by the Live Bottom Stipulations, which prevent the placement of oil and gas platforms in the immediate vicinity of live bottom areas or pinnacle features. The depth of the pinnacle features and live bottom areas, prevailing current speeds, and offsets of the discharges from the live bottom areas would also cause the produced waters to be diluted considerably prior to coming into contact with sensitive biological communities. As a result, the cumulative discharges from OCS activities should not have significant effects on the live bottom communities.

Non-OCS activities also have a potential to impact live bottom communities. While most of the non-OCS activities listed previously (see Section IV.L.1.b) are unlikely to affect live bottom communities, several activities may produce impacts when considered in a cumulative context. Both recreational and commercial fishermen utilize live bottom areas for fishing, and anchor in these areas. Anchor damage to the bottom can be substantial in easily accessible and popular locations. Although the pinnacles' hard-bottom areas are farther from shore, they are used for anchoring by larger commercial and recreational boats. Various size anchors, 5- to 10-pound fishing weights, and yards of heavy fishing line have commonly been observed during surveys of pinnacle features by remotely operated vehicles during MMS-funded studies (Continental Shelf Associates, Inc., 1992b; Continental Shelf Associates, Inc. and Texas A&M University, Geochemical and Environmental Research Group, 2001). Many of these live bottom and pinnacle areas are also along major shipping routes or fairways and could be subject to anchor damage from freighters on occasion.

Natural events, including hurricanes, turbidity plumes, and hypoxia, could also affect these features, although the associated communities should be adapted to such natural events. Regardless, a severe event could cause localized damage and could affect species diversity and productivity for a short period of time.

The cumulative impacts of OCS activities to the pinnacle trend and live bottom communities in the Gulf should be small. Implementation of the Live Bottom Stipulations should prevent the occurrence of any physical damage to the features from OCS activities, and effects from suspension of sediments would also be limited, due to the brief period of activity occurrences and requirements to locate oil and gas activities away from specific live bottom or pinnacle features. Overall, it is anticipated that community-wide impacts to live bottom communities from OCS activities are unlikely. Similarly, non-OCS impacts from fishing, anchoring, and natural events should be localized in nature, and community-wide effects are not expected.

Potential oil spills assumed under the cumulative scenario are presented in Table IV-17. Oil from surface spills could penetrate the water column to documented depths of 20 m, but at these depths, it would be at concentrations several orders of magnitude lower than those demonstrated to have an effect on marine organisms. Due to the water depths of the pinnacle features and live bottom communities, it is unlikely that any significant amounts of oil from surface spills would reach the sensitive communities. Oil spills from pipeline ruptures would be more likely to affect the live bottom communities, as discussed in Section IV.B.2.i(2). If a large subsurface pipeline spill were to occur near a pinnacle or live bottom area, the biota could be impacted, with lethal effects occurring in localized areas. The Live Bottom Stipulations (both low relief and pinnacle trend) described above should prevent drilling and pipeline installations in the immediate vicinity of pinnacles and live bottom communities, thereby preventing most of the adverse effects from oil spills. If oil from spills or pipeline ruptures was to come in contact with live bottom communities, the effects to sensitive biota would likely be sublethal, with recovery occurring within a 2-year period. It is anticipated that the accidents that could occur as a result of the proposed action would represent a small addition to accidental oil releases associated with cumulative OCS activities. As with any releases of oil, the magnitude and severity of potential effects to biota associated with pinnacle and live bottom habitats from such releases would be a function of the location, timing, duration, and size of the release; the proximity of the release to features; and the timing and nature of spill containment and cleanup activities.

As identified in the previous section, storms, operator error, and mechanical failures may result in accidental oil releases from a variety of non-OCS-related activities. In addition, natural seeps also contribute to the volume of oil entering the marine environment of the Gulf of Mexico. It is assumed that accidental oil releases from most non-OCS activities would be at the surface or located sufficiently far from topographic features that they would be unlikely to greatly affect communities associated with pinnacle or live bottom habitats. However, depending upon location, spills from non-OCS sources and releases from natural seeps could contribute to the overall exposure of communities associated with topographic features in the Gulf of Mexico OCS planning areas to oil, and thereby contribute to lethal or sublethal effects.

## (3) Submerged Seagrass Beds

As identified in Section IV.B.2.i(3), the principal OCS activities under the proposed action that could potentially affect seagrass beds include placement of structures (e.g., pipelines) and vessel traffic within the vicinity of the beds. In addition, coastal development associated with OCS exploration and development could contribute to cumulative impacts to submerged seagrass beds. Most of the seagrass beds in the Gulf of Mexico are in the Eastern Gulf of Mexico Planning Area, where no OCS activities are proposed.

There are, however, a wide variety of non-OCS activities that could also contribute to cumulative impacts on submerged seagrass beds. In coastal areas of the Gulf of Mexico, onshore development and recreational and commercial boat traffic have been identified as major factors leading to declines in the abundance of submerged aquatic vegetation (Dawes et al., 2004). The exact nature of effects on seagrasses would depend on the specifics of individual coastal development projects as they are built. There would be only very small incremental effects from the proposed action.

Hurricanes and tropical storms can also have impacts on seagrass areas. For example, seagrass beds have been repeatedly damaged by the natural processes of transgression from hurricane overwash of barrier islands. The Chandeleur Island chain has been hit by five storms in the past 8 years; these include Hurricane Georges, Tropical Storm Isadore, Hurricane Ivan, Hurricane Lili, and Hurricane Katrina (Michot and Wells, 2005). Storm-generated waves wash sand from the seaward side of the islands over the narrow islands and cut new passes through the islands. The overwashed sand buries seagrass beds on the back side of the islands. Cuts formed in the islands erode channels that remove seagrass in its path. Over time, seagrass recolonizes the new sand flats on the shoreward side, and the natural processes of sand movement rebuild the islands. Land mass rebuilt since Hurricane Ivan was washed away by Hurricane Katrina. The Chandeleur Islands were reduced by Hurricane Katrina from 5.64 $mi^2$ to 2.5 $mi^2$ (14.61 $km^2$ to 6.47 $km^2$) and then to 2.0 $mi^2$ (5.18 $km^2$) by Hurricane Katrina (Di Silvestro, 2006).

As noted in Section IV.B.2.i(3), oil spills reaching coastal areas could affect submerged seagrass beds. As identified in Table IV-17, it is assumed that 45 large oil spills (≥1,000 bbl), 200 medium-sized spills (50 to 999 bbl), and 2,500 small oil spills (≥ 1 bbl and < 50 bbl) could occur as a result of ongoing and currently planned OCS activities. As discussed previously, non-OCS activities and oil seeps could also contribute substantially to releases of oil in the Gulf of Mexico. Oil spills in shallow water in the Gulf of Mexico from OCS and non-OCS activities could have significant effects on submerged seagrass beds. The magnitude and severity of potential effects to seagrass beds from oil spills would be a function of the location, timing, duration, and size of the spill; the proximity of the spill to seagrass beds; and the timing and nature of spill containment and cleanup activities. Releases that occur in the shallow portions of the eastern Gulf have the potential to be of greatest significance, due to the more extensive growth of seagrasses along that coastline. It is unlikely that OCS spills would contact the extensive seagrass areas offshore Florida and along its coast because of the great distance between these resources and locations in the Central and Western Gulf of Mexico Planning Areas where leasing will occur.

## (4) Chemosynthetic (Seep) Communities

Chemosynthetic communities in the Gulf of Mexico could be potentially impacted under the OCS cumulative scenario. Most of the chemosynthetic communities are low diversity and spread throughout the deeper areas of the Gulf of Mexico, although high density communities may be found associated with high concentrations of seeping hydrocarbons, as described in Section III.A.12.e.

Cumulative impact factors for chemosynthetic communities include both OCS and non-OCS activities. Impact-producing factors from OCS routine operations that could potentially have an effect on chemosynthetic and seep communities include bottom-disturbing activities associated with rig or platform placement and removal, flowline/pipeline installation and removal, anchoring, and discharges of drilling muds and cuttings. These activities have been previously discussed in Section IV.B.2.i(4).

Mitigation measures instituted to protect these high-density chemosynthetic communities include Notice to Lessee (NTL) 2000-G20, which requires the avoidance of chemosynthetic communities or areas that have a high potential for supporting these community types, as interpreted from geophysical records. Also, the MMS Environmental Studies Program funds research to locate and understand the ecology of chemosynthetic communities. An example of a recently completed study is *Stability and Change in Gulf of Mexico Chemosynthetic Communities* (MacDonald, 2002). The MMS updates regulations and mitigations based on the data from studies and from the biological interpretations of geophysical surveys. These requirements and procedures are believed to be effective in identifying areas of chemosynthetic communities, but it may still be possible that some chemosynthetic communities would not be distinguished by these procedures. If any impacts were to occur, the communities would recover over time, although the rate of recovery would be slow (MacDonald, 2000).

Non-OCS activities that have the potential to adversely affect chemosynthetic communities include fishing/trawling, anchoring, dredging and ocean-dredged material disposal, offshore marine transportation, and USDOD operations. However, due to the water depths of these areas and the widely scattered nature of these habitats, such activities are unlikely to greatly affect the chemosynthetic communities of the Gulf.

Although petroleum hydrocarbons serve as a nutrient source for symbiotic microorganisms associated with the macrofaunal species comprising the chemosynthetic communities, large oil spills occurring on the seafloor could have adverse impacts on these communities as identified in Section IV.B.2.i(4).

It is anticipated that adherence to NTL 2000-G20 will minimize the potential for oil spills to occur in areas where chemosynthetic communities would be affected. In the event that localized areas containing chemosynthetic communities were affected, it is considered unlikely that the proportion of the chemosynthetic communities that could be affected would threaten the resource as a whole and that recovery would occur without mitigation.

## (5) Other Benthic Communities

Cumulative impact factors for continental shelf, slope, and deep-sea soft-bottom communities include both OCS and non-OCS cumulative activities. The OCS activities include bottom-disturbing activities associated with rig or platform emplacement and removal, flowline and/or pipeline installation and removal, anchoring, discharges of drilling mud and cuttings, and discharges of produced waters. Non-OCS factors could include fishing/trawling, anchoring, dredging and ocean-dredged material disposal, nearshore and offshore marine transportation, and hurricanes.

Types of impacts due to rig placement, platform installation and removal activities, pipeline placement and removal, and the discharge of drilling wastes and produced water have been discussed in Section IV.B.2.i(5). The estimated numbers of platforms and bottom areas disturbed by platform placement and pipeline installation under the OCS cumulative scenario are presented in Table IV-14. The maximum area of seafloor in the entire Gulf of Mexico (including the continental shelf, slope, and deep-sea habitats) that could be directly affected from platform placement and pipeline installation under the OCS cumulative scenario is approximately 17,000 ha out of an estimated area of more than 80 million ha in the Gulf as a whole.

Dredging operations in conjunction with ship channel maintenance and construction, pipeline placement and burial, and support facility access occur throughout the Gulf of Mexico as part of non-OCS activities. Sediments dredged and sidecast or transported to approved dredged material disposal sites could cause smothering and some mortality of sessile animals in the vicinity of the activity.

Non-OCS oil and gas exploration and production activities in Gulf of Mexico State waters occur primarily off Louisiana and Texas, and off Alabama in the vicinity of Mobile Bay. The States of Florida and Mississippi have had limited activities in State waters, with a moratorium on drilling activity now in effect in Florida waters. Impacts of drilling operations in State waters to benthic communities of the shelf would be similar to those discussed in Section IV.B.2.i(5).

It is anticipated that other non-OCS activities, including fishing/trawling, diving, anchoring, nearshore and offshore marine transportation, deepwater ports, USDOD activities, and hurricanes, would have minimal effects on Gulf of Mexico soft-bottom habitats. The predominant seafloor habitat on the Gulf of Mexico continental shelf, slope, and deep sea consists of soft bottom habitats with muddy to sandy sediments, as discussed in Section IV.B.2.i(5). The incremental impacts to benthic communities associated with such habitats under the proposed action would be very small relative to impacts from cumulative OCS and non-OCS activities.

Oil spills assumed under the OCS cumulative scenario have been detailed in Table IV-17. Large oil spills could occur from tanker spills in deep water, from platform spills in both shallow and deep water, and from pipeline spills in both shallow and deep water. Additionally, there could also be numerous smaller spills of up to 999 bbl of oil. Oil from surface spills is unlikely to affect most benthic communities, as discussed in Section IV.B.2.i(5). Oil spills from pipeline ruptures or blowouts would be more likely to affect soft-bottom benthic communities, although the hydrocarbon concentrations would be diluted to background levels within a few hundred meters to a few kilometers of the spill site. Given the widespread nature of soft-bottom habitats in the Gulf of Mexico as a whole, the potential areas that could be affected would not be likely to cause community-wide changes.

### Conclusion

Because stipulations that are currently in place restrict OCS activities in the immediate vicinity of seafloor areas containing important topographic features, live bottom habitat and chemosynthetic communities, there is relatively little likelihood that cumulative OCS activities will affect overall viability of ecological resources in such areas. The exclusion of OCS activity from the Eastern Gulf of Mexico Planning Area eliminates the potential for affecting important topographic, live bottom, or seagrass habitats. Non-OCS actions that may contribute to cumulative effects on seafloor habitats include anchoring, fishing/trawling, offshore shipping, diving, and continued onshore development. Communities that occur in deeper water, such as those associated with the major topographic features, live bottom habitats, and chemosynthetic areas, are unlikely to be greatly affected by such activities either because impacts would occur to relatively small proportions of the available habitats or because there are various restrictions in place to limit the potential for impacts. Important seafloor habitats that are in shallower water and closer to shore, such as the extensive seagrass beds located in the eastern Gulf of Mexico, may be more susceptible to impacts from non-OCS activities such as dredging and onshore development that contributes to increased sedimentation, turbidity, nutrient input, and various types of point and nonpoint source contamination.

The magnitude and severity of potential effects to seafloor habitats from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to particular seafloor habitats; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall community-level effects on seafloor habitats because of the relatively small proportion of seafloor area that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in the shallow portions of the eastern Gulf have the potential to be of greatest significance, due to the more extensive growth of seagrasses along that coastline. It is anticipated that ongoing, planned or proposed OCS activity will not occur in the Eastern Gulf of Mexico Planning Area; therefore, no impacts from the proposed action will contribute to the potential for cumulative impacts to seagrass beds.

## j. Areas of Special Concern

Section IV.B.2.j identified potential effects of the proposed action on areas of special concern in the Gulf of Mexico. This section identifies activities that could affect such areas in the Gulf of Mexico, including non-OCS activities and current and planned OCS activities that would occur during the life of the 2007-2012 program, and the potential incremental effects of implementing the proposed action.

### (1) National Marine Sanctuaries

Two national marine sanctuaries have been established in the Gulf of Mexico–the Flower Garden Banks National Marine Sanctuary and the Florida Keys National Marine Sanctuary, as discussed in Section III.A.13.a. The Flower Gardens sanctuary is protected from potential damage due to oil and gas exploration and development by an MMS Topographic Features Stipulation, which includes a No Activity Zone. Both sanctuaries are also protected by regulations (15 CFR 922) that prohibit certain activities, including: exploring for, developing, or producing minerals or hydrocarbons; removing, injuring, or possessing live rock; discharging or depositing materials; operating vessels in a manner that would strike or injure immobile organisms attached to the seabed; anchoring; taking or possessing any marine mammal, turtle, or seabird; and possessing or using explosives or electrical charges within the sanctuary boundaries. These regulations serve to prevent physical impacts to the sanctuaries from platform placement and removal, pipeline construction, and OCS-related vessel anchoring in the vicinity of the Flower Gardens sanctuary.

Additional OCS activities that could affect the marine sanctuaries include discharges of drilling cuttings, drilling muds, and produced waters. However, as identified in Section IV.B.2.j(1), the Topographic Features Stipulation does not allow discharges from OCS activities to be released within the vicinity of the Flower Garden Banks National Marine Sanctuary. Consequently, it is anticipated that the sanctuary would not be affected by discharges from OCS activities. Because there would be no OCS activities within 500 km of the Florida Keys National Marine Sanctuary under the cumulative scenario, organisms or communities within the sanctuary should not be affected by routine OCS operations.

Non-OCS activities that could affect the marine sanctuaries include fishing, diving, offshore marine transportation, and tankering. Natural events such as hurricanes could also impact the sanctuaries. Fishing and diving impacts are controlled by sanctuary guidelines regulating these activities. The distance of the Flower Garden Banks from shore (over 160 km) serves to reduce the number of visitors to the sanctuary, further reducing the potential for impacts from fishing and diving activities. Sanctuary regulations also prohibit collecting activities and ban anchoring within the sanctuary in order to minimize structural damage to the reef system from commercial and recreational vessels.

Impacts to the marine sanctuaries could occur due to discharges from non-OCS tankers or other marine traffic passing in the vicinity of the sanctuary. Discharges in the vicinity of the Flower Garden Banks National Marine Sanctuary should be greatly diluted before they could reach reef features because water depths within the sanctuary are greater than 20 m. Consequently, it is anticipated that concentrations of contaminants within such discharges would be diluted to levels unlikely to have toxic effects on reef organisms. Similar discharges within the vicinity of the Florida Keys National Marine Sanctuary could have greater effects, since many habitats within the marine sanctuary are located at depths of less than 20 m.

Hurricanes and winter storms could also impact corals at the shallowest depths in the Florida Keys National Marine Sanctuary, due to toppling the corals and abrasion by sand. Although the nature and strengths of hurricanes and other storms are unpredictable, they could have severe effects on sanctuary resources. Damaged areas would likely recover naturally, although recovery could take many years.

Oil spills could occur from tanker spills in deep water, platform spills in shallow water, pipeline spills in both shallow and deep water, and production facility spills in deep water. Oil from surface spills could penetrate the water column to depths of 20 m; however, concentrations of hydrocarbons at these depths are several orders of magnitude lower than those demonstrated to affect marine organisms. Due to the depths of the coral communities at the Flower Garden Banks, it is unlikely that significant amounts of oil from cumulative surface spills would reach these communities. Oil spills from pipeline ruptures or blowouts would be more likely to impact the Flower Garden Banks communities than surface spills. The No Activity Zone mandated in the Topographic Features Stipulation and adopted as a regulation for the Flower Garden Banks precludes placement of platforms or pipelines immediately adjacent to the marine sanctuary and reduces the likelihood that oil from a pipeline leak would reach bank communities. If oil from a series of subsurface spills were to reach one of these banks, sensitive biota could be affected. Potential impacts have been discussed in Section IV.B.2.j(1). Cumulative effects from spills that reach sensitive biota would most likely be sublethal, with recovery occurring within an estimated 2 years.

The Topographic Features Stipulation, with the additional regulations described above, would preclude drilling in the No Activity Zones, preventing most of the adverse effects from platform-associated oil spills. Oil spills outside the No Activity Zones should not affect organisms associated with the bank because of the distance from the spill to the bank. If spills reached sensitive biota, sublethal effects would be likely to occur, with recovery occurring within an estimated 2 years. In the unlikely event that oil from a subsurface spill were to reach the coral reef community in lethal concentrations, a limited area would be affected, and recovery should occur within 10-20 years.

There are no OCS leasing activities assumed for areas in the vicinity of the Florida Keys National Marine Sanctuary; the nearest areas offered for lease are located more than 500 km to the northwest of the sanctuary. This would prevent spills from either platforms or pipelines reaching the sensitive reef communities of the sanctuary. A more likely source by which oil spills could affect this area would be from a non-OCS activity, such as a tanker running aground in the shallow waters of the Florida Keys.

### Conclusion

The cumulative impacts to national marine sanctuaries from all activities and natural events are expected to be minor. Impacts would occur if an oil spill contacted the sanctuaries. The most likely scenario for oil-spill impacts is short-term effects because the sanctuaries are isolated from surface spills by water depth and from pipeline spills by either MMS regulations or distance from oil and gas activity. As a result of lease stipulations, and the MMS and sanctuary regulations currently in place, the incremental impacts of the 2007-2012 program should be negligible.

Potential incremental impacts on the Flower Garden Banks National Marine Sanctuary and the Florida Keys National Marine Sanctuary due to routine ongoing, planned, and proposed OCS operations would be largely prevented by provisions of the Topographic Features Stipulation. Accidents could affect the Flower Garden Banks National Marine Sanctuary, with the magnitude of the impact depending upon the location of the spill, spill size, the type of product spilled, weather conditions, effectiveness of cleanup operations, and other environmental conditions at the time of the spill. It is unlikely that there would be impacts from OCS-related spills on the Florida Keys National Marine Sanctuary because there are no ongoing, planned, or proposed exploration or development activities in the immediate vicinity.

## (2) National Parks, Reserves, and Refuges

As identified in Section IV.B.2.j(2), routine OCS activities potentially affecting parks, reserves, and refuges include placement of structures, pipeline landfalls, operational discharges and wastes, and vessel and aircraft traffic. It is assumed that pipeline landfalls, shore bases, and waste facilities would not be located in national parks, national wildlife refuges, or national estuarine research reserves because of the special status and protections afforded these areas. Consequently, there would be no impacts from these activities on any Gulf of Mexico national parks, reserves, or refuges.

It is possible that future pipeline landfalls, shore bases and waste facilities could be located in one or more estuaries in the Western or Central Gulf of Mexico Planning Areas that are included in the National Estuary Program. This includes Corpus Christi Bay (Coastal Bend Bays and Estuaries), Galveston Bay, Barataria-Terrebonne Estuarine Complex, and Mobile Bay. Under the cumulative scenario, it is anticipated that up to 40 new pipeline landfalls could occur in the Gulf of Mexico, with

6 of these resulting from the proposed action (Table IV-14). In addition, up to 14 gas-processing facilities could be built in the Gulf of Mexico area under the cumulative scenario, with up to 2 new facilities constructed as a result of the proposed action. It is assumed that new onshore facilities and structures would be subject to additional evaluations under the National Environmental Policy Act and that they would be sited to avoid national parks, reserves, and refuges and to limit impacts to estuarine and coastal habitats.

Trash and debris are a recognized problem affecting enjoyment and maintenance of recreational beaches along the Gulf Coast. From extensive aerial surveys conducted by NMFS over large areas of the Gulf of Mexico, floating offshore trash and debris was characterized by Lecke-Mitchell and Mullin, (1997) as a ubiquitous, Gulfwide problem. Not surprisingly, such trash and debris frequently washes up on beaches, including those associated with areas of special concern such as the Padre Island National Seashore. Trash and debris can detract from the aesthetic quality of beaches, can be hazardous to beach users, and can increase the cost of maintenance programs.

Trash and debris in the Gulf of Mexico originates from various sources, including OCS operations, State offshore and onshore oil and gas operations, naval operations; merchant vessels, commercial and recreational fishing activities, and onshore residences and businesses (J.E. Miller and Echols, 1996). The discharge or disposal of solid debris from OCS structures and vessels is prohibited by the MMS (30 CFR 250.40) and by the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]). Assuming that operators of OCS facilities comply with regulations, most potential impacts would be avoided, although some accidental loss of materials is inevitable. Natural phenomena (such as storms, hurricanes, and river outflows) contribute to movement of trash and debris onto the beaches in the Gulf of Mexico.

Vessel wakes from a large number of vessel trips can, over time, erode shorelines along inlets, channels, and harbors. The Gulf of Mexico is one of the world's most concentrated shipping areas, with extensive commercial traffic transporting a variety of materials ranging from agricultural products to domestic and foreign oil (COE, 2003a). For example, in 2003, the Port of New Orleans handled over 255,000 domestic and foreign container vessels, while the port at Gulfport, Mississippi, handled more than 161,000 foreign container vessels (COE, 2003b). The Gulf of Mexico also supports extensive commercial fisheries as well as recreational boating. Approximately 2 million recreational watercraft between 12 and 64 feet in length are registered in the Gulf States, many of which are used in Gulf waters (USCG, undated). The Gulf of Mexico also supports training by U.S. Navy vessels as well as routine USCG activities. The additional vessel activity that would occur under the proposed action will result in an incremental increase to the overall potential for wakes to affect sensitive shorelines in the Gulf of Mexico OCS planning areas.

Overall, it is assumed that there could be 3,000-4,000 OCS-related vessel trips per week in the Gulf of Mexico under the cumulative scenario; 400 to 500 of these would occur as a result of OCS activities attributable to the proposed action (Table IV-1 and IV-14). The majority of such vessel trips would occur in offshore waters, thereby precluding effects on shorelines associated with national parks, reserves, and refuges. Existing regulations typically limit vessel speeds in the sensitive inland waterways of areas of special concern. With these measures in place, most impacts due to vessel traffic in such areas would be avoided.

Under the proposed action, national parks, national wildlife refuges, national estuarine research reserves, or national estuary program sites could be exposed to oil accidentally released from platforms, pipelines, and vessels (see Section IV.B.2.j(2)). The potential exists for impacts to such areas if spills were to reach sensitive coastal habitats and could result from both oiling of the shoreline and mechanical damage during the cleanup process.

Most spills associated with the proposed action would be relatively small ($\geq$ 1 and < 50 bbl), and most would be expected to occur in waters depths of 200 m or more (Table IV-4). Such spills would occur as an addition to potential accidental oil releases associated with ongoing and planned OCS sales associated with the 2007-2012 program (Table IV-17). Because of the expected distribution of leasing activities, it is assumed that such spills would occur in either the Western or Central Gulf of Mexico Planning Areas.

In addition to the potential for spills from OCS sources, storms, operator error, and mechanical failures could also result in accidental oil releases from a variety of non-OCS-related activities including domestic transportation of oil, importing foreign crude oil, and development of oil production under State programs. As described in Section IV.L.2.b, a relatively large amount of crude oil also enters the Gulf annually from naturally occurring seeps.

Based on the expected distribution of activities and facilities associated with current or proposed activities under OCS leasing programs, it is assumed that any accidental large spills from OCS-activities would occur in either the Western or Central Gulf of Mexico Planning Area. In contrast, non-OCS spills could occur anywhere in the Gulf of Mexico. Thus, while it is considered likely that only national seashores, national wildlife refuges, national estuarine research reserves, and National Estuary Program sites in the Western or Central Gulf of Mexico are at risk from spills due to ongoing or proposed OCS activities, any of these types of properties located along the Gulf coast has a potential to be affected by non-OCS accidental spills. Regardless of the source, a large spill that reached the shoreline of any of these sites could have adverse effects on resources or resource values.

Hurricanes and tropical storms occur regularly in the Gulf of Mexico area. The natural environments that parks and refuges preserve and maintain have developed in a setting of regular occurrences of severe storms. In 2004 and 2005, however, Hurricanes Katrina, Rita, and Ivan severely impacted numerous national parks, national wildlife refuges, and national estuaries. In 2004, Hurricane Ivan damaged 10 National Wildlife Refuges between the Florida panhandle and Louisiana. In 2005 Hurricane Katrina affected 16 refuges in the same area, temporarily closing all of them. Impacts included damage to beaches, dunes, vegetation and infrastructure. Breton National Wildlife Refuge in Louisiana was reduced to about one-half its pre-Katrina size. Many impacted refuges remain impacted by huge quantities of debris and hazardous gases and liquids spread over large areas of wetlands within the sanctuaries. Should storms of similar strength and size occur during the life of the 2007-2012 program, long-term impacts to areas of special concern in the Gulf of Mexico could occur.

## Conclusion

Overall, routine OCS operations could result in minor incremental increases in effects on national parks, national wildlife refuges, national estuarine research reserves, and National Estuary Program sites compared to existing non-OCS activities within the Gulf of Mexico. Such impacts could include increases to the amount of trash or debris that currently washes up on shorelines, and increases in shoreline erosion due to increased vessel traffic in inshore waters. Compared to the existing potential for oil spills to affect such areas, the activities under the proposed action would be expected to result in a small incremental increase in the risk of impacts from oil spills to national parks, national wildlife refuges, national estuarine research reserves, or National Estuary Program sites. However, even a single large spill that reached the shoreline of such an area could have a relatively large adverse effect on resources or resource values. The cumulative level of impacts from spills would depend on spill frequency, location, and size; the type of product spilled; weather conditions; effectiveness of cleanup operations; and other environmental conditions at the time of the spill.

## k. Population, Employment, and Regional Income

This cumulative economic analysis focuses on the potential direct, indirect, and induced employment and labor income impacts of the OCS program's oil and gas activities in the Gulf of Mexico, together with those of other likely future projects, actions and trends in the region. Most approaches to analyzing cumulative effects begin by assembling a list of "other likely projects and actions" that will be included with the proposed action for analysis. However, no such list of future projects and actions could be assembled that would be sufficiently current and comprehensive to support a cumulative analysis for all 132 of the coastal counties and parishes in the analysis area (from Texas to Florida) over a 40-year period. Instead of an arbitrary assemblage of future possible projects and actions, this analysis employs the economic and demographic projections from Woods and Poole Economics, Inc. (2006) 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 employment 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. These 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 actions. These projections also include Woods and Poole's assumptions regarding Hurricanes Katrina and Rita's impact on the Southeast (see Section III.A.14.d). Hence, the regional economic impact assessment methodology used in Section IV.B.2.k to estimate changes to employment and labor income for the proposed action was used for the cumulative analysis. The MMS will continue to update baseline population, employment, and regional income numbers in future decision documents as new information becomes available from Woods & Poole Economics, Inc., the U.S. Department of Labor's Bureau of Labor Statistics, individual State data, and published reports.

Table IV-20 shows totals of direct, indirect, and induced employment and labor income projections for each of the economic impact areas (see Table III-13) of the Gulf States, the rest of the Gulf of Mexico (i.e. the remaining counties and parishes in the Gulf States), and the rest of the United States. Section IV.B.2.k provides a discussion of the economic impact model, MAG-PLAN (MMS Alaska-GOM Model Using IMPLAN), used to develop the projections. The MAG-PLAN numbers are based on the cumulative exploration and development scenarios provided by the MMS Resource Evaluation Division. High- and low-range estimates of activity drawn from this scenario form the basis for a range of estimates of employment and personal income effects.

Since the DEIS, the following changes/corrections have been made to the exploration and development scenarios used in the analysis: activity starts were delayed to 2008 (at the earliest) to account for the fact that the first sale is in August/September 2007 with a 90-day evaluation period; the timeframe for exploration activities was spread out over a longer, more realistic time period; the timing of platforms and production wells was adjusted for cases where production preceded platform installations; and an error in the way that workovers were distributed over time was corrected. New 2004 IMPLAN data became available and was incorporated into MAG-PLAN. In addition, the methodology used to develop onshore area distributions in MAG-PLAN was enhanced to better account for the fact that some service expenditures will only be made locally due to the underlying characteristics of the sector. For example, purchases that are needed immediately are not storable, and/or for which there is no advantage from regional "shopping" because any price savings will not offset the transportation differential. A more detailed description of how local sectors were identified and their expenditures allocated can be found in the OCS Study MMS 2006-075 (ICF, 2007).

The projections for the total economic impact area (EIA) show a range of 244,000 to 311,100 jobs in an average year attributable to cumulative OCS activities (Table IV-20). This represents between 1.9 and 2.5 percent of the economic impact areas total employment in 2005 (see Table III-19). This employment translates to between $9.4 billion and $12 billion in average yearly labor income. Most of the employment and income impacts accrue to Louisiana and Texas. An additional 69,500 to 87,700 jobs are projected to occur in other areas of the Gulf States, as well as 162,000 to 207,900 jobs in the rest of the United States (Table IV-20).

Employment demand will continue to be met primarily with the existing population and available labor force in most EIA's. The vast majority of these cumulative employment estimates represent existing jobs from previous OCS-program actions. The MMS does expect some employment will be met through in-migration; however, this level is projected to be small and localized. On a local level, Port Fourchon is experiencing full employment, housing shortages, and stresses on local infrastructure—roads (LA Hwy 1), water supply, schools, hospitals, etc. Port Fourchon is a focal point for OCS development, especially deepwater OCS operations. The port (and the surrounding community and infrastructure) is experiencing increased activity as a result of the 2005 hurricane season because of both the extent of repairs being made to offshore infrastructure and the damages and lost capacity at other service bases such as Venice and Cameron. Although some of this increase is expected to be temporary while repairs are being made, some of the increase is likely to be permanent. Any additional employment, particularly new residential employment, and the resultant strain on infrastructure due to the OCS program, are expected to have a significant impact on the area. In addition, ports throughout the Gulf are experiencing labor shortages for higher skilled positions such as electricians, fitters, crane operators, and boat captains, an issue that existed prior to the 2005 hurricane season. This may lead to additional in-migration to these areas to fill these positions.

Employment impacts of oil spills reaching landfall can vary considerably depending upon the total volume of oil reaching land, land area affected, and sensitivity of local environmental conditions to oil impacts. The primary impacts of oil spills would most likely fall on such activities as beach recreation (see Section IV.L.2.p), diving, commercial fishing (see Section IV.L.2.q(1)), recreational fishing (see Section IV.L.2.q(2)), and sightseeing. Oil spills reaching land can have both short- and long-term effects on these recreational coastal activities. Past studies (Sorenson, 1990) have shown that there could be a one-time seasonal decline in tourist visits of 5 to 15 percent associated with a major oil spill. Since tourist movement to other coastal areas in the region often offsets a reduction in the number of visits to one area, the associated loss of business tends to be localized. As discussed in Section IV.B.2.k, the employment and regional income impact from an oil spill would likely be greatest in Texas and Florida.

The cleanup and remediation of an oil spill would involve the expenditure of millions of dollars and the creation of hundreds of jobs. While such expenditures are revenues to businesses and employment/income to individuals, the cost of responding to a spill is not a benefit to society and is a deduction from any comprehensive measure of economic output.

## Conclusion

The employment and labor income impact of routine operations would likely be greatest in Texas and Louisiana. For the majority of the areas most affected, added employment demands would not likely burden the local labor market. However, activities relating to the OCS program are expected to significantly impact employment in Lafourche Parish, Louisiana, in EIA LA-3. Therefore, the population, housing, roads (LA Hwy 1), water supply, schools, and hospitals in the parish will be affected and strained. In areas with a large proportion of impact sensitive industry, the potential incremental impacts of proposed action oil spills would have short-term effects lasting for a season and resulting in a decline in business activity.

## l. Sociocultural Systems

Section III.A.15 describes the historical affects of OCS activities on sociocultural groups in the region. These effects include alterations in ethnic composition, self-identity, and cultural persistence of groups in the area. Under the cumulative scenario, localized onshore physical impacts are anticipated as a result of the construction of new pipeline landfalls and other onshore support facilities in the States adjacent to the Central and Western Gulf of Mexico Planning Areas. Additional helicopter and marine support activities also will occur. The nature and extent of these onshore physical impacts and additional traffic represent a small incremental increase in those effects already anticipated from current and planned OCS lease sales during the life of the 2007-2012 program. They are well within local experiences and expectations, and are unlikely to affect sociocultural systems

Impacts from the OCS leasing and development on sociocultural systems under the cumulative scenario will occur from the increasing trend toward deepwater activities in the Gulf of Mexico OCS. These trends promote sociocultural heterogeneity in coastal communities and longer periods of work offshore (See Section IV.B.2.l). We assume that 75 percent of the activity associated with future OCS operations during the life of the 2007-2012 program will occur in deepwater areas of the Gulf of Mexico, and that 10 percent will occur in ultradeep water, defined as greater than 5,000 feet water depth.

The increasing focus of OCS activities in deep and ultradeep water depths, and the continuing use of the coastal areas of the Gulf of Mexico, particularly in Louisiana and Texas, for staging, processing and support facilities will continue to promote changes in ethnic composition, self-identity, and cultural persistence of groups in coastal areas of States adjacent to the Central and Western Gulf of Mexico Planning Areas.

Non-OCS activities and processes with the potential for affecting sociocultural systems that are ongoing and are expected to continue into the foreseeable future include non-OCS oil and gas development, coastal habitat changes, coastal land loss, regional economic changes, and recovery from storms. These activities and processes can lead to changes in social organization by being a catalyst for population change, job creation and cessation, community development strategies, and overall changes in social institutions such as family, government, politics, education, and religion.

Accidental oil and other chemical spills may occur as a result of both OCS and non-OCS activities, as well as from oil seeps. The magnitude of impacts of such releases depends on their location, size, and timing, but they are expected to have only temporary physical or economic effects, which should not significantly alter sociocultural systems. Storm events can have significant sociocultural effects, causing populations to move, families to reorganize, and communities to reconsider their development strategies.

### Conclusion

The greatest contribution to cumulative impacts from the Proposed Program is expected to come from the expansion of deepwater activities, which will create jobs that require longer, unbroken periods of work offshore, specialized skills, and in-migration of part of the work force. These are already trends in the OCS industry. Since these, and other potential sociocultural effects, are expected to be minimal additions to existing trends, the cumulative impact on sociocultural systems during the life of the OCS 2007-2012 program will not result in significant changes to sociocultural systems.

## m. Environmental Justice

Section III.A.16 identifies potential environmental justice concerns, including those in which significant percentages of low-income and/or minority populations are located in proximity to onshore support infrastructure. This infrastructure includes helipads, heliports, waste management facilities, pipe coating yards, petrochemical plants, shipyards, platform fabrication yards, supply bases, natural gas storage facilities, repair yards, refineries, port facilities, and terminals. Each of these is associated with varying degrees of hazards that can potentially affect the environment, subsistence, health, and physical safety (The Louis Berger Group, 2004).

Under the cumulative scenario, localized onshore physical impacts are anticipated as a result of the construction of new pipeline landfalls and other onshore support facilities in the States adjacent to the Central and Western Gulf of Mexico Planning Areas (Table IV-14). Additional helicopter and marine support activities also will occur. Only small, incremental increases in onshore support activities are anticipated to result from the OCS activities during the life of the Proposed Program. These activities are not anticipated to expose nearby populations to notable higher risks. Few new facilities are anticipated.

Non-OCS activities and processes that are ongoing, expected to continue into the foreseeable future, and that have the potential for creating environmental justice impacts 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 can raise Environmental Justice (EJ) concerns by disproportionately impacting low-income and minority populations. As an example, low-income populations are disproportionately represented in low lying, flood prone areas and, thus, bore a disproportionate burden from the Hurricane Katrina aftermath.

The cumulative oil-spills scenario (Table IV-17) assumes there will be 45 large oil spills ($\geq$ 1,000 bbl), 200 medium spills (50-999 bbl), and 2,500 small spills ($\geq$ 1 bbl and $<$ 50 bbl). In addition, it is assumed that 42 large import tanker spills will occur. More oil and chemical spills could occur from other non-OCS sources such as natural oil seeps, State oil and gas activity, and petrochemical refining and processing. While the timing and location of these spills cannot be determined and some low-income and minority populations reside in some areas of the Gulf Coast, in general the coasts are home to more affluent groups. Low-income and minority groups are not more likely to bear more negative impacts than are other groups.

A reevaluation of the baseline conditions associated with EJ was recently conducted as a result of recent hurricane activity in the Gulf of Mexico. While it is expected that hurricane activity can have severe impacts on all coastal communities, impacts on minority and low-income populations may be disproportionate to the remainder of the local population. Since the hurricanes have not caused a significant shift in the location of the onshore infrastructure and the 5-year program would predominately use existing infrastructure, no difference from the existing conditions will be evident. Chapter 4.5.15.2 of the Draft Gulf of Mexico Multisale EIS (MMS, 2006d) discusses the potential strains on community infrastructure and services in the parishes/counties that sustained population increases immediately following Hurricanes Rita and Katrina. Any concentrations of poor and/or minority communities are expected to incur the same infrastructure and service strains as the overall resident population, therefore not causing disproportionate and negative effects on minority and low-income groups (see also MMS [2006d:chap. 4.5.15.4] for a discussion of cumulative EJ effects in Lafourche Parish, Louisiana). The distribution of low-income and minority populations also does not parallel the distribution of OCS-related industry activity.

**Conclusion**

The anticipated EJ effects of the Proposed Program under the cumulative scenario derive from the use of onshore support facilities. During the life of the 2007-2012 program, these effects will be similar to the effects that have been occurring historically in the States adjacent to the Central and Western Gulf of Mexico Planning Areas. Cumulative EJ impacts related to storm and hurricane damage and regional economic development issues could continue to occur, but such impacts are not expected to be substantially affected by the proposed program.

## n. Archaeological Resources

The following analysis considers the effects of trawling; sport diving; commercial treasure hunting; tropical storms; channel dredging; and activities associated with the proposed action, and prior and future OCS sales in the Gulf of Mexico. Specific types of impact-producing factors related to OCS mineral development considered in this analysis include drilling rig and platform emplacement, pipeline emplacement, anchoring, new onshore facilities, ferromagnetic debris associated with OCS activities, and oil spills.

### (1) Prehistoric Resources

Offshore development could result in an interaction between a drilling rig, platform, pipeline, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy artifacts or site features and could disturb the stratigraphic context of the site. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for the Americas and the Caribbean.

Since 1973, the MMS has required that an archaeological survey be conducted prior to development of mineral leases determined to have potential for prehistoric archaeological sites. The high-probability area for the occurrence of prehistoric sites in the Gulf of Mexico includes all areas of the continental shelf shoreward of the 45-m isobath. It is assumed that the archaeological survey has effectively mitigated most impacts from routine operations related to OCS mineral exploration activities. However, impacts to prehistoric resources may have resulted from OCS routine activities prior to the implementation of the archaeological survey requirement in 1973, but the magnitude of this possible impact is impossible to quantify.

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified prehistoric sites. This direct physical contact with a prehistoric site could cause physical damage to, or complete destruction of, information on the prehistory of the region and North America. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites have been located, evaluated, and mitigated prior to construction. However, impacts to coastal prehistoric resources may have resulted from onshore construction activities prior to enactment of the archaeological resource protection laws, but the magnitude of this possible impact is impossible to quantify.

Trawling activity in the Gulf of Mexico only affects the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors relating to the destructive effects of marine transgression and continuing effects of wave and current action. Therefore, the effect of trawling on most prehistoric archaeological sites would be minor.

Tropical storms and hurricanes are yearly occurrences in the Gulf of Mexico. These storms have impacted all areas of the Gulf from west Texas to south Florida (DeWald, 1980), and broad areas are affected by each storm. Prehistoric sites in shallow waters or coastal beach sites are exposed to the destructive effects of wave action and scouring currents during these events. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed, resulting in the loss of archaeological information. Overall, a significant loss of data from nearshore and coastal prehistoric sites has probably occurred, and will continue to occur, from the effects of tropical storms. It is assumed that some of the data lost have been significant and/or unique, resulting in a moderate to major level of impact.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for prehistoric archaeological sites as they are associated with drowned river valleys, which are known to have a high probability for prehistoric sites (Coastal Environments, Inc. [CEI], 1977). It is assumed that some of the archaeological data that have been lost as a result of dredging have been significant and unique; therefore, the impact to prehistoric archaeological sites as a result of past channel dredging activities has probably been moderate to major. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

An accidental oil spill could impact coastal prehistoric archaeological sites. Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, the Gulf of Mexico coastline has not been systematically surveyed for archaeological sites. Existing information indicates that, in coastal areas of the Gulf, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous. Thus, any spill that contacts land would involve potential impacts to prehistoric sites.

Heavy oiling of a coastal area (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in Carbon-14 ($^{14}C$) dating, and, although there are methods for cleaning contaminated $^{14}C$ samples, greater expense is incurred (Dekin et al., 1993). The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant archaeological information could result from the contact between an oil spill and a prehistoric archaeological site, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities; therefore, the cumulative impact from oil spills to prehistoric archaeological sites would probably be moderate.

## (2) Historic Resources

Direct physical contact between a routine activity and a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Since 1973, the MMS has required that an archaeological survey be conducted prior to development of mineral leases determined to have potential for historic-period shipwrecks. The high-probability area for the occurrence of historic-period shipwrecks in the Gulf of Mexico consists of nearshore areas, port vicinities, and ship-specific polygons (Fig. III-23). It is assumed that the archaeological survey has effectively mitigated most impacts from routine operations related to OCS mineral exploration activities. However, impacts to historic-period shipwrecks may have resulted from OCS routine activities prior to the implementation of the archaeological survey requirement in 1973, but the magnitude of this possible impact is impossible to quantify.

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified historic sites. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites have been located, evaluated, and mitigated prior to construction. However, impacts to coastal historic sites may have resulted from onshore construction activities prior to enactment of the archaeological resource protection laws, but the magnitude of this possible impact is impossible to quantify.

Trawling activities in the Gulf of Mexico would only affect the uppermost portion of the sediment column (Garrison et al., 1989). On many wrecks, this zone would already be disturbed by natural factors and would contain only artifacts of low specific gravity (e.g., ceramics and glass) which have lost all original contexts. Therefore, the effect of trawling on most historic shipwreck sites would be minor.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from shipwreck sites. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks. It is assumed that some of the data lost have been significant and/or unique. The known extent of these activities suggests that they have resulted in a major impact to historic-period shipwrecks.

Tropical storms and hurricanes are yearly occurrences in the Gulf of Mexico. These storms have impacted all areas of the Gulf from west Texas to south Florida (DeWald, 1980), and broad areas are affected by each storm. Shipwrecks in shallow waters and coastal historic sites are exposed to a greatly intensified longshore current and high-energy waves during tropical storms (Clausen and Arnold, 1975). Under such conditions, it is highly likely that artifacts of low specific gravity would be dispersed. Some of the original information contained in the site would be lost in this process, but a significant amount of information may also remain. Overall, a significant loss of data from historic sites has probably occurred, and will continue to occur in the Gulf of Mexico from the effects of tropical storms. It is assumed that some of the data lost has been significant and/or unique, resulting in a moderate to major level of impact.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for historic shipwrecks, and the greatest concentrations of historic wrecks are likely to be associated with these features (Garrison et al, 1989). Assuming that some of the data lost have been unique, the impact to historic sites as a result of past channel dredging activities has probably been moderate to major. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

Past, present, and future oil and gas exploration and development on the OCS will result in the deposition of tons of ferromagnetic debris on the seafloor. This modern marine debris will tend to mask the magnetic signatures of historic shipwrecks, particularly in areas that were developed prior to requiring archaeological surveys. Such masking of the signatures characteristic of historic shipwrecks increases the potential that significant or unique historic information may be lost. However, the MMS requires avoidance or investigation of any unidentified magnetic anomaly that could be related to a shipwreck site prior to permitting bottom-disturbing activities; therefore, the increase in impacts to historic shipwrecks from magnetic masking is probably minor.

An accidental oil spill could impact a coastal historic site, but the direct impact of oil on most historic sites would be temporary and reversible. The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant historic information could result from oil-spill cleanup activities, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities; therefore, the cumulative impact from oil spills to historic archaeological sites would probably be moderate.

### Conclusion

Under the cumulative scenario, the potential impact to both prehistoric and historic archaeological sites from routine activities should be largely eliminated due to archaeological surveys which are required prior to disturbance. However, routine activities that were approved prior to initiating the survey requirement may have impacted significant archaeological sites, but the magnitude of this possible impact is impossible to quantify. The factors not related to OCS mineral resource activities that probably have had, and will continue to have, an impact on both prehistoric and historic archaeological sites are channel dredging and tropical storms. Commercial treasure hunting and sport diving may result in a loss of artifacts at historic-period shipwreck sites. The primary oil-spill impacts to both prehistoric and historic archaeological sites would result from cleanup activities. The incremental contribution of the proposal to the cumulative impacts on archaeological resources should be very small due to the archaeological surveys that are required prior to disturbance.

## o. Land Use and Existing Infrastructure

Under the proposed action, localized site-dependent impacts to land use and existing infrastructure are anticipated as a result of the construction of new pipeline landfalls and onshore oil and gas-processing facilities in the Central and Western Planning Areas in the Gulf of Mexico. This onshore development could convert land from other existing or potential future uses, increase demands on roads and utilities, and increase demands on housing and public services. Additionally, exploration and development in deepwater areas could require expansion of the infrastructure to support deeper ports in certain onshore areas. For example, shore-based OCS and State servicing should increase in the ports of Galveston, Texas, and Port Fourchon, Louisiana. While there is sufficient land designated in commercial and industrial parks adjacent to the Galveston port to minimize disruption to current residential and business use patterns, Port Fourchon has limited land available, and operators have had to create land on adjacent wetland areas. Any changes in the infrastructure at Port Fourchon that lead to increases in Louisiana Highway 1 (LA Hwy 1) usage, will contribute to the increasing deterioration of the highway. In the absence of the planned expansions, LA Hwy 1 would not be able to handle future OCS and State activities. Any changes that increase OCS and State demand of water will further strain Lafourche Parish's water system. In addition to new pipeline landfalls associated with cumulative OCS activities, additional pipeline landfalls could occur as a result of increasing numbers of offshore LNG terminals expected to be installed during the life of the 2007-2012 program. These facilities will offload vaporized LNG into the existing offshore pipeline system, which could require more offshore pipeline construction and associated coastal landfalls to accommodate them. The nature and extent of land-use and infrastructure impacts are expected to represent only a small incremental increase in the impacts associated with current and planned OCS lease sales that would occur during the life of the 2007-2012 program (see Table IV-14).

Non-OCS activities that are ongoing, expected to continue into the foreseeable future, and could have an impact on land use and infrastructure include offshore construction (e.g., dredging and marine disposal, extraction of nonenergy minerals, State oil and gas development, the 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 vessel traffic (e.g., commercial shipping, recreational boating, and military training and testing) (Section IV.L.1.b).

As noted in Section IV.L.1.a, the OCS activities under the proposed action represent a small portion (about 10%) of the ongoing and future activities that would occur in the Gulf during the proposed 5-year period. Therefore, the impacts from the proposed development would be a small increment above the anticipated land use and infrastructure impacts that are already planned and/or are or have been occurring. The expansion of deepwater facilities is limited to specific locations and is, therefore, expected to be concentrated in certain onshore areas, limiting the areal extent of developmental impacts and perhaps reducing the potential for land-use conversion. Similarly, while coastal and community development are likely sources of impact to existing public and private infrastructure, these impacts will vary locally and will occur at varying rates. The proposed action would be unlikely to significantly or cumulatively alter the pace or location of this development.

Accidental oil releases may occur as a result of both OCS and non-OCS activities, as well as from naturally occurring seeps. The magnitude of the impacts would depend on the location and size of the releases. These releases are expected to have a temporary impact on land use and infrastructure in the Gulf of Mexico Region. Releases identified under the proposed action are anticipated, for the most part, to be small ($\geq$ 1 and < 50 bbl) and to occur in waters greater than 200 m in depth (Table IV-4). These releases would be a small addition to releases associated with other OCS and non-OCS activities (Table IV-17).

Severe storm events, such as hurricanes, have the potential to significantly impact beach and coastal areas which could, in turn, have an impact of local land-use patterns. In addition, such storms can damage existing infrastructure, sometimes requiring significant reconstruction efforts. While land-use and infrastructure patterns have developed against a background of recurring severe storms in the area, the occurrences of hurricanes in 2005 have had a profound impact on the infrastructure in the Gulf. For example, Hurricanes Katrina and Rita damaged 183 offshore pipelines, 33 of the Gulf's

40 refineries, numerous petrochemical facilities, gas processing plants, and many of the major ports in the region. Commercial and residential structures, roads, and bridges throughout the path of Katrina received extensive damage. Estimated damages to infrastructure from Katrina alone range from $21 billion for commercial structures, $49 billion for residential structures, $230 million for electric utilities, $3 billion for roads and highways, and $1.2 billion for sewer systems (Burton and Hicks, 2005). The occurrence of additional similar magnitude storms in the Gulf during the life of the 2007-2012 program could affect coastal land-use and infrastructure patterns.

### Conclusion

The most important contribution to cumulative impacts on land use and existing infrastructure attributable to the proposed action is expected to result from development of infrastructure to support deepwater activities. The expansion of deepwater exploration and development could impact existing infrastructure and, therefore, land use, since existing land bases may have to be expanded. Port Fourchon is expected to experience significant impacts to its land use from OCS-related expansion. Increased OCS-related usage from port clients is expected to significantly impact LA Hwy 1 in Lafourche Parish. Also, increased demand of water by the OCS will further strain Lafourche Parish's water system. Impacts on land use and infrastructure also could result from accidental oil releases. The overall contribution of the proposed 5-year OCS program to these cumulative impacts is the increase in deepwater activities and the potential for a relatively small number of accidental releases.

## p. Tourism and Recreation

Under the proposed action, the continuation of oil and gas development activities is not expected to result in adverse impacts to recreation and tourism in the planning areas in the Gulf of Mexico because the recreation and tourism industry is expected to continue to grow while the pace of oil and gas development is expected to remain consistent with past levels (see Section IV.B.2.p). However, some localized impacts are expected to occur as a result of aesthetic (visual and auditory) intrusions related to possible increases in the construction of new pipelines and gas-processing facilities, the addition of offshore platforms (which increases the number of artificial reefs), and possible increases in the amount of trash and debris washing to shore. The types of recreation and tourism opportunities that could be affected include beach recreation, sightseeing, diving, and recreational fishing.

Non-OCS activities that are ongoing, expected to continue into the foreseeable future, and might impact recreation and tourism include offshore construction (e.g., dredging and marine disposal, extraction of non-energy minerals, 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 vessel traffic (e.g., commercial shipping, recreational boating, and military training and testing) (Section IV.B.1).

As noted in Section IV.L.2.q, noise from platform installation and, likewise, platform removal can affect recreational fishing by temporarily disturbing fish and by possible fish kills if explosives are used to remove platforms. Platforms installed within 16 km (10 miles) 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 transportation activities that continue to occur within the Gulf of Mexico, can impact 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. The contribution of the proposed action to cumulative impacts, due to platform construction and increased transportation needs during construction, is expected to be limited. As noted in Section IV.L.2.q, the OCS activities under the proposed action represent a small portion (about 10%) of the ongoing and future activities that would occur in the Gulf during the proposed 5-year period. Therefore, the impacts from the proposed development would be only a small increment above the level of impacts already occurring or anticipated.

Accidental oil releases may occur as a result of both OCS and non-OCS activities, as well as from naturally occurring seeps. The magnitude of the impacts would depend on the location and size of the releases, as well as their timing with respect to peak tourism seasons. These releases are expected to have a temporary impact on recreation and tourism in the Gulf region. Closures of recreational areas for up to 6 weeks could occur to accommodate cleanup operations. Releases identified under the proposed action are anticipated to be small ($\geq$ 1 bbl and < 50 bbl) for the most part, and to occur in waters greater than 200 m in depth (Table IV-4). These releases would be a small addition to releases associated with other OCS and non-OCS activities (Table IV-17).

Severe storm events such as hurricanes have the potential to impact the recreation and tourism economy if they result in severe beach damage and/or destruction of existing public infrastructure. While hurricanes are regularly occurring events in the Gulf of Mexico, Hurricanes Katrina and Rita in 2005 caused unusually large amounts of damage to the tourism and recreation infrastructure in the area. These storms destroyed recreational beaches, public piers, hotels, casinos, marinas, recreational pleasure craft and charter boats, and numerous other recreational infrastructure. Almost 70 percent of the recreational fishing assets in Mississippi alone were damaged by Katrina (Posadas, 2005). Of the 13 casino-barge structures present along the Mississippi coast prior to Katrina, most suffered severe external damage, seven broke completely free of their moorings, two partially broke free and damaged adjoining structures, one sank, and one was deposited inland by the storm surge (National Institute of Standards and Technology, draft). The full extent of impacts to the tourism and recreation by the hurricanes has yet to be fully quantified, but it will likely take years for tourism and recreation to return to pre-hurricane levels. Long-term changes in tourism and recreation could occur in the Gulf of Mexico during the life of the 2007-2012 program should hurricanes of similar magnitude continue to occur.

### Conclusion

Cumulative impacts on recreation and tourism from both routine OCS and non-OCS activities would be limited for most activities, with the exception of possible impacts associated with large oil spills during the peak tourist season. The overall contribution of the proposed 5-year OCS program to these cumulative impacts is expected to be small incremental increases in construction and transportation noise and related visual intrusions, potential increases in trash and debris related to these activities, and the potential for a relatively small number of accidental releases.

## q. Fisheries

## (1) Commercial Fisheries

This section identifies potential effects of cumulative OCS and non-OCS activities on commercial fisheries. Commercial fisheries could be affected by activities or factors that alter either the abundance or distribution of fishery resources being targeted, that affect the ability of commercial fishing to be conducted in particular areas, or that affect the commercial value of fishery resources captured.

Section IV.L.2.f identified potential cumulative effects on fishes and fish habitats and indicated that some routine OCS activities could harm or kill individual fishes and could result in temporary movements of fishes away from areas where activities were being conducted. Although long-term effects on populations of most fishes in the Gulf of Mexico as a whole were not anticipated, populations of rare fishes or those that have highly limited distributions within the Gulf could be more substantially affected if activities occurred in areas with high concentrations of individuals. Depending upon the location, magnitude, and timing of accidental oil spills from OCS platforms or pipelines, lethal or sublethal toxic effects could occur, especially for species that have pelagic eggs and larvae. If spills occurred in areas with high concentrations of eggs or larvae of a particular species, the abundance of a particular year-class could be affected.

Section IV.L.2.f also identified a variety of non-OCS activities and factors that could affect fish populations in the Gulf of Mexico. These factors include State oil and gas activities, commercial shipping, land development, dredging and dredge-disposal operations, marine mineral extraction, and water quality degradation from both point and nonpoint pollution sources. In addition, commercial and recreational fishery activities themselves could affect fish populations through overharvesting.

In particular, space-use conflicts and vessel and drilling noise would have impacts on commercial fisheries in the Gulf of Mexico. The level of such activities in the Gulf of Mexico planning areas under the proposed action would represent an incremental increase in the overall level of similar activities associated with current and planned OCS lease sales that would occur during the life of the 2007-2012 program (see Table IV-14).

Space-use conflicts will occur because of exploration and delineation activities and establishment of development and production platforms (Table IV-1). Some areas will be precluded from commercial fisheries while each of these platforms is in place in order to avoid potential conflicts and to maintain safety. As identified in Section IV.B.2.q(1), vessels longer than 100 ft may be required to maintain a distance of up to 500 m from production platforms (Continental Shelf Associates, Inc. 2002), which would preclude fishing in approximately 80 ha of surface area for each production platform. It is anticipated that cumulative OCS activities would result in a total area of 219,000-290,000 ha being designated as safety zones in the Gulf of Mexico. While 3,000 new platforms are assumed to be installed during the life of the 2007-2012 program in the cumulative scenario, about 5,000 older platforms (4,000 removed with explosives) will be removed during the same time period, resulting in a net decrease of about 2,000 platforms in the Gulf of Mexico. Also, there are also temporary exclusions from fishing in areas during exploration and delineation activities.

Underwater OCS structures such as pipelines could also cause space- and gear-related conflicts. Conflicts between commercial fishers and the offshore oil and gas industry in the Gulf of Mexico are mitigated by the Fisherman's Contingency Fund (Continental Shelf Associates, Inc. 2002). Most pipelines are buried or weighted with cement coatings (so they do not float) and are covered, usually with concrete mats or similar materials for stability and protection. Most fishing equipment passes over these structures. Fishing hooks, lines, or bottom weights may get snagged in pipeline covers from rod-and-reel fisheries and bottom longlines.

Increased vessel traffic to and from the rigs and platforms will also increase the amount of marine traffic and possible conflicts with commercial fishers. The proposed action would add 400-500 vessel trips per week to the Gulf as a whole (Table IV-1) compared to the 3,000-4,000 that are estimated to occur as a result of cumulative OCS activities (Table IV-14). Frequent radio communications between vessels should avoid most conflicts.

The potential for spatial preclusion also exists in both nearshore and offshore waters with increased levels of seismic survey activity. There is a potential for fishing gear (e.g., longlines) to become entangled in the long seismic arrays (streamers) being towed behind seismic survey vessels (Continental Shelf Associates, Inc. 2002). In addition, catch efficiency could be affected by the noise generated by seismic activity. Observations either document or suggest that noise from seismic surveys could cause a temporary reduction in the commercial catch of fishes within at least several kilometers of an area undergoing seismic surveys (Chapman and Hawkins, 1969; Lokkeborg, 1991; Skalski et al., 1992; Lokkeborg and Soldal, 1993).

In addition to these factors that affect the ability to fish or the capture efficiency within certain areas, activities that substantially reduce the population levels of commercially important fish species or their prey in specific areas could also affect commercial fishing. As discussed in Section IV.L.2.f, this would include activities that temporarily disturb sediments and increase turbidity, such as the installation of new pipelines and platforms and discharges of drill cuttings and associated fluids. Drilling mud discharges contain chemicals that could be toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those normally found more than a few meters from the discharge point. Offshore discharges of drilling muds are regulated by the USEPA and typically dilute to background levels within 250 m of the discharge point (Neff et al., 2005). Because discharges of drilling muds and cuttings near topographic features are limited due to the Topographic Features Stipulation, only soft-sediment portions of the Gulf should be affected. Because the proportion of such areas that would be affected is very small, it is anticipated that these discharges would not have a detectable effect on Gulf of Mexico fisheries.

Non-OCS activities, such as competition between fisheries, coastal development, commercial shipping, dredge and fill activities, marine mining, and water quality degradation, may also impact commercial fisheries. The effects of increased levels of OCS- and non-OCS related vessel traffic on estuarine nursery areas may also produce adverse impacts to species of commercial importance that use these habitats.

Competition between large numbers of commercial fishers, commercial operations employing different fishing methods, and commercial and recreational fishers for a given fishery resource increase pressure on the fisheries' stocks and could have a major effect on population sizes (Coleman et al., 2004). Space-use conflicts can result from different forms of commercial operations. Some types of gear damage bottom habitat by dragging heavy equipment over and into the sediments (Jones, 1992) or alter biodiversity by affecting organisms such as corals, aquatic vegetation, or burrowing organisms that enhance structural complexity for other species (Coleman and Williams, 2002). In addition, nonselective fishing tactics may inadvertently capture and harm immature fish or other bycatch, which could affect future year classes and prey species of commercially important fish (Lewison et al., 2004; Diamond et al., 2000).

Loss of wetlands due to dredging and filling could negatively impact many of the Gulf of Mexico fish species that use these areas as nursery habitat.

Potential oil spills assumed under the OCS cumulative scenario are provided in Table IV-17. The effects of spilled oil on commercial fisheries include fishing ground area closures, contaminated fish, fouled fishing gear and associated equipment, and degradation of fishing grounds. Accidental oil releases from non-OCS activities are possible anywhere on the OCS or in State waters (i.e., from vessel collisions or transfer/lightering operations). As described in Section IV.L.2.f, crude oil may also enter the environment from naturally occurring seeps. Although such releases typically occur in deeper water, the released oil should rise to the surface relatively quickly. Although it is anticipated that most adult fish would be able to avoid the resulting plumes of oil, larvae or eggs of some fish species could be affected and commercial fishing gear could become fouled with oil.

From a cumulative perspective, all larger spills, regardless of source, would preclude a small amount of fishing area. It is estimated that slicks from large (≥ 1,000 bbl) offshore spills of crude oil would persist for 1-10 days, depending upon the size of the spill and water temperature (MMS, 2003e). In many cases, commercial fisheries would be able to return to the area after slicks have been cleaned up or dispersed. However, shallow coastal spills could contaminate tissues of target organisms (e.g., oyster beds and shallow benthic fishes), and affected commercial fisheries could be closed for one or more seasons.

Hurricanes and tropical storms are recurring elements in Gulf of Mexico fisheries. While most impacts from storms are short-term and localized, affecting fishing activity and infrastructure for up to a season, recent impacts from Hurricanes Katrina and Rita (2005) introduce concerns about longer term changes to fisheries. Commercial fisheries landings of the central Gulf Coast were drastically impacted by the hurricanes because of the associated damage to and destruction of coastal port facilities and fishing vessels. There is no conclusive estimate of the number of fishing vessels sunk or driven ashore because of the 2005 storms, but the USCG initially estimated the number to be between 3,500 and 5,000. This estimate includes nearly 2,400 commercial vessels and 1,200 recreational boats (Hogarth, 2005). Almost 70 percent of all the commercial and recreational fishing industry assets in coastal Mississippi were damaged by Hurricane Katrina (Mississippi State University, 2006b). The area from western Florida to Texas experienced a 97 percent reduction in shrimp landings and a 94-percent reduction in oyster landings in September 2005 compared to the previous year. Catches of several other species were essentially zero in September 2005, including menhaden, blue crab, spiny lobster, stone crab, yellowfin tuna, mullets, and freshwater crawfish. Reef fish catches declined by 44 percent across the region. These reductions in commercial catches have persisted in most affected areas since September 2005 (Hogarth, 2005). Limited shrimp, crab, and other seafood processing has been reestablished in the central areas of Louisiana that received the least damage as reported in October 2005 (Bell, 2006). Other fishing, shrimping, crabbing, and shellfish harvesting activities are anticipated to resume as the industry recovers in different areas from the hurricane damage.

As a result of the U.S. Department of Commerce issuing a fishery failure and fishery resource disaster declaration for the Gulf of Mexico, the Secretary of Commerce is authorized to request Federal relief funds from the Congress and to make those funds available to the affected Gulf States. These funds can be used to assess the impacts of the disaster, to restore fisheries, to prevent future failure, and to assist affected fishing communities' recovery after the disaster (Diop, 2006). Substantial funding for commercial fishing infrastructure rebuilding was added to Gulf Coast recovery legislation in June 2006.

The NOAA studies found no evidence of hydrocarbons, persistent organic pollutants, or bacterial contamination in the fish they sampled (Hogarth, 2005; NOAA, 2005d). The survey results are consistent with similar findings announced by the Food and Drug Administration, the USEPA, and the States of Mississippi, Louisiana, and Alabama, which concluded Gulf seafood was deemed safe for human consumption. As reported in a 6-month progress update (U.S. Dept. of Homeland Security, 2006), NOAA is also surveying the fisheries infrastructure including processing plants, ice plants, boatyards, piers, and supply stores. The NOAA has also been directly involved in prioritizing vessel removals based on pollution and habitat threats for the thousands of vessels impacted.

The NMFS, USGS, and others are conducing characterization and monitoring studies to more accurately assess the nature, extent, and magnitude of effects to fisheries from Katrina and Rita (NOAA, 2006; FWS, 2006). It is unknown at this time how the extensive impacts to coastal habitat, such as wetlands, may affect the availability of spawning, nursery, and foraging habitats for many species important to commercial and recreational fisheries. There is also concern regarding long-term bioaccumulation of toxins by mollusks, shellfish, and fish that could affect not only the abundance and distribution of some species, but also their availability for commercial and recreational fisheries (Congressional Research Service, 2005). Occurrences and landfalls of additional destructive hurricanes during the life of the 2007-2012 program would place additional stresses on recreational and commercial fisheries in the Gulf of Mexico.

### Conclusion

It is anticipated that the proposed action would represent a small increment to the potential for overall cumulative effects on fisheries in the Gulf of Mexico. Routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population- or community-level effects on fishery resources because of the limited timeframe over which most individual activities would occur; because a small proportion of habitat, relative to similar available habitat, could be affected during a given period; and because of existing stipulations that are in place to avoid impacts to sensitive habitats such as hard-bottom areas and topographic features. Based on the anticipated slight net decrease in the number of platforms and structures in the Gulf of Mexico during the life of the 2007-2012 program, only a small decrease in space-use conflicts with fishery activities would be expected to occur during the life of the 2007-2012 program compared to current conditions.

The magnitude and severity of potential effects to fisheries from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to particular fishery areas; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall community-level effects on fish resources because of the relatively small proportion of important fish habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in the shallow portions of the Gulf have a greater potential to affect fisheries because of the more extensive availability of seagrass and wetland habitats that serve as nursery habitat and feeding areas for large concentrations of fishes. Overall, it is anticipated that the likelihood of fishery closures from oil spills due to the proposed OCS activities would not be greatly increased compared to those from existing OCS and non-OCS activities.

## (2) Recreational Fisheries

Impact producing factors and associated cumulative effects to recreational fisheries from routine OCS operations include space-use conflicts. Conflicts are usually minimal, compared to some types of commercial fisheries. However, there is recreational shrimp trawling for wild shrimp, and trawls could become entangled with OCS structures in the water. Deepwater recreational rod-and-reel anglers typically target oil and gas platforms because these structures usually attract target species (Continental Shelf Associates, Inc. 2002).

Noise from rig and platform installation and from seismic surveys during exploration and delineation activities could scatter target species away from some recreational fishing areas while activities are occurring and, potentially, for some period afterward. Temporary reductions in hook-and-line captures have been reported in some areas following seismic surveys. This may result in decreased recreational catch. Platform removal using explosives may also impact recreational fisheries. The noise would drive some fish away, some fish would be killed, and a structure that may be targeted as a fishing location by recreational anglers could be eliminated.

Non-OCS activities also have the potential to adversely affect recreational fisheries, with most impacts occurring in nearshore coastal waters. Recreational fisheries may be affected by coastal development, commercial fishing, commercial shipping, dredge and fill activities, and marine mining.

As identified above for commercial fisheries, oil spills from OCS or non-OCS sources could affect recreational fisheries by fouling gear with oil, tainting the catch, and degrading water quality and fishing grounds. Accidental oil releases from non-OCS activities are possible anywhere on the OCS or in State waters (i.e., from vessel collisions or transfer/lightering operations) and, as described in Section IV.L.2.f, crude oil may also enter the environment from naturally occurring seeps.

The OCS oil spills most likely to affect recreational anglers would be shallow water spills, since recreational anglers are less likely to venture far offshore. Because most of the OCS activities will occur in waters deeper than 300 m, it is anticipated that only a proportional number of the assumed spills would occur in shallower waters. Thus, it is assumed that approximately 10 of the 45 total spills of greater than 1,000 bbl could occur in shallow waters under the cumulative scenario as a result of OCS activities. Non-OCS oil and gas activities likely pose a greater risk in terms of potential oil spills that could affect recreational fisheries, because such activities are located closer to shore.

Closure of some areas to fishing, perhaps for multiple seasons, could occur as a result of oil spills. In addition, public perception of the effects of a spill on marine life and its extent could result in a loss of revenue for the fishing-related recreation industry. Party and charter boat recreational fisheries often have losses of income because of reduced interest in fishing when a spill has occurred. Local hotel, restaurant, bait-and-tackle shops, and boat rental companies associated with recreational fisheries may experience reduced sales because of public perception related to an oil spill.

Hurricanes and tropical storms are recurring elements in Gulf of Mexico recreational fisheries. The discussion of the cumulative impacts of these storms discussed in the commercial fisheries section above applies also to recreational fisheries.

## Conclusion

It is anticipated that the proposed action would represent a small increment to the overall cumulative effects on recreational fisheries in the Gulf of Mexico. Routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population- or community-level effects on fishery resources because of the limited timeframe over which most individual activities would occur; because a small proportion of habitat, relative to similar available habitat, could be affected during a given period; and because of existing stipulations that are in place to avoid impacts to sensitive habitats such as hard-bottom areas and topographic features. Construction of new platforms could represent a small increase in the availability of desirable recreational fishing locations for recreational anglers.

The magnitude and severity of potential effects to recreational fisheries from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to important fishing areas; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall community-level effects on a fishery because of the relatively small proportion of important fish habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects, and because a relatively small proportion of recreational angling occurs in deepwater areas. Large oil releases that occur in the shallow portions of the Gulf have a greater potential to affect recreational fisheries because of the more extensive availability of seagrass and wetland habitats that serve as nursery habitat and feeding areas for large concentrations of fishes. Overall, it is anticipated that the likelihood of increases in fishery closures from oil spills due to the proposed OCS activities would not be greatly increased compared to those from existing OCS and non-OCS activities. However, public perception could reduce the number of recreational anglers interested in utilizing specific areas if a spill were to occur.

## 3. Alaska Region

## a. Air Quality

The cumulative analysis considers the impacts from future OCS oil and gas development during the 40-year life of the 2007-2012 program, emissions on the OCS that are not associated with oil and gas development, and onshore emissions.

Air quality in Alaska is relatively pristine due to the lack of large industrial emission sources and sizable population centers. Alaska has the lowest emission rates of all the U.S. States. The primary industrial emissions are associated with oil and gas production, power generation, small refineries, paper mills, and mining. While some growth of these activities is likely to take place in the future, overall emissions will remain low. More stringent emission standards on motor vehicles and new USEPA standards on nonroad engines and marine vessels would tend to result in a downward trend in emissions.

On the Alaska North Slope, onshore oil production from the Prudhoe Bay, Kuparuk, Milne Point, Colville River, and Badami fields, and oil production from the Duck Island field in State waters are the largest source of emissions. Production from North Slope reservoirs peaked at about 2 MMbbl of oil per day in 1988, and declined to 1.1 MMbbl per day in 2000 (USDOE, 2001). Production is predicted to remain relatively steady at about 1 million bbl per day through 2010 and then decline to 0.5 MMbbl per day by about 2020 to 2025 depending upon the amount of oil recovered from the National Petroleum Reserve-Alaska (USDOE, 2001). There are a number of planned and potential future oil development projects onshore and in State and Federal waters. There are very few existing emission sources in the Chukchi Sea or Bering Sea Planning Areas.

Existing emission sources in the Cook Inlet Planning Area include oil production activities in State waters, onshore petroleum processing and refining, onshore oil and gas production, marine terminals, and commercial shipping. Oil production in State waters is relatively small and is declining. Any potential future development in State waters is expected to be small. Overall, emissions in the area are not expected to change significantly in the future. Existing air quality is well within the Federal and State standards and is not expected to change significantly.

Ambient air quality monitoring in the existing North Slope oil production areas has shown that air pollutant levels are well within Federal and State standards. No ambient air quality data have been collected in the Chukchi Sea or Bering Sea areas. As very few emission sources exist in those areas, air quality should be relatively pristine.

Modeling studies of proposed OCS production facilities in the Beaufort Sea and Cook Inlet show that concentrations of $NO_2$, $SO_2$, and $PM_{10}$ are within the PSD incremental limits and the NAAQS. The maximum concentrations of $NO_2$, $SO_2$, and $PM_{10}$ occur within about 200 m of the facility and are considerably lower at distances greater than 1 km (MMS, 2001c). There would, therefore, be little cumulative interaction between facilities that would be located some distance apart. Pollutant concentrations would be within the PSD Class I increments in the Tuxedni National Wilderness Area in Cook Inlet. Cumulative impacts from the OCS program would not differ significantly from those associated with the Proposed Program.

Impacts from OCS activities on ozone and visibility are discussed in Section IV.B.3.a. Cumulative impacts from the OCS program would not differ significantly from those associated with the Proposed Program.

Small accidental oil spills would cause small, localized increases in concentrations of VOC due to evaporation of the spill. Most of the emissions would be expected to occur within a few hours of the spill and decrease drastically after that period. Large spills would result in emissions over a large area and a longer period of time. A discussion of the effects of oil spills on air quality is presented in Section IV.B.3.a.

A discussion of the effects of in situ burning is presented in Section IV.B.3.a. Studies of in situ burn experiments have shown that air quality impacts are localized and short-lived and that pollutant concentrations do not pose a health hazard to persons in the vicinity.

In the cumulative scenario, there would be a slightly larger number of oil spills in the Arctic area compared to the predicted number of spills for the 2007-2012 program. However, the effect of an individual spill would not change; only the probable number of spills would increase. The air quality impacts for the cumulative case would, therefore, be the same as those associated with the Proposed Program.

### Conclusion

Air quality in Alaska is expected to remain good, with a pollutant concentrations associated with all offshore and onshore emission sources expected to be well within applicable standards. The contribution of OCS program activities would be very small. Air quality impacts from oil spills would be localized and of short duration.

## b. Water Quality

As discussed in Section IV.B.3.b, impacts from the proposed action could affect water quality in the Beaufort and Chukchi Sea Planning Areas (Alaska Subregion), the North Aleutian Basin Planning Area (Bering Sea Subregion) and the Cook Inlet Planning Area (South Alaska Subregion). There are also a number of existing and future OCS activities that are not part of the proposed action, non-OCS activities that are ongoing or reasonably expected to take place in these Planning Areas in the foreseeable future, increased use and development of LNG facilities, climate change, and accidental discharges that could affect water quality. Activities of the proposed action would, therefore, incrementally add to the overall adverse cumulative impact to water quality. Cumulative impacts of OCS activities not related to the proposed action, non-OCS activities, increased use and development of LNG facilities, climate change, and accidental releases are discussed below.

### (1) OCS Activities Not Part of the Proposed Action

Routine ongoing and future OCS activities that are not part of the proposed action could affect water quality in the Alaska Region. Table IV-15 summarizes OCS activities that could occur from all OCS lease sales during the life of the 2007-2012 OCS program. The estimates provided also include activities associated with previous and future OCS programs. These activities include the installation of platforms, exploration and delineation wells, onshore and offshore pipelines, pipeline landfalls, new shore bases, vessel trips, new process and waste facilities, and the discharge of drilling fluids, cuttings, and produced waters into Alaska Region waters. Most of these activities are expected to occur in North Slope fields of the Arctic Subregion.

For the Beaufort and Chukchi Sea Planning Areas, OCS activities under the proposed action represent an increase of up to 100 percent over the ongoing and future activities that would be expected to occur within the region for the period of the proposed action. Increasing the number of activities within a planning area would increase adverse impacts to water quality. However, the cumulative impacts would still be local and temporary because of dilution, settling, and associated natural processes (e.g., evaporation). In the case of onshore construction, proper siting and requirements associated with construction permits should largely mitigate adverse impacts to nearby waters. The magnitude of the impacts would depend on the activity, time of year, location of the activity, and the locations of similar activities. A magnitude evaluation of potential cumulative impacts will be appropriately determined in lease-sale-specific environmental impact statements (EIS's).

Cumulative impacts of proposed action OCS activities for the North Aleutian Basin and Cook Inlet Planning Areas would entail up to a 100-percent increase in all associated OCS activities. Cumulative impacts from these activities would adversely affect water quality. However, the impacts would be expected to be local and temporary because of dilution, settling, and other natural processes (e.g., evaporation). In the case of onshore construction, proper siting and requirements associated with construction permits should largely mitigate adverse impacts to adjacent waters. As in the Beaufort and Chukchi Sea Planning Area, the magnitude of the impacts would depend on the activity, time of year, location of the activity, and the locations of similar activities. A magnitude evaluation of potential cumulative impacts will be appropriately determined in lease-sale-specific EIS's.

## (2) Cumulative Impacts of Non-OCS Activities

Existing and future non-OCS activities occurring in the Alaska Region that would affect water quality in the Arctic, Bering Sea, and South Alaska Subregions include the transportation of oil, gas, and commodities (e.g., domestic transport and the transport of foreign imports), and NASA, USDOD, and USDOT activities. Discharges from domestic and foreign commercial and military vessels, cruise ships, and recreational vessels (e.g., bilge water, waste, incidental spills, and leaching from anti-fouling paints – MMS, 2001d) would adversely affect the quality of Alaska Region waters. Other non-OCS activities include dredging and marine disposal, coastal and community development, disposal of municipal wastes and other effluents, extraction of nonenergy minerals, and State and Canadian oil and gas activities.

## (3) Domestic Transport, Foreign Imports, and Other Vessel Activities

Crude oil and finished product transport in the Alaska Region is primarily by vessel. These vessels include tankers to move crude oil from the region to receiving ports, vessels used in crude oil production, vessels used to deliver finished oil products to Alaska, NASA and USDOD vessels (the U.S. Air Force, Navy, and Coast Guard conduct flight and vessel operations in the Anchorage area [Cook Inlet Planning Area] and in the Aleutians [North Aleutian Basin Planning Area]), commercial fishing boats, and cruise ships. Such activities adversely impact water quality through oily releases from the vessels during transport, and the dumping of oily bilge water and toxic chemicals by cruise ships (particularly in southeast Alaska coastal waters of the Cook Inlet Planning Area). Although vessel trips that are part of the proposed action (up to three vessel trips/week/platform for each of the three Alaska Subregions) would add to cumulative adverse impacts to water quality, they would represent a small percentage of the non-OCS vessel traffic in waters of the Cook Inlet and North

Aleutian Basin and would be expected to produce little incremental increase in adverse impacts. However, this traffic would represent an increase in the Chukchi and Beaufort areas.

A second component of crude oil transport in the Beaufort and Chukchi Sea Planning Areas is domestic transport. The principal domestic conveyor of crude oil in Alaska is the Trans-Alaskan Pipeline System (TAPS) (Alyeska Pipeline Services Company, 2006). This 48-inch pipeline extends from the Alaska North Slope to Valdez and currently transports about 1.1 MMbbl of crude oil daily. At Valdez, crude oil is loaded onto tankers for transport to west coast ports, ports in the Gulf of Mexico, and the Far East (about 6% of North Slope production). Activities of the proposed action would have little if any additional effect on TAPS, which is a well established oil transportation system.

Oil from the Cook Inlet Planning Area would be transported from offshore production platforms to shore using new subsea pipelines. Onshore common-carrier pipeline systems would then deliver the oil and gas to existing local refineries and the transmission pipeline grid. Incremental impacts of the proposed action on these domestic transportation systems would be expected to be negligible.

## (4) Dredging and Waste Disposal

Non-OCS dredging operations would adversely affect water quality in the Alaska Region during the period of the proposed action. Dredging trenches for pipelines would disturb the seafloor and increase the suspended sediment load in the water column. Turbidity and plumes containing sediments would depend on the season, sediment grain size, the rate and duration of discharge within the disturbed areas, and the currents. The incremental increase in turbidity created by dredging activities associated with the proposed action in the Alaska Region would be expected to be negligible.

The proposed action would also increase the number of waste disposal facilities by up to 50 percent for the Beaufort and Chukchi Sea Planning Areas and by 100 percent for the North Aleutian Basin and Cook Inlet Planning Areas. These new facilities would add to the adverse impacts to water quality; however, with proper siting and adherence to requirements associated with construction permits, the incremental increase would be expected to be negligible to small. The magnitude of the impacts would be more formally analyzed in appropriate future EIS's.

## (5) Coastal and Community Development and Municipal Wastes

Logging activity in southeastern Alaska within the Tongass National Forest and elsewhere can adversely impact the quality of water in the Alaska Region by adding suspended and dissolved solids to streams that discharge to coastal waters. Activities of the proposed action would increase suspended and dissolved solids to the Alaska Region waters; however, the incremental increase in adverse impacts would be expected to be local and temporary because of dilution, settling, and other natural processes (e.g., evaporation).

Activities of the North Slope Borough Capital Improvements Program, including the disposal of municipal wastes, would adversely affect Alaska waters in the Beaufort and Chukchi Sea Planning Areas by contributing contaminated runoff water to streams and rivers that discharge to coastal waters. Activities of the proposed action would add to this contamination; however, the incremental increase in adverse impacts would be small, local, and temporary.

## (6) Nonenergy Related Minerals

Non-OCS extraction activities are primarily limited to lead and zinc mining at the Red Dog Mine located in northwestern Alaska. This mine is located about 55 miles from the Chukchi seacoast in the Arctic Subregion (Teck Cominco, 2006). Ore from the mine is shipped during open-water periods to smelters on the Pacific Coast of North America, the Far East, and Europe. Adverse impacts would be related to increased water turbidity in receiving waters and the addition of soluble contaminants to the water column. The additional incremental adverse impacts to water quality from the proposed action would be expected to be small, local, and temporary.

## (7) State and Canadian Oil and Gas Activities

The State of Alaska has more than a million acres of offshore waters under lease (Section IV.L.1.b(1)). The majority of the leases are on the North Slope (Beaufort and Chukchi Sea Planning Areas), and in the Cook Inlet Planning Area. Other oil and gas activities in the Arctic are being done by Canada (Section IV.L.1.b(2)). Canadian drilling began in northern Canada in the 1960's, with more than 237 wells installed offshore and onshore. The largest Canadian gas discoveries have been offshore (Indian and Northern Affairs Canada, 1995).

Activities of the proposed action (e.g., installation of platforms, exploration and delineation wells, onshore and offshore pipelines, pipeline landfalls, new shore bases, vessel trips, new process and waste facilities, and the discharge of drilling fluids, cuttings, and produced waters into Alaska Region waters) would add to impacts produced by State and Canadian oil and gas activities. However, the incremental increase in adverse impacts of the proposed action would be expected to be small because of dilution, settling, and associated natural processes (e.g., evaporation). In the case of onshore construction, proper citing and requirements associated with construction permits should largely mitigate adverse impacts to nearby waters. The magnitude of the impacts would depend on the activity, time of year, location of the activity, and the locations of similar activities. A magnitude evaluation of potential cumulative impacts will be appropriately determined in lease-sale-specific EIS's.

## (8) Increased Use and Development of LNG Facilities

As discussed in Section IV.L.1.e, LNG facilities may also be used in the development of gas in Alaska because of their economic advantages over pipeline construction. An LNG facility might be constructed in the North Aleutian Basin Planning Area. Environmental effects of LNG operations and facilities are associated with explosions, fires, and cryogenic cooling effects of either an accidental release of LNG or the release of water used during the vaporization process. In addition, discharges from the facility could contain biocides added to prevent fouling, such as copper and sodium hypochlorite. Impacts of these operations and effluents would incrementally increase adverse impacts to water quality. These impacts will be investigated further during the leasing, development, and construction stages by MMS and other Federal and State agencies.

## (9) Climate Change

Temperatures in Alaska have slowly been increasing (Section IV.L.1.c). Arctic temperatures during the late 20th century appear to have been the warmest in 400 years (USEPA, 2006a); since the 1950's, Alaska has warmed by an average of 4 degrees Fahrenheit ($^{o}$F). Increased temperatures in Alaska have resulted in a decreased extent and thickness of sea ice, a retreat of glaciers, and changes in stream flows. The extent of northern hemisphere spring and summer sea ice decreased by about 10-

15 percent, and researchers have measured a decline of roughly 40 percent in the thickness of Arctic sea-ice during late summer and early autumn during the past several decades (USEPA, 2006a). Such effects could impact water quality in the planning areas and affect construction activities in the Arctic Subregion that rely on winter construction activities (e.g., the construction of ice roads and ice islands in the Beaufort and Chukchi Sea Planning Areas). Because the magnitudes of the changes produced by climatic change are poorly known, adverse incremental increases derived from the proposed action cannot be accurately predicted.

### (10) Accidental Releases

Oil spills in the Alaska Region would adversely affect water quality. Nearly 85 percent of the 0.7 MMbbl (29 million gallons) of petroleum that enter North American ocean waters each year as a result of human activities comes from land-based runoff, polluted rivers, airplanes, and small boats and jet skis; less than 8 percent comes from tanker or pipeline spills. Oil exploration and extraction are responsible for only 3 percent of the petroleum that enters the sea. Another 1.1 MMbbl (47 million gallons) seep into the ocean naturally from the seafloor (NRC, 2003a).

As indicated in Table IV-4, the number of spills projected for the proposed action would be about two thirds of the number of spills predicted cumulatively for the Beaufort and Chukchi Sea Planning Areas, and an equal number of spills for the North Aleutian Basin and Cook Inlet Planning Areas under the proposed action would be the same as those expected cumulatively. The incremental increase in water quality impacts from these spills is difficult to predict because water quality impacts would depend on the location of the spills, existing weather conditions, spill volumes, and the type of product spilled. In most cases, spills are isolated events that produce local and temporary effects, and incremental adverse impacts to water quality, and even large spills such as the *Exxon Valdez* oil spill, did not have measurable impacts to water quality after the first week (Short and Rounds, 1993), with the exception of a few areas near the coast where clean up activities were occurring.

#### Conclusions

Normal operational activities under the proposed action would adversely impact water quality in the Alaska Region. However, the incremental increase of such activities relative to impacts derived from existing and future OCS activities that are not part of the proposed action and non-OCS activities would be expected to be negligible to small. The incremental increase in water quality impacts from spills to Alaska Region waters would depend on existing weather conditions at the location of the spills, their volumes, and the type of product spilled. Incremental impacts would be expected to be negligible to small because of dilution, dispersion, and other natural processes (e.g., evaporation). Incremental impacts to water quality from proposed action activities and global climate change, including their nature, direction, and magnitude, would be speculative at best.

## c. Marine Mammals

### Routine Activities

Marine mammals and their habitats in the Arctic (Beaufort Sea and Chukchi Sea Planning Areas), Bering Sea (North Aleutian Basin Planning Area) and the South Alaska (Cook Inlet Planning Area) Subregions could be affected by a variety of exploration, development and production activities as a result of the proposed and future OCS leasing actions (see Section IV.B.3.c). These activities include seismic exploration, offshore and onshore infrastructure construction (including construction of artificial islands and ice roads), the discharge of operational wastes, and vessel and aircraft traffic. Impacts to marine mammals from these activities may include physical injury or death; behavioral disturbances; lethal or sublethal toxic effects; and loss of reproductive, nursery, feeding, and resting habitats. The degree of impact at the population level depends greatly on the status of the population (i.e., its listing under the ESA) and the degree of disturbance or harm from OCS-related activities in areas important to species survival (i.e., feeding, breeding, molting, rookery or haulout areas).

Under the 2007-2012 program, up to 23 platforms or artificial islands (Arctic Subregion only), 90 exploration and delineation wells, and 900 development and production wells could be placed in offshore waters in Alaska planning areas. In addition, up to 575 miles of offshore and 625 miles of onshore pipelines could be constructed to transport oil from these wells to collection facilities (Table IV-15). Most of this activity would occur in the Arctic Subregion.

**Seismic Surveys and Exploration:** Potential impacts to marine mammals could occur in all the planning areas included in the 2007-2012 program. Depending on the specific circumstances around the disturbance, impacts could be short-term (i.e., temporarily leaving a feeding area, avoiding seismic vessel) or long-term (i.e., repeated disruption of important behaviors, avoidance of prime habitat, chronic increased stress). In some cases, there is also a potential for population-level impacts (i.e., abandonment of areas for denning or young, repeated avoidance of traditional breeding grounds, or opportunities by a large enough portion of the population so as to affect the reproductive potential). The extent of the impact depends largely on factors related to the animal's sex and reproductive status, age, auditory sensitivity, accumulated hearing damage, type of activity engaged in at the time, group size, and/or whether the animal has heard the sound previously and any associations it may have made with that sound (e.g., Olesiuk et al., 1995; Richardson et al., 1995; Kraus et al., 1997; NRC, 2003b, 2005). It also depends on the mitigation and monitoring measures in place to reduce the potential for these impacts to occur. These measures would be determined after an analysis of the site-specific activity. In addition, authorizations for the taking of marine mammals under the MMPA and, in some cases, the ESA would also implement additional requirements to lessen the potential impacts of offshore exploration on marine mammals.

**Construction and Operation of Offshore Facilities:** Impacts from OCS construction and operation activities could include the temporary disturbance and displacement of individuals or groups by construction equipment and long-term disturbance of some individuals from operational noise. Effects would be greater for those specials inhabiting nearshore or coastal areas (i.e., ice seals, beluga whales and polar bears), especially in areas where animals traditionally aggregate. Appropriate mitigation and monitoring measures, determined on a site-specific basis, could lessen the potential for impacts.

**Construction and Operation of Onshore Facilities:** Impacts from OCS construction and operation activities could include the temporary disturbance and displacement of individuals or groups by construction equipment and long-term disturbance of some individuals from operational noise. Effects would be greater for those specials inhabiting nearshore or coastal areas (i.e., ice seals, beluga whales and polar bears), especially in areas where animals traditionally aggregate or in polar bear denning sites. Appropriate mitigation and monitoring measures, determined on a site-specific basis, could lessen the potential for impacts.

**Operational and Waste Discharges:** Under the proposed actions during development and production, produced water, drilling muds, and drill cuttings would be disposed of through downhole injection into NPDES-permitted disposal wells, and thus would not be expected to result in any incremental impacts to marine mammals. Liquid wastes (such as bilge water) may also be generated by OCS support vessels and on production platforms. While these wastes may be discharged (if permitted) into surface waters, they would be rapidly diluted and dispersed, and would not be expected to result in any incremental impacts to marine mammals from exposure to these wastes. Drilling and production wastes may contain materials such as metals and hydrocarbons, which can bioaccumulate through the food chain into the tissues of marine mammals. Although the bioaccumulation of anthropogenic chemicals has been reported for a variety of marine mammals, adverse impacts or population-level effects resulting from such bioaccumulation have not been demonstrated (Norstrom and Muir, 1994; Muir et al., 1999).

**Vessel and Aircraft Traffic:** Up to 6 weekly support vessel trips in the Cook Inlet Planning Area, 18 weekly support vessel trips in the North Aleutian Basin Planning Area, and 45 weekly trips in the Arctic, including both the Beaufort Sea and Chukchi Sea Planning Areas, could occur under the proposed action. Marine mammals could be temporarily disturbed by OCS vessel traffic (all species) or incur injury or death from collisions with support vessels (primarily larger, slower moving cetaceans). The low level of OCS vessel trips in any of the planning areas under the proposed actions would likely limit potential cumulative impacts to a few individuals, be largely short-term in nature, and not result in population-level effects. However, any impacts affecting survival or reproductive capabilities of northern right whales could result in population-level impacts, given the highly endangered status of this species. Vessel traffic in the North Aleutian Basin and Cook Inlet Planning Areas is dominated by commercial fishery activities, and the OCS vessel traffic associated with the proposed actions would represent a relatively small incremental increase to overall vessel traffic in Alaskan waters. Recent estimates of vessel strikes from all sources in Alaskan waters range from 0.2 per year for the fin whale to 1.2 per year for the gray whale, and are not considered to affect marine mammal populations in Alaskan waters (Angliss and Lodge, 2004).

Up to 6 daily helicopter trips to platforms in the Cook Inlet Planning Area, up to 18 daily trips in the North Aleutian Basin Planning Area, and up to 45 daily trips in the Beaufort Sea and Chukchi Sea Planning Areas could occur under the proposed action. Overflights would be transient in nature, and the total number of such flights would be relatively small (between 5 and 45 total flights per day among all platforms). Impacts to marine mammals would be behavioral in nature, primarily resulting in short-term disturbance in normal activities, and would not be expected to result in population-level effects. Overflights disturbing active rookery sites could result in decreased pup survival and in population-level impacts to some species, although overflight restrictions and flightline selection to avoid rookeries would greatly limit the potential for adversely affecting animals at these locations. However, appropriate mitigation measures could lessen the potential for impacts.

**Non-OCS Activities:** Marine mammals in the four Alaska OCS planning areas could also be affected by a number of non-OCS activities, especially State oil and gas exploration and development, and commercial and subsistence fishing and harvesting. Many of the effects of these activities on marine mammals would be similar in nature to those resulting from OCS-related activities, namely, behavioral disturbance, habitat disturbance, injury, or mortality from ship strikes and exposure to toxic substances. Marine mammals in Alaska may also be adversely affected by climate change. There is growing evidence that climate change is occurring and having adverse affects on marine biota and habitats throughout polar regions (Anisimov and Fitzharris, 2001; Ferguson et al., 2005; also see Section IV.L.1.c).

**State Oil and Gas Exploration and Development**—The State of Alaska has made nearshore State lands available for leasing along much of the coast of the North Aleutian Basin, along the Beaufort Sea coast, and in the northern portion of Cook Inlet (above Homer). For example, the State of Alaska sold 62 tracts for oil and gas exploration and development, totaling more than 230,000 acres along the Beaufort Sea from Point Barrow to the Canadian border (ADNR, 2006b). The exploration activities (and associated impacts to marine mammals) that could result with State oil and gas lease sales may greatly outnumber exploration activities (and potential impacts to marine mammals) that could occur under the OCS proposed actions.

Exploration, construction, and operation activities associated with State leases would occur in nearshore and coastal areas, while OCS platforms and pipelines would be located away from coastal areas (with the exception of relatively few pipeline landfalls and onshore bases and processing facilities). Thus, State oil and gas leasing activities may be expected to have a greater potential for affecting marine mammals in coastal habitats than would the proposed OCS actions.

**Commercial and Subsistence Fishing and Harvesting**—Commercial and subsistence fishing has been identified as impacting many of the marine mammals in Alaskan waters (Angliss and Lodge, 2004). These fisheries employ a variety of methods, such as longlines, seines, trawls, and traps, which have been reported to result in the entanglement, injury, and death of individuals of many mammal species. Minimum estimated annual mortality rates incidental to commercial fisheries range from as low as 0.5 individuals per year for Pacific gray whales in Bristol Bay to 31 harbor seals per year for the Bering Sea stock (Angliss and Lodge, 2004). Annual mortality from commercial and subsistence fishing is considered to have little adverse effect on some marine mammals populations or stocks (such as the Bristol Bay beluga whale stock), but is considered significant for other species (i.e., humpback whale, western North Pacific stock). There is insufficient information regarding fishing effects on other species (such as the harbor seal, harbor porpoise) (Angliss and Lodge, 2004).

Subsistence harvest has and continues to target some marine mammal species, especially some of the whale species. For example, the annual subsistence harvest of beluga whales from the Bristol Bay stock has averaged 19 whales per year from 1999 to 2003, while the annual subsistence harvest of bowhead whales between 1999 and 2003 ranged from 35 to 49 per year (Angliss and Lodge, 2004). While subsistence harvest has been determined not to result in population-level impacts on the more common species or stocks (such as the Bristol Bay beluga whale stock), there is insufficient information regarding subsistence harvest effects on less abundant species such as the ribbon seal (Angliss and Lodge, 2004). Commercial and subsistence harvest of the Pacific walrus has averaged more than 5,700 animals per year from 1996 to 2000, and is not considered to pose a threat to this species (Angliss and Lodge, 2004).

**Climate Change**—A concern regarding marine mammals in polar regions is the potential for climate change and associated changes in the extent of sea ice in some arctic and subarctic waters. Some species, such as the bearded seal and polar bear, are dependent on sea ice for at least part of their life history, and may be more sensitive to changes in arctic weather, sea-surface temperatures, or extent of ice cover (Angliss and Lodge, 2004).

The southern Beaufort Sea polar bear population is unique in that a substantial proportion of its maternal dens occur annually on the pack ice (Amstrup and Garner, 1994), which requires a high level of sea-ice stability for successful denning. Reproductive failure is known to occur in polar bears that den on unstable sea ice (Lentfer, 1975; Amstrup and Garner, 1994). If sea-ice extent in the Arctic continues to decrease and the amount of unstable ice increases, a greater proportion of polar bears may seek to den on land (Durner et al., 2006). Those that do not may experience increased reproductive failure, which would have population-level effects. As a result, land denning likely will become more important in the future, which further highlights the importance of protecting sensitive terrestrial denning habitat.

It is not possible at this time to identify the likelihood, direction, or magnitude of any changes in the environment of Alaskan waters due to changes in the climate, or how climate change could impact marine mammals in these waters. However, the current state of climate change and its impacts on marine mammals would need to be further considered in any subsequent environmental reviews for lease sales or other OCS-related activities.

## Accidents

Marine mammals could be exposed to oil accidentally released from platforms, pipelines, and vessels in each of the areas offshore Alaska included in the 2007-2012 program (Table IV-17).

Non-OCS sources of oil in the four planning areas may include the domestic transportation of oil, State oil and gas development, and natural sources such as seeps and eroded petroleum source rock (for example, see Page et al., 1995; Boehm et al., 2000). Accidental oil releases from OCS activities and other sources could expose marine mammals to oil by direct contact or through the inhalation or ingestion of oil or tar deposits. The magnitude and duration of exposure will be a function of the location, timing, duration, and size of the spill; the proximity of the spill to feeding and other important habitats; the timing and nature of spill containment; and the status of the affected animals. Depending on their location, as well as the location of non-OCS oil sources, accidental spills associated with the proposed actions could contribute to the overall exposure of marine mammals in the four Alaska OCS planning areas.

While effects to marine mammals would depend on the timing, location, and magnitude of specific oil spills, as well as the species' status and number of individuals exposed, it is anticipated that most of the small to medium spills would have limited effects on marine mammals due to the relatively small areas likely to incur high concentrations of hydrocarbons and the short period of time during which potentially toxic concentrations would be present. The magnitude of impact would be expected to increase should a spill occur in habitats important to marine mammals, affect a number of individuals from a population listed under the ESA, or occur during periods of animal aggregations or during times for maternal care. However, some spills from OCS activity may locally represent the principal source of oil exposure for some species, especially for spills contacting important coastal and island habitats or collecting along ice leads.

## Conclusion

Impacts to marine mammals in the Beaufort Sea and Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas may occur in the future as a result of normal activities related to the proposed actions, as a result of current and planned leasing (and associated activities) in the planning areas, and as a result of several non-OCS related activities such as commercial and subsistence fishing and State oil and gas leasing. Marine mammals, especially seals and polar bears, may also be affected by changes in sea ice resulting from climate change. The amount of OCS development and associated activity is relatively small and even a small increase in activity in the region would be noticeable. Impacts associated with normal operations under the proposed actions would be largely limited to a few individuals,and be short-term in nature. Population-level effects are possible where activities repeatedly disrupt biologically significant behaviors or cause abandonment of important habitats where enough individuals are affected so as to reduce the reproductive or recruitment potential of a population. These types of impacts are more likely for isolated or threatened/endangered populations, especially the North Pacific right whale, during periods of animal aggregations or maternal care. However, appropriate site- or species-specific mitigation and monitoring measures would limit the potential for these types of effects to occur. Thus, for most marine mammal populations, the overall contribution to the cumulative impacts from new and future OCS leasing during the life of the 2007-2012 program are expected to be mainly short-term in nature. However, there is a greater potential for population level impacts to those species listed as threatened or endangered or as species of concern under the ESA. The potential for population-level impacts can be limited with the implementation of appropriate site- and species-specific mitigation and monitoring measures.

With the highly endangered status of the North Pacific right whale, MMS acknowledges that there is a higher potential for population level impacts should OCS activities result either in the direct loss of even one animal or indirectly affect reproductive success or calf survival. Population-level effects are also likely should a large oil spill occur during period of polar bear aggregations. As such, MMS also acknowledges that very careful analysis will be needed should any OCS-related activities occur within habitat for these and other ESA-listed species and that this analysis will require close coordination with NMFS and/or FWS.

## d. Marine and Coastal Birds

Four hundred and fifty-seven species of birds occur in Alaska, of which 298 appear ‘regularly’ (Armstrong, 1995). See Section III.B.7 and Table III-63 for more information on marine and coastal bird presence and distribution in Alaska. Refer to Table 2 in Alaska Shorebird Working Group (2000) for list of shorebird species of high conservation concern and their associated Bird Conservation Regions in Alaska. For additional information on Alaska shorebird species of concern, globally important shorebird areas within Alaska, and population estimates of shorebirds in North America refer to Gill et al. (1994), Gill and Senner (1996), Gill and Tibbits (1999), and Morrison et al. (2001).

A number of activities associated with the 2007-2012 program could affect marine and coastal birds or their habitats. These activities include offshore exploration, construction of offshore platforms and pipelines, construction of onshore pipelines and other infrastructure, operational discharges and wastes, and vessel and aircraft traffic (see Table IV-17).

Impacts to marine and coastal birds from OCS-related activities may include physical injury or death from collisions (e.g., with aircraft or platforms); lethal or sublethal toxic effects from exposure to contaminants in operational discharges or wastes and accidental oil spills; injury or death from entanglement in debris from facilities and vessels; a reduction, loss, or degradation of feeding, nesting, and other habitats due to construction; and the disturbance of feeding, breeding, and nesting birds by construction activities and normal operations (Section IV.B.3.d).

There are also a number of non-OCS activities occurring in Alaska that could affect marine and coastal birds in each of the planning areas. These activities include coastal and community development, onshore and offshore construction; operations of facilities associated with State oil and gas development; construction and operation of the LNG facility; commercial and recreational boating; aircraft traffic; commercial fishing operations; subsistence or other harvests; lead-shot contamination; tourism introduced predators; climate change; and severe storm events (Section IV.L.1.c).

### Routine Operations

Overall, impacts from OCS activities are dependent on the type of species, location and timing of activities with critical natural behaviors, and the intensity and degree of disturbance. Depending on these factors, the effects of disturbance ranges from temporary disruptions of natural behaviors or displacement from local areas to cumulative physiological and energetic costs resulting in a decrease of individual reproductive success or other population-level effects. Normal operations could affect listed bird species in the same manner as nonlisted species (i.e., primarily behavioral disturbance). Compliance with ESA regulations and coordination with the NMFS and FWS would ensure that lease-specific operations would be conducted in a manner that avoids or greatly minimizes the potential for impacting these species.

Marine and coastal birds may be affected by the construction of onshore and offshore facilities; by boats, aircraft, and on-land vehicle traffic; and by noise and human activities during normal operations and maintenance activities. In most cases, affected birds would temporarily leave the area, while in other cases, the displacement could be long-term. Construction of onshore facilities and pipelines, offshore pipeline landfalls, and offshore gravel islands (to support drilling platforms) would result in the permanent disturbance of potential habitat within the immediate footprint of the new facilities and gravel excavation areas. Depending on the species present at and in the vicinity of the construction areas, the numbers of birds affected, and the activity (nesting, molting, feeding, staging) that the affected birds were undergoing at the time of disturbance, the displacement could reduce reproductive success, foraging success, and survival, and could result in population-level impacts. New onshore facilities may result in local increases of predator species. Increases in these predators would increase predation pressure of local bird populations, and, depending on the birds affected, could result in population-level effects.

**Non-OCS Related Impact Factors:** Short- and long-term fluctuations in abundance, sometimes including one-time catastrophic losses, are normal in healthy populations of seabirds. Tens of thousands of seabirds sometimes die from starvation or disease or by drowning in fishing nets. If mortality from natural causes and anthropogenic causes are interchangeable as a means of population reduction, then oil mortality, by itself, may not be biologically significant in a stable population. However, if oil-spill mortality occurs in addition to natural mortality, then significant levels of oil mortality could lead to a population decline. Therefore, oil spill mortality cannot be considered independently from other sources of mortality, but must be considered as an additive source of mortality (Piatt et al., 1991). Also, an oil spill that contaminates critical habitat for a listed species, even when the species is not present, could have devastating impacts.

Populations of marine and coastal birds throughout Alaska may be adversely affected by climate change and, to a lesser extent, by severe storm events or natural disasters. As previously discussed (Section IV.L.1.c), there is growing evidence that climate change is occurring, and potential effects in Alaska may include a change (i.e., rise) in sea level or a change in water temperatures. Such changes could affect the distribution, availability, and quality of feeding habitats and the abundance of food resources. It is not possible at this time to identify the likelihood, direction, or magnitude of any changes in the Alaskan marine due to changes in climate, so it is too speculative to further discuss how or to what extent climate change could affect Alaskan populations of marine and coastal birds. However, glacier stagnation or retreating that is likely hastened by global warming might result in a further decline in Kittlitz’s murrelet populations (Kuletz et al., 2003b). In addition, this species (and others) is faced with cumulative impacts from habitat loss and fragmentation, oil spills, incidental take in gillnets, and possibly disturbance from increased boat traffic. These cumulative impacts could impair the ability of the Kittlitz’s murrelet to adapt to global warming (Kuletz et al., 2003b).

Severe storm events may result in direct or indirect mortality of marine and coastal birds and impact important coastal habitats. Storms that produce extreme wave action can erode coastlines and restructure barrier island habitats. Such events can eliminate nesting and broodrearing habitat or, depending on time of year and location, cause direct loss of birds. Such loss of nesting habitat could lower a species' productivity, thus hindering the recovery resulting from any short-term losses associated with OCS development (MMS, 2002b). Heightened wave action and intensity could alter nearshore channels, affecting the abundance and distribution of shallow-water habitats such as lagoons and bays, while sediments deposited into foraging habitats by storm waves may alter the thermal environment and affect aquatic vegetation in feeding habitats. Extreme wind conditions could damage or destroy historic rookery sites or disrupt nesting birds. Because storms are annual events that are an inherent component of the overall Alaskan marine ecosystem, it may be assumed that marine and coastal birds have experienced and largely tolerated extreme weather conditions in the past and may be expected to continue to do so in the foreseeable future.

The most significant threat to the short-tailed albatross is the potential for destruction of their main extant breeding habitat on a Japanese island by volcanic eruption. The short-tailed albatross could also be adversely impacted by monsoon and typhoon rains during the nesting season. The resultant mudslides and erosion could kill individual birds and destroy breeding habitat (MMS, 2003b).

## Accidents

In the event of an accidental oil spill, exposed marine and coastal birds may experience a variety of lethal or sublethal effects, and the magnitude and ecological importance of any such effects would depend upon the size and location of the spill, the species and life stage of the exposed birds, and the size of the local bird population. Although the potential for a large spill is unlikely, it could result in the loss of hundreds to thousands of large numbers of birds, depending on the season and location of the spill, and result in potentially long-term reductions in populations. Spills in offshore locations have the greatest potential for affecting the greatest number of birds, especially if a spill occurs in or reaches an area where birds have congregated and are carrying out important activities (e.g., nesting, molting, and staging). A spill in onshore habitats would affect relatively few birds unless the spill was to reach a surface water body such as a stream, pond, or lake that provides important nesting, brood-rearing, foraging, or staging habitat. Spill cleanup activities may also disturb birds in the vicinity of the cleanup, causing them to leave the vicinity of the cleanup activity.

The number of potential oil spills from OCS activities would be small during the lifetime of the OCS program. For example, large spills ($\geq$ 1000 bbl) would total up to 3 in the Arctic Subregion; while 1 large spill would be expected in each of the two other planning areas. The numbers of OCS-related medium (50-999 bbl) and small spills ($\geq$ 1 bbl and < 50 bbl) in the Arctic Subregion are 15 and 150, respectively. The number of medium and small oil spills in each of the other subregions would be 2 and 10, respectively.

Most spills associated with the proposed action would be relatively small (> 1 bbl and < 50 bbl), and most would be expected to occur in waters well away from coastal areas. Depending on their location, as well as the location of such spills from other sources and natural seeps, accidental spills associated with the proposed action could represent a major component of the overall exposure of marine and coastal birds in the Alaska planning areas. It is not known how much oil would be released from non-OCS activities. However, these activities are expected to be the major contributors to spilled oil, especially when spills from tankers are considered. The cumulative mortality of seabirds from small, unreported spills may often be higher than that from a single large spill (Burger and Fry, 1993). Because most spills under the proposed action would be expected to occur in deep waters, exposure may be limited to marine birds foraging in the vicinity of the accidental release.

The magnitude and duration of exposure, and any subsequent adverse effects, would be a function of the location, timing, duration, and size of the spill; the proximity of the spill to feeding habitats; and the timing and nature of spill containment. For example, the greatest risk to seabirds in the Cook Inlet Planning Area would be if an oil spill occurred during summer when hundreds of thousands of birds may be present in the lower Cook Inlet and northern portion of Shelikof Strait. A spill during this time could contact thousands to tens of thousands of birds (MMS, 2003b). There is also a potential for cumulative effects from contact in succeeding years if all spilled oil is not removed from the environment in the first year (MMS, 2003b). Spills in nearshore coastal areas have the greatest potential for impacting bird populations. Similarly, birds that are concentrated in an area (e.g., a heavily used migration staging area) are more susceptible to population-level impacts from a spill than those that are more dispersed.

Projected losses of marine and coastal birds from a single large oil spill (e.g., 1,500-4,600 bbl) could total hundreds to possibly more than ten thousand birds (MMS, 2003b). Some marine and coastal bird species that can occur within more than one planning area could be subject to increased oil-spill risk. Spills that adversely affect breeding stocks at more than one major nesting area could result in substantial reduction of their regional population and longer periods required for recovery to their former levels (MMS, 1985b). Recovery of a species from mortality associated with a large oil spill is not expected for species whose populations are already exhibiting a declining trend (MMS, 2004a). For example, the degree of recovery of Kittlitz's murrelet from the Exxon Valdez oil spill is still uncertain (Exxon Valdez Oil Spill Trustee Council, 2004). Also, recovery potential would lengthen in the unlikely event that more than one oil spill affects the same population (MMS, 2003b).

The highly migratory nature of many of the marine and coastal bird species suggest that, during their annual cycle, they will move through several OCS (and State) planning areas and nest and overwinter in others, thereby potentially exposing their populations to multiple oil spills and other adverse factors associated with oil and gas development. Presumably, multiple oil spills are more likely as additional OCS development occurs (MMS, 1991c). Locally, spills under the proposed action may represent the principal source of exposure for some species; especially in deepwater areas where most accidental spills are expected to occur under the proposed action.

## Conclusion

Impacts to marine and coastal birds in the Alaska OCS planning areas may occur in the future as a result of some activities conducted under the proposed action, as a result of current OCS-related leasing activities, and as a result of a variety of non-OCS related activities. Potential differences between cumulative impacts and the impacts from the proposed action for each planning area would depend on the intensity (magnitude), scale (geographic area), duration, timing and frequency, any synergies (impact interactions), and likelihood of the impacts associated with cumulative actions (COE, 1999). Human-related factors that can contribute to cumulative impacts include: (1) habitat contamination, (2) habitat loss and degradation, (3) disturbance, (4) alteration in the size and composition of marine fish populations, (5) human harvest, and (6) bycatch from commercial fishing (MMS, 2003b). Impacts occurring as a result of the proposed OCS activities may be expected to add little to the overall cumulative impacts to marine and coastal birds in Alaska, although locally they may represent the dominant impact in the environment and locally affect birds.

Marine and coastal birds may also be affected by exposure to oil that is accidentally released during normal operations under the proposed action. Exposure to oil may also result from accidental releases from other OCS-related activities as well as numerous non-OCS activities and naturally occurring seeps. The various spills that could occur from the proposed action and other activities would not be expected to contact the same resources or to occur before those resources recover from the first spill. The extirpation of a single colony or subpopulation from an oil spill may not by itself be significant on a regional or global scale, but the cumulative effect of a series of such events might be catastrophic to a species over the long term (Piatt et al., 1991). No species of marine or coastal birds have been threatened with extinction as a direct result of oil spills, but some local populations have been substantially reduced as a result of spills (Burger and Fry, 1993). Spill-cleanup operations could also cause short- to long-term disturbances to marine and coastal birds.

Populations of marine and coastal birds may also be affected by climate change, which has the potential to affect the quality and distribution of habitats, and by direct injury or loss of habitat due to major storm events or other natural disasters. The overall contribution to these cumulative impacts resulting directly from new leasing under the proposed action is expected to be small. Potential effects of cumulative factors may include the loss of increasing numbers of marine and coastal birds as cumulative projects are developed. Nevertheless, potential cumulative impacts to federally-listed species warrant continued close attention and effective mitigation practices.

Some species of marine and coastal birds may not be present in some planning basins where impacts would be expected to occur. For example, in the Arctic Subregion, seabirds, waterfowl and shorebirds occur only during the summer months when breeding (and rearing) takes place (MMS, 2002c). Since ice covers much of the area in winter, overwintering sea ducks and seabirds are concentrated in the St. Lawrence Island polynya, and in the ice front when present. Birds can be seasonally abundant in these habitats (MMS, 2002c). Nevertheless, as the number of developments increase, the potential for an impact (such as an oil spill) to occur during a period and/or location of high risk (e.g., an area where birds stage for molting or migration) increases. It is not always clear what human-related impacts there are on a given population, what the magnitude of the impacts are, and whether such impacts are having a significant effect on the population. Because of this, it is difficult to assess the cumulative effects on a population and the contribution of OCS-related activities to the cumulative impacts (MMS, 2003b). However, cumulative effects that cause direct mortality, reduced reproductive success, and habitat loss are relatively localized, but long term. Recovery could require multiple generations, and in some cases, such as when a species with a declining population is impacted, recovery may not occur (MMS, 2003b).

## e. Terrestrial Mammals

Terrestrial mammals and their habitats could be affected by a variety of activities associated with the proposed OCS actions (see Section IV.B.3.e). These activities include construction and operation of onshore facilities, pipelines, and associated infrastructure, and vehicle and aircraft traffic. Under the current, planned, and proposed OCS activities, up to 625 miles of onshore pipelines and up to 17 onshore facilities (shore bases, and processing and waste facilities) could be constructed among the areas included in the 2007-2012 program (Table IV-15). Most of this activity would occur in the Arctic Subregion (Beaufort Sea and Chukchi Sea Planning Areas). Impacts to terrestrial mammals from these activities may include physical injury or death; behavioral disturbances; lethal or sublethal toxic effects; and loss of reproductive, nursery, feeding, and resting habitats. In the Arctic Subregion, these impacts would be in addition to similar (in nature) impacts resulting from ongoing and planned OCS lease sales under the 2002-2007 program (MMS, 2002c). There are currently no ongoing or planned future OCS activities in the Cook Inlet and North Aleutian Basin Planning Areas; thus all OCS development and any associated impacts to terrestrial wildlife in these planning areas would result only from the proposed action.

**Construction and Operation of Onshore Facilities:** Implementation of the proposed actions could result in a 300-percent increase in the miles of onshore pipeline, and a 20- to 100-percent increase in the number of pipeline landfalls, shore facilities (such as processing and waste facilities), docks, and causeways currently present or planned in the Arctic Subregions (Table IV-15). Because there are no ongoing or planned future OCS activities in either the Cook Inlet or North Aleutian Basin Planning Areas, impacts to terrestrial mammals in these planning areas from OCS-related construction and operation of onshore facilities would be solely associated with the proposed actions. While these increases in OCS activities appear large, they overall represent a relatively small number of new facilities and pipelines that could be constructed within very large areas. Thus, although implementation of the proposed actions would suggest a potentially large incremental increase in impacts to terrestrial mammals, the amount of habitat that would be incrementally affected is small compared to the habitat available in the planning areas.

Impacts from OCS construction and operation activities could include the injury or death of smaller mammals (such as mice and voles) and the disturbance and displacement of individuals or groups of larger species (such as caribou, deer, and brown bear). Individuals most affected by these impacts would be those in the immediate vicinity of construction sites and operating facilities. Because of the limited areal extent of new facilities under the proposed action, disturbance (primarily behavioral in nature) of most of these species during construction would be largely temporary, and no long-term population level effects would be expected. However, construction activities in the Arctic could disturb caribou in calving, foraging, or insect avoidance habitats, which could affect adult and calf survival. However, the potential for such impacts could be minimized by careful sitting of new facilities and pipelines to avoid important habitats.

Species such as the arctic fox and black bear that habituate to human activity and facilities could experience local increases in density, while bears may experience increases in mortality associated with defense of life and property killings. In the Arctic, pipelines and roads associated with the proposed actions have the potential to incrementally affect local and seasonal movements of caribou.

**Vehicle and Aircraft Traffic:** Under the proposed actions, vehicle traffic associated with normal operations and maintenance of onshore facilities and pipelines could disturb wildlife near the onshore facilities and pipelines. Vehicle traffic could disturb wildlife foraging along pipelines or access roads, causing affected wildlife to temporarily stop normal activities (e.g., foraging, resting) or leave the area, while collision with vehicles could injure or kill some individuals. Because vehicle traffic would be infrequent, vehicle-related impacts associated with the proposed action would result in little incremental increase in vehicle-related impacts from current or ongoing OCS activities in the Arctic. In the Cook Inlet and North Aleutian Basin planning areas, vehicle traffic along any new roads would similarly be very light and infrequent and, thus, would not be expected to affect more than a few individual nor result in population-level impacts to wildlife.

Helicopter traffic servicing OCS platforms would increase 100-200 percent under the proposed action for the Beaufort and Chukchi Seas Planning Areas (Table IV-15). Up to 6 daily trips to platforms in the Cook Inlet Planning Area, and up to 18 daily trips in the North Aleutian Basin Planning Area, would occur under the proposed action, which would represent all such OCS-related activity in these planning areas. Impacts to terrestrial mammals from helicopter overflights would be behavioral in nature, primarily resulting in short-term disturbance in normal activities, and would not be expected to result in population-level effects. Overflights disturbing active calving and overwintering sites could result in decreased survival of young or adults, and potentially result in population level impacts to some species. Although the proposed action could more than double the amount of helicopter traffic in the Beaufort and Chukchi Seas Planning Areas, overflights would be transient in nature, and the total number of such flights would be relatively small (totaling between 5 and 45 total flights per day to all platforms). In addition, selection of flight lines to avoid overflights of important habitats would greatly limit the potential for adversely affecting calving or overwintering animals. In the Cook Inlet and North Aleutian Basin Planning Areas, helicopter traffic would be very light and not be expected to affect more than a few individuals nor result in population-level impacts to wildlife.

**Non-OCS Activities:** Terrestrial mammals in the four Alaska OCS Planning Areas (Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet) could also be affected by a number of non-OCS activities, including State oil and gas exploration and development, and coastal and community development. Terrestrial mammals on the Alaska Peninsula adjacent to the North Aleutian Basin could also be affected by the construction and operation of an LNG facility and associated pipeline proposed for the peninsula. Many of the effects of these activities on terrestrial mammals would be similar in nature to those resulting from OCS-related activities, namely behavioral disturbance, habitat disturbance, and injury or mortality.

The State of Alaska has made leases of State lands available along much of the coasts of the North Aleutian Basin, the Beaufort Sea, and the northern portion of Cook Inlet (above Homer). For example, 145 leases totaling more than 242,000 ha (599,000 acres) were sold in early 2006 for the North Slope (ADNR, 2006). Impacts to terrestrial mammals that could result with State oil and gas lease sales may greatly exceed potential impacts that could occur under the OCS proposed action.

Terrestrial mammals may be affected in each of the four planning areas as a result of coastal and community development (see Section IV.L.3.n). Such development may result in the loss of habitat and the permanent displacement of some species from the developing areas. Implementation of the proposed actions, especially in the North Aleutian Basin, could increase coastal and community development, indirectly adding to impacts to terrestrial mammals and their habitats.

**Oil Spills:** Terrestrial wildlife could be adversely affected by the accidental release of oil from an onshore pipeline, or by offshore spills contacting beaches and shorelines utilized by terrestrial mammals (such as Sitka black-tailed deer or brown bear). While spills occurring under the proposed action would account for approximately 67 percent of the all OCS-related spills assumed for the cumulative scenario in the Beaufort Sea and Chukchi Sea Planning Areas, and 100 percent of the OCS spills in Cook Inlet and North Aleutian Basin Planning Areas, the majority of such spills would probably be associated with wells, platforms, and the more extensive pipelines located offshore (Table IV-17).

Impacts to wildlife from an oil spill would depend on such factors as the time of year and volume of the spill, type and extent of habitat affected, and home range or density of the wildlife species. Spills contacting high-use areas (such as coastal habitats along Shelikof Strait heavily used by brown bears or caribou calving areas in the Arctic planning areas) could locally affect a relatively large number of animals. It is anticipated that most of the spills would have limited effects on terrestrial mammals, due to the relatively small areas likely to be directly exposed to the spills, and the small number and size of spills projected for the proposed action and for current and planned OCS oil and gas developments. However, some spills may locally represent the principal source of oil exposure for some species, especially for spills contacting important calving or overwintering habitats.

State oil and gas development poses a major potential for accidental oil releases in the four planning areas. Because of the much greater level of State oil and gas development, accidental spills associated with the proposed OCS action could contribute relatively little to the overall potential exposure of terrestrial mammals to accidental oil releases in the four OCS planning areas.

### Conclusion

Terrestrial mammals in the Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas may be affected by normal activities related to the proposed OCS actions, by current and planned OCS leasing (and associated activities) in the Arctic Subregion, by local coastal and community development, and by State oil and gas leasing. Terrestrial mammals may also be adversely affected by climate changes. While the proposed OCS activities represent a relatively large cumulative addition to the level of current and planned OCS activities in the Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas, the actual amount of development and associated activity is relatively small. Impacts associated with normal operations under the proposed action would be largely limited to a few individuals, be short-term in nature, and not be expected to result in population-level effects. Thus, the overall contribution to the cumulative impacts to terrestrial mammals resulting directly from new leasing under the proposed action is expected to be small.

## f. Fish Resources and Essential Fish Habitat

This section evaluates the cumulative effects of the proposed action, ongoing or planned OCS activities that would occur during the life of the 2007-2012 program, and non-OCS activities on populations of fishes and shellfishes in Alaskan waters. Depending on the levels of effects, impacts to fish or shellfish populations could occur as a consequence of activities that lead to increased mortality, reductions in the availability of food resources, decreases in reproductive success, reductions in the quantity or quality of required habitat, or alterations in distribution. The cumulative levels of OCS exploration, development, and production activities for Alaska are derived by considering activities from ongoing and planned OCS lease sales together with similar activities that would occur in the Beaufort and Chukchi Seas, North Aleutian Basin, and Cook Inlet Planning Areas under the proposed action (see Table IV-15). Non-OCS activities that could also contribute to cumulative effects on fishery resources would occur due to State oil and gas exploration and development; commercial logging operations, and commercial, sport, and subsistence fishing.

### (1) Fish Resources

As identified in Section IV.B.3.f, routine OCS activities in the Alaska region that could result in direct mortality to fish and shellfish include seismic surveys; construction of artificial islands, ice roads, platforms, and pipelines; releases of permitted discharges from wells; and removal of existing structures. Although it is likely the numbers would be smaller, a total of up to 23 platforms (including up to 15 artificial islands in the Artic Subregion), up to 90 exploration and delineation wells, and up to 900 development and production wells could be placed in waters offshore of Alaska as a result of the cumulative OCS activities. In addition, up to 575 miles of offshore pipelines and up to 625 miles of onshore pipelines could be constructed to transport oil from wells to collection facilities (Table IV-15). It is anticipated that most of this activity would occur in the Arctic Subregion, where the proposed action would approximately double the number of artificial islands and wells to be constructed compared to ongoing and planned OCS activities alone. Although the potential overall level of exploration, development, and production would be lower in the North Aleutian Basin and Cook Inlet Planning Areas, there is currently no OCS development in these areas. Consequently, all OCS development in these areas would result from the proposed action.

Implementation of the proposed action would result in a small incremental increase in seismic survey activity compared to those that would occur under ongoing and planned lease sales. As discussed in

Section IV.B.3.f, effects to fishes from seismic surveys would be highly localized and seasonal in nature, with acute effects limited to eggs, larvae, and young-of the-year fish located within 2 to 3 m of seismic sources. No discernible population-level effects on fishes or shellfishes are anticipated due to seismic surveys that would occur within individual planning areas under the proposed action. It is anticipated that up to 23 platforms could be constructed under the cumulative OCS case and that seismic surveys associated with that level of development could cover up to approximately 530 $km^2$ of ocean surface area (see seismic survey assumptions in Section IV.B.3.f [Cook Inlet Planning Area]) over the proposed lease period. Even considered together, the areas that would be subjected to seismic surveys as a result of cumulative OCS activities would be very small compared to overall areas that contain potentially affected species. If sensitive areas and seasons are avoided, as called for in lease stipulations, discernible changes in population levels of fishery resources in Alaskan waters due to seismic surveys would not be expected to occur. In addition to these OCS-related seismic surveys, additional surveys could be conducted in offshore or nearshore Alaskan waters as a result of State oil and gas exploration.

Potential environmental impacts associated with the building and operation of OCS facilities such as platforms, artificial islands, and pipelines would increase in conjunction with the increased number of wells. Although construction of platforms, artificial islands, and pipelines would all disturb bottom habitats to some degree, artificial islands result in a more complete loss of benthic habitat due to larger footprints (approximately 9 ha for artificial islands versus less than 1.5 ha for platforms) and due to complete burial of existing substrate during construction. Construction of both platforms and artificial islands would temporarily increase turbidity and could disturb or kill benthic organisms within the footprint of the facility and within the immediately surrounding area; increases in turbidity could reduce photosynthesis and the resulting food production that supports fish communities. In addition, fishes and other organisms may become exposed to hydrocarbons, heavy metals, or other contaminants (some naturally occurring) associated with sediments as disturbed sediments are suspended into the water column. It is anticipated that no platforms or artificial islands would be decommissioned or removed under the proposed action or under the cumulative OCS scenario for Alaska.

The effect of habitat loss would likely be lethal to the existing benthic communities in the footprints of artificial islands. Up to 1,000 ha of habitat for fishes and shellfishes could be affected by OCS construction of islands (up to 15 in the Arctic Subregion), platforms (up to 8 in the Bering and South Alaska Subregions combined), or pipelines (up to 575 miles) in waters offshore of Alaska during the 40-year period covered by associated OCS leases. Overall, this represents a small area compared to the availability of similar habitats in surrounding areas. Although increased turbidity resulting from construction of these structures could impede photosynthesis and interfere with primary production, the effect would be localized to an area surrounding individual structure and would generally be limited only to the period of construction. Similarly, exposure of organisms to sediment-bound contaminants as a consequence of sediment disturbance would occur within relatively limited areas and for limited periods during the construction and removal activities. In addition, regulations and mitigating measures should preclude the construction of platforms or artificial islands and the placement of pipelines in environmentally sensitive areas. Provided that OCS construction does not occur in environmentally sensitive areas, construction of artificial islands and platforms would be unlikely to result in cumulative effects on overall populations of fishes or shellfishes in Alaskan waters.

Effects on fish resources from non-OCS dredging and marine disposal activities are expected to be similar to those described for the installation of pipelines in Section IV.B.3.f. Due to the small number and limited use of disposal sites in the vicinity of these OCS planning areas, these activities are not expected to noticeably alter populations of fishes and shellfishes in these areas.

Anadromous fish species (e.g., salmon) that could be affected by OCS activities in offshore areas could also be affected by loss of habitat in freshwater systems used for reproduction. Such losses could result from bank hardening, draining of water bodies, changing or temporarily diverting river or stream channels, excavating streambed materials (e.g., gravel), removing riparian vegetation, or causing changes in water quality parameters. Although OCS activities do not typically directly affect freshwater areas, some activities associated with oil and gas exploration and development, such as installation of pipeline stream crossings or construction of onshore roads and facilities, have the potential to affect anadromous fish through similar means if there are ground- or vegetation-disturbing activities in or near waterways or if there are discharges of chemicals or wastes into waterways. Withdrawal of water for construction of ice roads and ice pads on the North Slope has the potential to reduce water depth in overwintering areas for some anadromous species, thereby reducing the ability to support fish; it could entrain fish through the pumps. Permits from the State of Alaska are required under Alaska Title 16 for activities in or near fish streams that could affect anadromous fish and their freshwater habitat or the free and efficient migrations of resident fish. Discharge of wastes and treated water from facilities also require compliance with the Clean Water Act and NPDES permits. Compliance with such requirements should minimize the cumulative effects of the described actions on freshwater habitats.

Logging could also degrade riverine habitats that are important for salmon reproduction and the rearing of juveniles. Erosion from areas undergoing commercial logging could increase the silt load in streams and rivers, which could reduce levels of invertebrate prey species and adversely affect spawning success and egg survival. The introduction of fine sediments into spawning gravels may render these habitats unsuitable for salmon spawning. Logging could also remove riparian canopies along some streams, which could increase solar heating of freshwater habitats. Downed timber could physically block salmon migrations. Because of past damage inflicted by commercial logging, improved forestry practices have been initiated, and timber harvests have been curtailed. Continued implementation of effective forest management techniques should help mitigate the adverse effects of logging in the future.

Cumulative impacts to anadromous or diadromous species could also occur as a result of activities that obstruct fish movement in marine environments during migration periods. For example, some structures along the Beaufort Sea mainland (e.g., the West Dock) have been shown to block the movements of diadromous fishes, particularly juveniles, under certain meteorological conditions (Fechhelm, 1999; Fechelm et al., 1999), Because many of these species avoid high-salinity marine conditions, they tend to remain nearshore where they forage up and down the coast within a narrow band of warm, low-salinity water (Craig, 1984). Causeways may impede coastal movement either by directly blocking fish or by modifying nearshore water conditions to the point where they might become too cold and saline for these species (Fechhelm et al., 1999). However, investigations have shown that breaching may alleviate blockage (Fechhelm, 1999), and it is anticipated that proper placement and design considerations for future causeway construction along the North Slope would alleviate the potential for such effects on fish movement.

The Red Dog Mine in Alaska is the largest lead and zinc mine in the world, and is presently the only base-metal lode mine operating in northwest Alaska. The seaport for the mine is located approximately 27 km southeast of Kivalina and consists of a dock and causeway 40 m wide and 60 m long extending out to a water depth of 4 m. Although the presence of causeways has been an issue associated with oil development activities in the Beaufort Sea, the small size of the Red Dog causeway would likely have little effect on the coastal movements and distributions of Chukchi Sea fishes and shellfishes.

Drilling discharges are generated by State and Federal OCS oil and gas exploration and production activities. Drilling discharges will only be disposed of in marine waters during exploration activities. All drilling solids and fluids will be disposed of in the well hole during development activities. Drilling discharges contain materials that could be toxic to fishes and shellfishes and to benthic organisms that are important as food sources. Toxic components such as metals and hydrocarbons may bioaccumulate through the food chain, although population-level effects have not been demonstrated. Toxic components are rapidly diluted, and concentrations that are considered injurious to fishes and shellfishes are typically not found farther than about 100 m from discharge points. Soluble components, including saline formation waters, rapidly dilute in open water. The benthic disturbance from the insoluble components of drilling discharges is also limited to the area immediately surrounding the discharge point. Overall, it is anticipated that there would be no adverse effects on overall populations of fishes and shellfishes in Alaskan waters because (1) the areas affected by drilling discharges are small relative to the distributions of potentially affected fish and shellfish species, (2) discharge points are widely dispersed in the vicinity of the considered OCS planning areas, and (3) discharges are regulated by the USEPA to address potential impacts. There is also a potential for contaminants to enter the marine environment in the Arctic Subregion as ice roads melt at the end of each winter (Section IV.B.3.f).

The commercial fishing industry can affect fishery resources within Alaskan waters.. A wide variety of methods are used to target numerous species of fishes and shellfishes, including longlines, seines, setnets, trawls, and traps. Some fisheries target particular fish species returning to their natal stream or river, while other fisheries take place in pelagic waters and target mixed stocks of fishes or shellfishes. As a consequence of the pressure commercial fishing places on fishery resources, appropriate management is required to reduce the potential for depletion of stocks due to overharvesting. Fisheries in Alaskan waters and in adjacent offshore areas are managed by the Alaska Department of Fish and Game and the North Pacific Fishery Management Council of the National Marine Fisheries Service through implementation of fishing regulations such as fishing seasons and harvest limits and through hatchery production of some fishery resources (primarily salmon).

Even with management, the possibility of overfishing still exists. Occasionally fisheries are closed when stocks are considered insufficient to support harvesting, and will sometimes remain closed for multiple seasons before stocks are deemed sufficient. While occasional or sustained declines in fishery stocks may not be fully attributable to commercial fishing, it appears that commercial fishing is an important factor in the abundance of fishery resources. Although the magnitude of harvests is considerably smaller than for commercial fisheries, sportfishing and subsistence fisheries may also contribute to cumulative effects on the abundance of some fishery resources.

The total number of oil spills and the extent of affected areas would likely increase under the proposed action in conjunction with increased levels of petroleum exploration and production (Table IV-17). The proposed action would contribute approximately 67 percent of the spills assumed for the OCS cumulative scenario in the Beaufort and Chukchi Seas Planning Areas and 100 percent of the OCS spills in the North Aleutian Basin and Cook Inlet Planning Areas. It is anticipated that up to 170 small spills (each < 50 bbl) could occur as a result of all OCS activities, under the cumulative scenario, with up to 120 of these assumed to occur as a consequence of the proposed action. It is further assumed that up to 19 medium-sized (50-999 bbl) and up to 5 large-sized (1,000-4,600 bbl) OCS spills could occur under the cumulative scenario. Non-OCS activities, such as State oil and gas development, domestic transportation of oil or refined petroleum products, and commercial shipping, may also result in accidental spills that could potentially impact fish resources within the Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas, as described in Section IV.B.3.f. While effects to fishery resources would depend on the timing, location, and magnitude of specific oil spills, it is anticipated that most small to medium spills that occur in OCS waters would have limited effects on fishery resources due to the relatively small areas likely to be exposed to high concentrations of hydrocarbons and the short period of time during which potentially toxic concentrations would be present.

Because of the higher concentrations of individuals likely to be present, anadromous salmon would be at greater risk from an OCS oil spill in the North Aleutian Basin and Cook Inlet Planning Areas than in the Beaufort and Chukchi Seas Planning Areas. The greatest potential for damage to salmon stocks would be if a spill were to occur along migration routes. However, because of the limited area affected by even large oil spills relative to the wide pelagic distribution and highly mobile migratory patterns of salmonids, it is anticipated that most impacts would be limited to small fractions of exposed salmon populations. Oil spills occurring at constrictions in migration routes, such as Unimak Pass, would have an increased potential for adversely affecting salmon. However, the weathering and dispersal of the spilled oil would limit the length of time that an area would be affected. Pacific salmon are also able to detect and avoid oil spills in marine waters (see Section IV.B.3.f [Cook Inlet]), which would also help to reduce the potential for contact. Aggregations of salmon in marine waters typically consist of mixed stocks, so even in the unlikely event of contact with an oil spill, it is anticipated that only a small fraction of any unique spawning population would be adversely affected.

Adverse effects of oil spills to groundfishes of southern Alaska would also be a function of spill magnitude, location, and timing. Adult groundfishes are primarily demersal and would generally be subjected only to the insoluble oil and water-soluble fractions of oil that reach deeper strata. Insoluble oil fractions would sink to the bottom and be distributed diffusely as tar balls over a wide area, and would unlikely produce noticeable reductions in the overall numbers of adult fishes. Egg and larval stages would be at a greater risk of exposure to oil spills because spawning aggregations of many groundfish species (e.g., walleye pollock) produce pelagic eggs that could come into contact with surface oil slicks. Herring are also potentially susceptible to oil spills because they spawn in nearshore waters for protracted periods of time.

Commercial shellfish stocks (such as tanner, snow, and red king crab) are unlikely to be exposed to surface oil. Although soluble and insoluble hydrocarbon fractions could reach deeper strata, these fractions would be distributed diffusely over wide areas and would likely not constitute a threat to shellfish stocks. Pelagic crab larvae could be affected if a large surface oil spill occurred during the spring spawning season. However, because the area affected by most spills would be expected to be small relative to overall distributions of crab larvae, overall population levels are unlikely to be noticeably affected.

Arctic fishes could also be susceptible to adverse effects of oil spills  Although offshore spills would likely have little effect on overall populations, since the areas with significant hydrocarbon concentrations would be localized relative to the broad distributions of most marine and anadromous fishes of the Beaufort and Chukchi Seas, some anadromous species of the Alaskan North Slope could be at greater risk because of their unique life-history cycles. Juveniles of some species of whitefish (including broad whitefish, humpback whitefish, and least cisco) are intolerant of highly saline marine conditions. During their summer feeding dispersals in the Beaufort Sea, these species tend to remain within a narrow band of warm, low-salinity water along the coast. Offshore barrier islands offer additional protection by helping to maintain low-salinity corridors. Thus, unlike most subarctic fishes, North Slope whitefish have a reduced capacity to bypass localized disruptions to their migration corridor by moving offshore and around the impasses. An oil spill, even one of limited area, could block the narrow nearshore corridor and prevent fishes from either dispersing along the coast to feed or returning to their overwintering grounds in North Slope rivers. If a spill were localized in the sensitive nearshore zone, its location would also make it more amenable to cleanup by environmental response teams. There is no tanker traffic on the North Slope, which eliminates the possibility of a collision spill in that area.

### Conclusion

Routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population-level effects on fish resources because of the limited timeframe over which most individual activities would occur and the small proportion of available habitats that would be affected during a given period.

The magnitude and severity of potential effects to fish resources from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to particular fish habitats; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall population-level effects on fish resources because of the relatively small proportion of similar available fish habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in the shallower nearshore areas of these planning areas have the potential to be of greatest significance to fish communities.

Even with State and Federal fishery management programs in place, impacts from overfishing commercial species could lead to depletion of some fish stocks.

## (2) Essential Fish Habitat

As identified in Section IV.B.3.f, essential fish habitat (EFH) in the vicinity of the Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas could be affected by any activity that degrades coastal or marine environments. Cumulative effects on EFH in Alaskan waters could occur from a variety of OCS and non-OCS activities that have a potential to directly kill managed fish species, disturb ocean-bottom habitats, increase sediment suspension, degrade water quality, affect the food supply for managed resources, or impede movements of migratory fishes.

Routine OCS activities in the Alaska region that could result in direct mortality to fish and shellfish include seismic surveys; construction of artificial islands, ice roads, platforms, and pipelines; releases of permitted discharges from wells; and removal of existing structures. Although it is likely the numbers would be smaller, a total of up to 23 platforms (including 15 artificial islands in the Artic Subregion), up to 90 exploration and delineation wells, and up to 900 development and production wells could be placed in waters offshore of Alaska as a result of cumulative OCS activities (Table IV-15). In addition, up to 575 miles of offshore pipelines and up to 625 miles of onshore pipelines could be constructed to transport oil from wells to collection facilities. It is anticipated that most of this activity would occur in the Arctic Subregion, where the proposed action could approximately double the number of artificial islands and wells to be constructed compared to ongoing and planned OCS activities alone. Although the potential overall level of exploration, development, and production would be lower in the North Aleutian Basin and Cook Inlet Planning Areas, there is currently no OCS development in these areas. Consequently, all OCS development in these areas would result from the proposed action.

Implementation of the proposed action would result in a small incremental increase in seismic survey activity compared to those that would occur under ongoing and planned lease sales. As discussed in Section IV.B.3.f, effects to fishes from seismic surveys would be highly localized and seasonal in nature, with acute effects limited primarily to eggs, larvae, and young-of the-year fish located within 2-3 m of seismic sources. No discernible population-level effects on fishes or shellfishes are anticipated due to seismic surveys that would occur within individual planning areas under the proposed action. It is anticipated that up to 23 platforms (including up to 15 artificial islands in the Arctic Subregion) could be constructed under the cumulative OCS scenario and that seismic surveys associated with that level of development could cover up to approximately 530 $km^2$ of ocean surface area over the 40-year life of the Proposed Program. Considered together, the areas that would be subjected annually to seismic surveys as a result of cumulative OCS activities would be very small compared to overall areas that support the potentially affected life stages of managed species. If sensitive areas and seasons are avoided, as called for in lease stipulations, discernible changes in the status of managed EFH resources in Alaskan waters would not be expected to occur due to these seismic surveys. In addition to OCS-related seismic surveys, additional surveys could be conducted in offshore or nearshore Alaskan waters as a result of State oil and gas exploration activities.

Under the proposed action, the potential impacts on EFH associated with the building and operation of OCS facilities such as platforms, artificial islands, and pipelines would increase in conjunction with the increased number of wells. Although construction of platforms, artificial islands, and pipelines would all disturb bottom habitats to some degree, artificial islands result in a more complete loss of benthic habitat due to larger footprints (approximately 9 ha for artificial islands versus less than 1.5 ha for platforms) and complete burial of existing substrate during construction. Construction of both platforms and artificial islands would temporarily increase turbidity and could damage EFH resources within the footprint of the facility and, to a lesser degree, within the immediately surrounding area; increases in turbidity may reduce photosynthesis and the resulting food production that supports managed species. In addition, managed species of fishes and invertebrates could become exposed to hydrocarbons, heavy metals, or other contaminants (some naturally occurring) associated with sediments as disturbed sediments are suspended into the water column. No platforms or artificial islands would be decommissioned or removed under the cumulative OCS scenario for Alaska.

The effect of habitat loss would likely be lethal to the existing benthic communities in the footprints of artificial islands. The approximate cumulative amount of habitat for EFH resources that could be affected by OCS construction of islands (up to 15 in the Arctic Subregion) and platforms (up to 8 in the North Aleutian Basin and Cook Inlet Planning Areas combined) in waters offshore of Alaska during the 40-year period covered by associated OCS leases would be up to 150 ha. Overall, this represents a small area compared to the availability of similar habitats in surrounding areas. Although increased turbidity associated with construction of these structures could impede photosynthesis and interfere with primary production, the effect would be localized to an area surrounding the individual structure and would generally be limited only to the period of construction. Similarly, exposure of organisms to sediment-bound contaminants as a consequence of sediment disturbance would be expected to occur within relatively limited areas and for limited periods during the construction and removal activities. In addition, regulations and mitigating measures should preclude construction of platforms or artificial islands in environmentally sensitive areas. Additional islands or platforms could also be constructed in Alaskan waters as a consequence of State oil and gas exploration activities. Overall, it is anticipated that construction of artificial islands and platforms would be unlikely to result in detectable cumulative effects on EFH resources in Alaskan waters.

The EFH resources in the immediate vicinity of areas subjected to pipeline construction could be affected by excavation of the sediment (if trenching is required), temporary increases in turbidity, and deposition of disturbed sediment. Assuming that the area affected by each mile of pipeline would be approximately 1.5 ha, up to approximately 860 ha of benthic EFH could be affected by offshore pipeline construction under the OCS cumulative scenario. Considering that pipeline construction activities would occur over a 40-year period (Section IV.L.1), only a very small portion of the benthic environment offshore of Alaska is likely to be disturbed annually. Eventually, the areas disturbed by pipeline installation activities would be recolonized, and most immobile benthic communities are expected to recover within 3 years following disturbance (MMS, 1996c).

Deposition of drilling fluids and cuttings could potentially affect EFH by altering grain size distributions and chemical characteristics of sediments such that benthic prey of some managed fish species or water quality in offshore areas would be affected in the immediate area surrounding drill sites. Although muds and cuttings from exploration and delineation wells could be discharged to surrounding waters, all muds, cuttings, and produced waters from production wells would be discharged into wells and not released to open waters. Using an estimate of 610 tons of muds and cuttings per well in the Arctic Subregion and 522 tons per well in North Aleutian Basin and Cook Inlet Planning Areas, it is estimated that the level of activity assumed under the cumulative OCS scenario could result in the release of approximately 52,000 tons of drilling muds and cuttings to offshore areas (Table IV-15). Of this amount, the proposed action would contribute up to 34,000 tons of muds and cuttings, or approximately 65 percent of the total. Based upon existing NPDES permits for drilling discharges, it is anticipated that dilution of drilling discharges to nontoxic levels would occur within 100 m from the discharge points, and it is estimated that an area of no more than approximately 3 ha around each well would be affected. Thus, while some species composition changes could occur in the immediate vicinity of exploration and delineation wells, it is estimated that no more than approximately 270 ha of benthic EFH should be affected by discharges from exploration and delineation wells under the cumulative OCS scenario. Drilling of wells under State oil and gas programs could have additional effects on EFH.

Water quality, considered to be an element of EFH, could also be affected throughout Alaskan waters by discharges from vessels, including oil tankers coming into and leaving the terminal in Valdez, cruise vessels, and fishing vessels. In most cases, offshore discharges would be expected to mix and rapidly dilute within the water column. Ocean dumping sites for dredge spoils and other wastes could also affect water quality in some areas, which are considered EFH for both open-water (e.g., walleye pollock adults) and benthic (e.g., yellowfin sole adults and late juveniles) species.

Freshwater areas used by salmon and other anadromous fish are considered to be EFH and could be affected by nearshore oil and gas activities such as pipeline dredging or by onshore pipelines that cross bodies of water, especially streams. The primary effects of pipeline crossings would be increasing turbidity and sedimentation of the benthic environment during construction and blocking migration of anadromous fish following construction. Onshore, up to 625 miles of onshore oil pipeline could be constructed under the OCS cumulative scenario (Table IV-15), of which only a small portion would likely cross freshwater areas. While an exact route cannot be determined at this time, any pipeline route would be required to comply with various Alaska Coastal Management Program policies. As a consequence, crossings of anadromous fish streams would be minimized and consolidated with other utility and road crossings of such streams. In addition, onshore pipelines would be designed, constructed, and maintained to reduce risks to fish habitats from a spill, pipeline break, or construction activities. Pipelines for both OCS and State oil and gas facilities would be required to comply with Alaska Coastal Management Program policies. Other non-OCS activities, such as logging, road construction, and development in general could also contribute to water quality degradation and blockage of fish passage in anadromous fish streams.

Commercial and sportfishing activities could also impact EFH. Fishing activities have a potential to result in overharvest of fishes and shellfishes, including managed species. Fishing methods used in Federal and State waters of Alaska include trawling, longlining, and trap fishing for several groundfish species, as well as dredging for scallops, trap fishing for crabs, and gill netting for salmon. Some of these methods, especially trawling and dredging, could damage benthic EFH resources, such as corals and kelp beds.

The total number of oil spills and the extent of affected EFH areas would likely increase under the proposed action in conjunction with increased levels of petroleum exploration and production. The proposed action would contribute approximately 67 percent of the spills assumed for the OCS cumulative scenario in the Beaufort and Chukchi Seas Planning Areas and 100 percent of the OCS spills in the North Aleutian Basin and Cook Inlet Planning Areas. It is anticipated that up to 170 small spills (each < 50 bbl) could occur as a result of all OCS activities under the cumulative scenario, with up to 120 of these assumed to occur as a consequence of the proposed action. It is further assumed that up to 19 medium-sized (50-999 bbl) and up to 5 large-sized (1,000-4,600 bbl) OCS spills could occur under the cumulative scenario (Table IV-17). Non-OCS activities, such as State oil and gas development, domestic transportation of oil or refined petroleum products, and commercial shipping, may also result in accidental spills that could potentially impact fish resources within the Arctic, Bering Sea, or South Alaska Subregions, as described in Sections IV.B.3.f. While effects to EFH resources would depend on the timing, location, and magnitude of specific oil spills, it is anticipated that most small to medium spills that occur in OCS waters would have limited effects on EFH, due to the relatively small areas likely to be exposed to high concentrations of hydrocarbons and the short period of time during which potentially toxic concentrations would be present.

Because of the higher concentrations of individuals likely to be present, EFH for anadromous salmon would be at greater risk from an OCS oil spill in the North Aleutian Basin and Cook Inlet Planning Areas than in the Beaufort and Chukchi Seas Planning Areas. The greatest potential for damage to salmon stocks would be if a spill were to occur along migration routes. However, because of the limited area affected by even large oil spills relative to the wide pelagic distribution and migratory patterns of salmonids, it is anticipated that most impacts would be limited to small fractions of exposed salmon populations. Oil spills occurring at constrictions in migration routes, such as Unimak Pass, would have an increased potential for adversely affecting salmon. However, the weathering and dispersal of the spilled oil would limit the length of time that an area would be affected. Pacific salmon are also able to detect and avoid oil spills in marine waters (see Section IV.B.3.f [Cook Inlet], which would also help to reduce the potential for contact. Aggregations of salmon in marine waters typically consist of mixed stocks, so even in the unlikely event of contact with an oil spill, it is anticipated that only a small fraction of any unique spawning population would be adversely affected.

Adverse effects of oil spills to EFH for groundfishes of southern Alaska would also be a function of spill magnitude, location, and timing. Adult groundfishes are primarily demersal and would generally be subjected only to the insoluble oil and water-soluble fractions of oil that reach deeper strata. Insoluble oil fractions would sink to the bottom and be distributed diffusely as tar balls over a wide area, and would unlikely produce noticeable reductions in the overall numbers of adult fishes. Egg and larval stages would be at greater risk of exposure to oil spills because spawning aggregations of many groundfish species (e.g., walleye pollock) produce pelagic eggs that could come into contact with surface oil slicks. Herring are also potentially susceptible to oil spills because they spawn in nearshore waters for protracted periods of time.

Commercial shellfish stocks (such as tanner, snow, and red king crab) are unlikely to be exposed to surface oil. Although soluble and insoluble hydrocarbon fractions could reach deeper strata, these fractions would be distributed diffusely over wide areas and would likely not constitute a threat to shellfish stocks. Pelagic crab larvae could be affected if a large surface oil spill occurred during the spring spawning season. However, because the area affected by most spills would be expected to be small relative to overall distributions of crab larvae, overall population levels are unlikely to be noticeably affected.

Arctic fishes could also be susceptible to adverse effects of oil spills (see Section IV.B.3.f [Arctic]). Although offshore spills would likely have little effect on overall populations, since the areas with significant hydrocarbon concentrations would be localized relative to the broad distributions of most marine and anadromous fishes of the Beaufort and Chukchi Seas, some anadromous species of the Alaskan North Slope could be at greater risk because of their unique life-history cycles. Juveniles of some species of whitefish (including broad whitefish, humpback whitefish, and least cisco) are intolerant of highly saline marine conditions. During their summer feeding dispersals in the Beaufort Sea, these species tend to remain within a narrow band of warm, low-salinity water along the coast. Offshore barrier islands offer additional protection by helping to maintain low-salinity corridors. Thus, unlike most subarctic fishes, whitefish along the North Slope have a reduced capacity to bypass localized disruptions to their migration corridor by moving offshore and around the impasse. An oil spill, even one of limited area, could block the narrow nearshore corridor and prevent fishes from either dispersing along the coast to feed or returning to their overwintering grounds in rivers of the North Slope. If a spill were localized in the sensitive nearshore zone, its location would also make it more amenable to cleanup by environmental response teams. There is no tanker traffic on the North Slope, which eliminates the possibility of a collision spill in that area.

Oil from spills occurring under the ice in the Beaufort and Chukchi Seas could remain trapped there throughout the winter unless removed, which, while difficult, could be done. Water quality would be negatively impacted, and overwintering eggs, larvae, and invertebrate prey would likely be killed in affected areas. Surface spills occurring in the summer months would temporarily reduce EFH for surface-dwelling eggs, larvae, and pelagic prey species. Oil reaching nearshore areas could travel short distances upriver in anadromous fish streams as a result of tidal water movements, and some oil could become trapped in the interstitial spaces of the sediments. In such cases, EFH for salmon eggs and larvae could be affected.

## Conclusion

It is anticipated that the proposed action would represent a small increment to the potential for overall cumulative effects on EFH in Alaskan waters. Routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population-level effects on managed species because of the limited timeframe over which most individual activities would occur and the small proportion of available habitats that would be affected during a given period. Various other activities in Alaskan waters, including State oil and gas development, logging, shipping, commercial fishing, and sportfishing, would also contribute to cumulative effects on EFH resources.

The magnitude and severity of potential effects to EFH in Alaskan waters from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to particular fish habitats; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall population-level effects on fish resources because of the relatively small proportion of similar available fish habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in the shallower, nearshore areas of these planning areas have the potential to be of greatest significance to fish communities.

## g. Coastal Habitats

### (1) Coastal Barrier Beaches and Dunes

A number of activities associated with the proposed action could result in impacts to coastal barrier beaches and dunes in the Alaska Region (Section IV.B.3.g). These activities include pipeline, causeway, and facility construction, and vessel traffic. Impacts associated with these activities could include losses of beach and dune habitat and indirect effects that contribute to reductions in beach habitat or impacts to biota. Similar activities are associated with current and planned OCS sales in the Alaska Region and would occur during the life of the 2007-2012 program (see Table IV-15). In the Beaufort Sea and Chukchi Sea Planning Areas, the activities associated with the proposed action would represent approximately 25-100 percent of such OCS activities. In the North Aleutian Basin and Cook Inlet Planning Areas, the activities associated with the proposed action represent 100 percent of the cumulative OCS activities.

Impacts to barrier beaches and dunes primarily result from factors that contribute to increased erosion of beaches and dunes. Activities may disturb dune vegetation, thereby promoting dune erosion, or directly disturb beach and dune substrates, resulting in increased erosion of beaches and dunes. Increases in wave action could also contribute to the erosion of beaches. Sedimentation from physical disturbance of substrates or erosion may affect biota in intertidal or shallow subtidal habitats. Additionally, accidental spills may impact beach or dune habitat.

Ongoing non-OCS activities that could affect barrier beaches and dunes include those related to State oil and gas development, commercial shipping and other marine vessels, coastal development, and logging. These activities can be reasonably expected to continue into the future.

The construction of pipelines, docks, causeways, or shorebases associated with State oil and gas exploration and development could result in direct losses of beach or dune habitat. Construction of facilities on barrier islands in the Arctic Subregion could impact beach, dune, or tundra habitat. Erosion of beach or dune substrates adjacent to these constructions may result in additional habitat losses. Intertidal and shallow subtidal organisms in nearby areas may be buried by excavated materials or indirectly impacted by turbidity and sedimentation. Sand beaches and dunes along lagoon shorelines and on the margins of lakes and rivers on the Arctic Coastal Plain (ACP) may also be impacted by pipeline construction. Vegetated dunes in the Arctic Subregion may be impacted by vehicles associated with seismic activities (ADNR, 1999a). Beaches and associated biota within the Beaufort Sea, Chukchi Sea, North Aleutian Basin, and Cook Inlet Planning Areas could also be impacted by routine discharges from marine vessels, discharges of municipal and industrial wastewater, or sedimentation from upland areas, including erosion from logging operations within the Cook Inlet or North Aleutian Basin watershed.

Coastal beaches on the south coast of the Alaska Peninsula could be affected by the construction of a LNG facility and associated marine and coastal facilities. Such facilities may include a gas conditioning and LNG conversion plant; LNG marine loading terminal; and airport, dock, warehouse and storage, waste disposal, and administrative facilities. Direct losses of beach habitat may occur at the facility locations. Erosion of beach substrates adjacent to these construction activities may result in additional habitat losses. Intertidal and shallow subtidal organisms in nearby areas may be buried by excavated materials or indirectly impacted by turbidity and sedimentation. The impacts to barrier beaches and dunes from substrate-disturbance activities associated with construction under the proposed action would represent a small contribution to the past, ongoing, and expected future impacts to barrier beaches and dunes from non-OCS activities.

Activities that increase wave action along barrier beaches and dunes could contribute to their erosion. Barge and service vessel traffic supporting State oil and gas development may result in wake erosion along barrier islands in the Beaufort Sea, Chukchi Sea, and North Aleutian Basin Planning Areas. A portion of the impacts related to vessel traffic would be associated with the proposed action; however, activities conducted under the proposed action would contribute a relatively small number of vessel trips to the total.

Accidental spills of oil or other liquid hydrocarbons, resulting from activities conducted under the proposed action, could impact beaches and dunes. Such spills would represent approximately 67 percent of the spills resulting from ongoing OCS activities and planned future sales in the Beaufort and Chukchi Seas Planning Areas and 100 percent of the OCS spills in North Aleutian Basin and Cook Inlet Planning Areas (Table IV-17). As under the proposed action, the majority of these spills would be small ($\geq$ 1 bbl and < 50 bbl). Non-OCS activities, such as State oil and gas development, domestic transportation of oil or refined petroleum products, and commercial shipping, may also result in accidental spills that could potentially impact coastal barrier beaches and dunes. Oil spills have resulted in past impacts to beaches and other intertidal habitats, as in the case of the *Exxon Valdez* oil spill. Spills can result in short- or long-term changes in the composition of intertidal or shallow subtidal communities, or extensive mortality of biota associated with coastal habitats, and may persist in substrates for decades. The amount of oil contacting beaches from a spill depends on a number of factors such as the location and size of the spill, waves and water currents, and containment actions. Naturally occurring seeps may also be a source of crude oil introduced into nearshore waters (Kvenvolden and Cooper 2003). The magnitude of resulting impacts and the persistence of oil would depend on factors such as the amount of oil deposited, remediation efforts, substrate grain size, and localized erosion and deposition patterns. The impacts of potential spills associated with the proposed action would be expected to add a small contribution to the impacts of other sources of beach degradation in the Alaska Region.

Indirect effects to coastal barrier beaches and dunes could result from global climate change. Potential thermal expansion of ocean water and melting of glaciers and ice caps could result in a global rise in mean sea level (Section IV.L.1.c). Sea-level rise could result in increased inundation of barrier landforms and erosion of beach habitat. In the Arctic, greater wave activity during storms due to decreases in sea-ice cover, as well as changes in permafrost due to temperature increases, could result in increased coastal erosion.

## (2) Wetlands

A number of activities associated with the proposed action could result in impacts to coastal wetlands in the Alaska Region (Section IV.B.3.g). These activities include construction of pipelines, shoreline facilities, pipeline landfalls, onshore facilities and roads, and activities that result in poorer water and air quality and altered hydrology. Impacts associated with these activities could include elimination of wetland habitat and indirect effects that contribute to reductions in wetland habitat. Similar activities are associated with current and planned OCS lease sales in the Beaufort Sea, Chukchi Sea, North Aleutian Basin and Cook Inlet Planning Areas, and would occur during the life of the 2007-2012 program (see Table IV-15). In the Beaufort and Chukchi Seas Planning Areas, the activities associated with the proposed action would represent approximately 25-100 percent of such OCS activities. In the North Aleutian Basin and Cook Inlet Planning Areas, the activities associated with the proposed action represent 100 percent of the cumulative OCS activities.

Factors that impact coastal wetlands include the direct elimination of wetland habitat by excavation or filling and the degradation of wetland communities by reduced water or air quality or hydrologic changes. Construction projects may fill wetlands for facility siting or excavate wetlands for the construction of pipelines, causeways, or shore bases or for gravel mining. A number of activities may degrade wetlands or promote wetland losses indirectly by causing changes to wetland hydrology or introducing contaminants.

Ongoing non-OCS activities that could affect coastal wetlands include those related to State oil and gas development, commercial shipping and other marine transportation, coastal development, discharge of municipal wastes and other effluents, domestic transportation of oil and gas, and logging. These activities can be reasonably be expected to continue into the future. Wetlands on the south coast of the Alaska Peninsula could also be affected by the construction of a new LNG facility and associated marine and coastal facilities.

A number of these activities result in the localized destruction of wetlands. The construction of pipeline landfalls, docks, causeways, or shorebases associated with State oil and gas exploration and development could result in direct losses of tidal wetlands. The construction of onshore facilities to support State oil and gas development and the exploration of oil reserves on the National Petroleum Reserve-Alaska on the ACP have impacted freshwater wetlands, and future impacts associated with oil and gas development are expected to continue. The construction of buried pipelines results in direct impacts to wetlands due to excavation, and the construction of gravel pads and gravel roads eliminates wetland habitat by filling. Current technology allows for smaller and fewer drilling pads, and some new developments in the Arctic Subregion would not include interconnecting roads. On the ACP, gravel has been used in support of oil development to construct pads for camps, drilling sites, operations and maintenance facilities, airports, roads for facility access as well as the Dalton Highway/haul road, offshore islands, and causeways (MMS, 2003a). Gravel mining operations often result in the excavation of wetland habitat in and near rivers and other water bodies. Over 730 ha (1,800 acres) of tundra have been removed by gravel mining on the Arctic Coastal Plain (MMS, 2003a). The construction of vertical support members for elevated pipelines also contributes to small localized wetland losses. Although activities that impact wetlands are regulated by State and Federal agencies, construction of industrial facilities, commercial sites, and residential developments would be expected to result in continued wetland losses. On the ACP, over 3,900 ha (9,600 acres) of tundra habitat, most of which is wetland, have been impacted by oil development activities (MMS, 2002b, 2003a).

Wetlands along the south coast of the Alaska Peninsula could be affected by the construction of a LNG facility and associated marine and coastal facilities. Direct losses of tidal wetland habitat may occur at the locations of facilities built along the peninsula shoreline. Freshwater wetlands near the coastline may be impacted by the placement of fill material for facility construction. The direct impacts to coastal wetlands from pipeline or facility construction under the proposed action would represent a very small contribution to the past, ongoing, and expected future losses of wetlands from non-OCS activities.

Indirect impacts of many activities have also resulted in wetland losses. The construction of gravel roads and pads has resulted in altered hydrology in some areas, particularly in the Arctic Subregion, by blocking natural drainage patterns, converting vegetated wetlands to open water, or drying wetlands by restricting water inflow. Snow accumulations adjacent to pads and roads can result in vegetation changes and thermokarst. Windblown dust near gravel pads and roads causes changes in plant communities, reduction of vegetation, and thermokarst, leading to wetland losses. Sedimentation from gravel pads, roads, and gravel mining operations, and vehicular impacts to streambanks adversely impacts wetlands and may result in losses of vegetation or other associated biota. Ice roads in the Arctic could result in compression of vegetation, microtopography, and tundra soils, altering wetland communities. Vehicles used for seismic surveys could compress microtopography and cause changes to the vegetation community. Organisms in wetland areas near construction activities may be buried by excavated materials or indirectly impacted by turbidity and sedimentation. Degradation of wetlands could result from water quality impacts due to discharges of waste water from vessels, municipal treatment plants, and industrial facilities, and stormwater discharges. Water quality may also be impacted by waste storage and disposal sites. Spills of produced water could kill vegetation and other biota in freshwater wetlands. Impacts to air quality near construction sites or industrial facilities could result in local effects to wetland vegetation, and may include sources such as fugitive dust, off-gassing from processing facilities, or exhaust emissions. Indirect impacts to wetlands from non-OCS activities are expected to continue to contribute to wetland degradation and losses in the Alaska Region. The indirect impacts to wetlands from pipeline or facility construction under the proposed action would represent a very small contribution to the past, ongoing, and expected future impacts to wetlands from non-OCS activities.

Accidental spills of oil, condensate, or petroleum products as a result of activities conducted under the proposed action could impact tidal or freshwater wetlands (see Section IV.B.3.g). Such spills would represent approximately 67 percent of the spills resulting from ongoing OCS activities and planned future sales in the Beaufort Sea and Chukchi Sea Planning Areas, and 100 percent of the OCS spills in the North Aleutian Basin and Cook Inlet Planning Areas (Table IV-17). Most of these spills would be small ($\geq$ 1 bbl and < 50 bbl), as under the proposed action. Spills in shallow water, primarily those from vessel accidents and pipelines, would be most likely to affect coastal wetlands, whereas deep-water spills, such as those from platforms, would be less likely to impact wetlands. Spills from onshore pipelines and facilities could impact freshwater wetlands, or tidal wetlands if carried to coastal habitats by streams. Non-OCS activities such as State oil and gas development; the domestic transportation of oil or refined petroleum products, including LNG from Cook Inlet and the Alaska Peninsula; the production and storage of petroleum products and LNG; and commercial shipping may also result in accidental spills that could potentially impact wetlands. Naturally occurring seeps may also be a source of crude oil that could potentially affect coastal wetlands. The amount of oil contacting wetlands, the magnitude of resulting impacts, and the length of time for recovery would depend on a number of factors such as the location and size of the spill, containment actions, waves and water currents, type of oil, types of remediation efforts, amount of oil deposition, duration of exposure, season, substrate type, and extent of substrate penetration. Impacts from oil spills would be expected to range from short-term effects on vegetation growth to extensive mortality. Recovery of affected wetlands could require several decades. The impacts of potential oil spills associated with the proposed action would be expected to constitute a small addition to the impacts of all other sources of oil in the Alaska Region.

Global climate change could result in indirect effects to coastal wetlands. Potential thermal expansion of ocean water and melting of glaciers and ice caps could result in a global rise in mean sea level (Section IV.L.1.c). Sea-level rise would result in greater inundation of coastal wetlands, and likely result in conversion of wetlands to open water. In addition, large changes in river flows into nearshore marine waters could affect salinity and water circulation in estuaries, which, in turn, could impact estuarine wetland communities.

### Conclusion

The cumulative impacts of past activities have resulted in losses of coastal habitats in the Alaska Region. The proposed action would be expected to result in direct as well as indirect impacts to coastal habitats, which would contribute to the past, ongoing, and future impacts of other activities within the Region, including naturally occurring events that affect those habitats. However, the impacts of the proposed action would generally represent a relatively small contribution to other impacts to coastal habitats, with pipeline and onshore facility construction and potential oil spills the most likely to contribute to cumulative impacts.

## h. Seafloor Habitats

A number of activities could directly or indirectly affect seafloor habitats and benthic communities. As identified in Section IV.B.3.h, impacts to seafloor habitats could result from direct physical damage, sedimentation, and lethal or sublethal toxic effects resulting from routine activities and from accidental oil spills.

The cumulative levels of OCS exploration, development, and production activities for the Alaska Region are derived by considering activities from leasing during the 2007-2012 program and from future OCS lease sales. A total of up to 23 platforms or artificial islands (Artic Subregion only), up to 90 exploration and delineation wells, and up to 900 development and production wells could be placed in waters offshore of Alaska as a result of the cumulative OCS activities. In addition, up to 575 miles of offshore pipelines could be constructed to transport oil from wells to collection facilities. It is anticipated that most of this activity would occur in the Arctic Subregion (Table IV-15).

Potential environmental impacts associated with the building and operation of OCS facilities such as platforms, artificial islands, and pipelines would increase in conjunction with the increased number of wells. Although construction of platforms, artificial islands, and pipelines would each disturb bottom habitats to some degree, construction of artificial islands would result in a more complete loss of benthic habitat, due to larger footprints (approximately 9 ha for artificial islands versus less than 1.5 ha for platforms) and complete burial of existing substrates during construction. Construction of both platforms and artificial islands would temporarily increase turbidity and could disturb or kill benthic organisms within the footprints of the facilities and the immediately surrounding areas. It is anticipated that no platforms or artificial islands would be decommissioned or removed under the proposed action or under the OCS cumulative scenario for the Alaska Region.

The effect of habitat loss would likely be lethal to the existing benthic communities in the footprints of artificial islands. The cumulative amount of seafloor habitat that could be affected by OCS construction of islands (up to 15 in the Arctic Subregion [Beaufort and Chukchi Seas Planning Areas]), platforms (up to 8 in the Bering Sea Subregion [North Aleutian Basin Planning Area] and the South Alaska Subregion [Cook Inlet Planning Areas] combined), or pipelines (up to 575 miles) in waters offshore of Alaska during the 40-year period covered by associated OCS leases would be up to 1,000 ha. Overall, this represents a small area compared to the availability of similar habitats in surrounding areas. Although increased turbidity resulting from construction of these structures could impede photosynthesis and interfere with primary production, the effect would be localized to an area surrounding each structure and would generally be limited to only the period of construction. Construction of platforms and artificial islands in areas previously lacking hard substrate could have localized effects on the biodiversity and distribution of benthic communities by favoring organisms that prefer a hard substrate. Benthic invertebrates and plants needing a hard substrate are expected to colonize platforms within 1 or 2 years.

Seafloor habitats and benthic organisms in the immediate vicinity of areas subjected to pipeline construction could be affected by excavation of the sediment (if trenching is required), by temporary increases in turbidity, and by deposition of disturbed sediment. Assuming that the seafloor area affected by each mile of pipeline would be approximately 1.5 ha, up to approximately 860 ha of seafloor could be affected by offshore pipeline construction under the OCS cumulative scenario. Considering that pipeline construction activities would occur over a 40-year period (Section IV.L.1), only a very small portion of the seafloor environment offshore of Alaska is likely to be disturbed annually by pipeline construction related to OCS lease sales. Eventually, the areas disturbed by pipeline installation activities would be recolonized, and most immobile benthic communities are expected to recover within 3 years following disturbance (MMS, 1996c).

The increased amount of drilling anticipated under the proposed action will result in OCS discharges of drill muds, cuttings, and produced waters. Deposition of drilling fluids and cuttings could potentially affect benthic organisms by altering grain size distributions and chemical characteristics of sediments such that benthic organisms in offshore areas could be affected in the immediate areas surrounding drill sites. Although muds and cuttings from exploration and delineation wells could be discharged to surrounding waters, all muds, cuttings, and produced waters from production wells would be discharged into wells and not released to open waters. Using an estimate of 610 tons of muds and cuttings per well in the Beaufort Sea and Chukchi Sea Planning Areas and 522 tons per well in the North Aleutian Basin and Cook Inlet Planning Areas, it is estimated that the level of activity assumed under the OCS cumulative scenario could result in the release of approximately 52,000 tons of drilling muds and cuttings to offshore areas (Table IV-15). Of this amount, the proposed action would contribute up to 34,000 tons of muds and cuttings, or approximately 65 percent of the total.

Drilling muds and cuttings could contain materials at concentrations that could be toxic (primarily sublethal effects) to benthic organisms. Based upon existing NPDES permits for drilling discharges, it is anticipated that dilution of drilling discharges to nontoxic levels would occur within 100 m of the discharge points, and it is estimated that an area of no more than approximately 3 ha around each well would be affected. Thus, while some species compositional changes could occur in the immediate vicinity of exploration and delineation wells, it is estimated that no more than approximately 270 ha of seafloor habitat should be affected by discharges from exploration and delineation wells under the OCS cumulative scenario (Table IV-15). Overall, it is anticipated that there would be no adverse effects on overall populations of benthic organisms in Alaskan waters because the seafloor areas affected by drilling discharges would be very small relative to the distributions of similar habitat types, because discharge points would be widely dispersed in the vicinity of the considered OCS planning areas, and because discharges would be regulated by the USEPA to address potential impacts.

Regulations and mitigating measures should preclude construction of platforms or artificial islands and placements of pipelines or wells in environmentally sensitive areas, such as the Stefansson Sound Boulder Patch in the Beaufort Sea (Section IV.B.3.h). Provided that OCS construction does not occur in environmentally sensitive areas, construction of artificial islands and platforms would be unlikely to result in cumulative effects on populations of benthic organisms in Alaskan waters.

Various non-OCS activities, including State oil and gas programs, dredging and disposal of dredging spoils in OCS waters, and commercial or sportfishing activities, could contribute to cumulative effects on seafloor habitats. Drilling of wells under State oil and gas programs could also require construction of artificial islands, platforms, and pipelines in waters of Alaska. Effects on seafloor habitats and benthic organisms would be similar to those described above for OCS oil and gas programs. Non-OCS dredging and marine disposal activities would involve excavation of nearshore sediments and subsequent disposal in offshore or nearshore areas, thereby disturbing seafloor habitats in some areas and burying benthic organisms in other areas. The effects of dredging activities on seafloor habitats are expected to be similar to those described for the installation of pipelines. Due to the small number and limited use of disposal sites in the vicinity of the OCS planning areas identified in the proposed action, these activities are not expected to noticeably alter benthic communities in these areas. In addition, some fishing methods, such as trawling and shellfish dredging, could damage seafloor habitats and organisms, such as corals and kelp beds.

The total number of oil spills and the extent of affected seafloor habitat would likely increase under the cumulative scenario, in conjunction with increased levels of petroleum exploration and production. The proposed action would contribute approximately 67 percent of the spills assumed for the OCS cumulative scenario in the Beaufort Chukchi Seas Planning Areas and 100 percent of the OCS spills in the North Aleutian Basin and Cook Inlet Planning Areas. It is anticipated that up to 170 small spills (≥ 1 bbl and < 50 bbl) could occur as a result of all OCS activities under the cumulative scenario, with up to 120 of these assumed to occur as a consequence of the proposed action. It is further assumed that up to 19 medium-sized (50 to 999 bbl) and up to 5 large-sized (1,000 to 4,600 bbl) OCS spills could occur under the cumulative scenario (Table IV-17). Non-OCS activities, such as State oil and gas development, domestic transportation of oil or refined petroleum products, and commercial shipping, may also result in accidental spills that could affect seafloor habitats within the Beaufort and Chukchi Seas Planning Areas or in the North Aleutian Basin or Cook Inlet Planning Area, as described in Section IV.B.3.h. While effects to seafloor habitats would depend on the timing, location, and magnitude of specific oil spills, it is anticipated that most small to medium spills that occur in OCS waters would have limited effects on seafloor habitats because of the relatively small areas likely to be exposed to high concentrations of hydrocarbons and the short period of time during which potentially toxic concentrations would be present.

In most cases, seafloor habitats and benthic organisms would be exposed only to the insoluble oil and water-soluble fractions of oil that reach deeper strata. Although soluble and insoluble hydrocarbon fractions could reach deeper strata, these fractions would be distributed diffusely over relatively wide areas and would likely not constitute a threat to stocks of benthic organisms. Pelagic larvae of some benthic species (e.g., crabs) could be affected if a large surface oil spill occurred during the spring spawning season. However, because the area affected by most spills would be expected to be small relative to overall distributions of crab larvae, overall population levels are unlikely to be noticeably affected.

Large oil spills would likely affect benthic communities in shallow subtidal waters and in intertidal areas. The effects of such spills on benthic organisms could range from sublethal to lethal. Estimates of recovery time for directly impacted subtidal benthic communities range from 3 to 10 years (MMS, 1996c). Damage caused by oil contamination would depend on the size and duration of the spill, time of year, and the types and density of biota in the affected area. Multiple spills would further contribute to cumulative effects.

Oil reaching sensitive seafloor habitats could have substantial effects on biota. For example, if a large amount of oil from a spill in the Beaufort Sea were to sink and inundate the Stefansson Sound Boulder Patch, sensitive species could require 10 or more years to recover (MMS, 1996c). However, most of the oil associated with open-water spills usually remains floating at the water surface; even in the case of a leak or rupture in a buried pipeline, most of the released oil would likely float to the surface. The benthic area directly contaminated by such a leak would be expected to be within a 100-m radius of the leak or break in the pipeline (COE, 1999). Planning and permitting procedures and requirements will likely be sufficient to minimize construction of pipelines in sensitive habitats.

Although subtidal plants in the Boulder Patch are not likely to be coated by oil, due to their depth in the water column, photosynthesis could be reduced if floating oil reduced light penetration for an extended period. This could have short-term effects on growth and reproduction of the kelp. In the event of a surface spill in the vicinity of the Boulder Patch, the concentrations of soluble oil fractions reaching Boulder Patch benthic organisms are likely to be below levels that would be lethal; consequently, shifts in community structure would not be expected to occur. The resulting concentrations could elicit sublethal effects on growth or reproduction, although it is anticipated that such effects would be relatively short-lived.

### Conclusion

It is anticipated that the proposed action would represent a significant percentage of the potential for overall cumulative effects on seafloor habitats and benthic organisms in Alaskan waters, largely because there is currently no OCS development offshore Alaska. Planning and permitting procedures and stipulations that promote identification and avoidance of sensitive habitats should minimize the potential for direct impacts to sensitive seafloor areas. Because of the limited timeframe over which most individual activities would occur and the small proportion of available habitats that would be affected during a given period, routine OCS activities from ongoing, planned, and proposed actions would be unlikely to have cumulative population-level effects on benthic organisms. Non-OCS activities, including State oil and gas development, commercial fishing, and sportfishing, could also contribute to cumulative effects on seafloor habitats.

Approximately 70 percent of the spills that are assumed to occur are associated with the proposed action. The magnitude and severity of potential effects to seafloor habitats from oil spills would be a function of the location, timing, duration, and size of spills; the proximity of spills to particular benthic habitats; and the timing and nature of spill containment and cleanup activities. Spills in deeper water, whether from OCS or non-OCS sources, are unlikely to have overall population-level effects on seafloor habitats because of the relatively small proportion of similar available habitats that would come in contact with released oil at concentrations great enough to elicit toxic effects. Large oil releases that occur in or reach shallower nearshore areas have the greatest potential to affect benthic organisms.

## i. Areas of Special Concern

Section IV.B.3.i identified potential impacts to national parks, national refuges, and national forests that could result due to activities or accidents related to the proposed leasing programs in the Beaufort and Chukchi Seas, North Aleutian Basin and Cook Inlet Planning Area. In considering the potential cumulative effects of OCS activities on these areas, the level of routine activities and the potential for accidental spills under the proposed action would represent an incremental increase in the overall level of activities associated with current and planned OCS sales that would occur during the 40-year life of the Proposed Program (Section IV.L.1). Overall cumulative impacts to these areas of special concern in the Alaskan Region consider impacts from both OCS and non-OCS activities.

## (1) National Park Service Lands

As identified in Section IV.B.3.i, four National Park Service (NPS) lands in Alaska are potentially susceptible to impacts from activities related to OCS oil and gas development as a consequence of the Proposed Program. The potentially affected parks include the Cape Krusenstern National Monument and the Bering Land Bridge National Preserve (Arctic Subregion) and the Lake Clark National Park and Preserve and the Katmai National Park and Preserve (South Alaska Subregion). These areas are shown in Figures III-41 and III-43.

Impacts from routine OCS operations could come from facilities developed to support oil drilling and production, and could include effects from pipeline landfalls, dredging, air pollution, and the construction of roads and new facilities. Onshore oil facilities are permissible only on private acreage within each national park land. All of these national parks, monuments, and preserves contain privately held acreage, but the development of onshore oil support facilities is unlikely on most of these. Consequently, no cumulative impacts from routine operations would be expected on park lands within these facilities. Because of the more confined nature of Cook Inlet, OCS construction of facilities within the Cook Inlet Planning Area could have some negative effects on scenic values for some users of the Lake Clark and Katmai National Parks and Preserves if the facilities were visible from shore. The nearest State oil and gas facilities currently located within Cook Inlet are located at least 25 miles distant from these national parks and are unlikely to be visible from the parks on most days.

Activities associated with the Red Dog Mine and its port facility south of Kivalina on the Chukchi Sea would contribute to cumulative impacts on the Cape Krusenstern National Monument. The road from the mine (located just outside the monument) to the port crosses the northern boundary of the monument. Impacts from this facility, such as habitat loss or disturbance, are expected to be minor due to the limited activity associated with the mine.

Increased traffic (i.e., land, sea, and air) and development within the vicinity of NPS lands could also contribute to cumulative impacts to these areas. Because the amount of traffic is restricted and activities within the parks regulated, traffic would likely create a minor addition to cumulative impacts on the NPS lands. It is anticipated that noise generated by OCS offshore construction activities would be at low levels, intermittent, and would not persist for more than a few months. It is considered unlikely that these additional activities would noticeably affect wildlife or park user values compared to current (non-OCS) activities within the considered planning areas.

Impacts to these areas could occur due to accidental releases of oil spilled from onshore facilities and offshore drilling rigs (Table IV-15). Non-OCS activities, such as State oil and gas development, the domestic transportation of oil or refined petroleum products, including LNG from Cook Inlet and the Alaska Peninsula, the production and storage of petroleum products and LNG, and commercial shipping, could also result in accidental spills that could affect park lands. Naturally occurring seeps may also be a source of crude oil introduced into nearshore waters (Kvenvolden and Cooper 2003). An oil spill would have the greatest effect if it came into contact with shoreline habitats. Impacts would depend primarily on the spill location, size, and time of year. In general, directly affected coastal fauna could include marine mammals; fishes that reproduce in, inhabit, or migrate through coastal areas; terrestrial mammals that feed on these fishes; and marsh birds and seabirds. Spilled oil could also affect subsistence harvests in those parks in which subsistence hunting and fishing are allowed and could affect the number of park visitors.

## (2) National Wildlife Refuges

National wildlife refuges (NWR's) in the vicinity of the considered planning areas are identified in Section IV.B.3.i for the Beaufort and Chukchi Seas, North Aleutian Basin Planning Area, and Cook Inlet Planning Areas. Overall, eight NWR's (including three units of the Alaska Maritime NWR) generally occur in the vicinity of the considered planning areas, including: the Arctic National Wildlife Refuge (ANWR), Alaska Maritime NWR (Chukchi Sea Unit, Gulf of Alaska Unit, Alaska Peninsula Unit), Alaska Peninsula NWR, Becharof NWR, Kodiak NWR, Kenai NWR, Izembek NWR, and Togiak NWR.

Oil drilling and facility development are prohibited in the ANWR and are discretionary on all refuges; however, there are seven refuges (Figs. III-41, III-42, and III-43) that could potentially be affected by OCS oil and gas development from adjacent regions under the cumulative case scenario. These refuges could be contaminated by oil spilled from offshore projects, or could be subject to negative effects from routine operations associated with the development of onshore oil and gas support facilities. They could also be affected by non-OCS activities within or adjacent to refuges including State oil and gas development, the domestic transportation of oil or refined petroleum products, including LNG from Cook Inlet and the Alaska Peninsula, the production and storage of petroleum products and LNG, and commercial shipping. Numerous refuge lands have been conveyed to private owners and Native corporations. Section 22(g) of the Arctic Native Claims Settlement Act (1971) requires that new development on these lands must be in accordance with the purpose for which the refuge was formed. Thus, while development of onshore oil and gas support facilities is technically possible, such development would be subject to intensive review (as would any other development).

The potential cumulative effects of routine operations and accidental events on these NWR's are essentially the same as those discussed above for the NPS lands. In addition, subsistence hunting and fishing are permitted on all refuges in Alaska and could, therefore, be affected by accidents and routine operations in the immediate vicinity of refuge properties.

## (3) National Forests

The only national forest within the vicinity of the considered planning areas is the Chugach National Forest, which is located mainly on the eastern side of the Kenai Peninsula (Figure III-43). Because there would be no OCS-related development, such as pipelines or other onshore facilities, within the Chugach National Forest, it would not be affected by routine OCS activities associated with lease sales in the Cook Inlet Planning Area. Because of the forest location, oil spills from OCS platforms or pipelines within the Cook Inlet Planning Area would not be expected to affect shoreline areas or other resources within Chugach National Forest.

The Chugach National Forest is in the South Alaska Region adjacent to the Gulf of Alaska (Fig. III-43); it also borders Prince William Sound and is close to Valdez. The Chugach National Forest is, therefore, potentially susceptible to cumulative effects of routine oil-related operations from transport and tanker loading of oil produced (OCS and non-OCS) in other regions (e.g., the Beaufort Sea Planning Area) and transported by pipeline to the Port of Valdez. Potential effects include increased noise and air pollution from tanker traffic.

Additional, non-OCS-related cumulative impacts in the national forest are related to timber harvest and mining operations (e.g., for gold or gravel/stone). However, the impacts of these activities are regulated through a permitting process following an approved resource use plan.

The Chugach National Forest would be potentially susceptible to oil (mostly non-OCS) spilled from tankers that utilize the loading facilities at the Port of Valdez. Oil spills that reached the coastline could affect coastal fauna; subsistence, recreational, and commercial fishing; and tourism. Impacts would depend on the size and timing of a spill and would be expected to be minor to moderate.

### Conclusion

Development of onshore facilities within national park lands in the vicinity of the areas included in the 2007-2012 Leasing Program is considered unlikely, thereby making impacts from cumulative routine OCS operations unlikely in these areas. Offshore construction of pipelines and platforms could contribute to cumulative effects on wildlife and on scenic values for park visitors due to noise and activity levels, particularly in the vicinity of Cook Inlet. However, such effects would be localized, intermittent, and temporary. Although development could be allowed in some units of the Alaska Maritime NWR, it is anticipated that reviews of individual lease sales would minimize the potential for cumulative impacts from routine operations on these areas.

Large oil spills in areas adjacent to the national parks, national wildlife refuges, or national forests, whether from OCS or non-OCS sources, could negatively impact coastal habitats and fauna and could also affect subsistence uses, commercial or recreational fisheries, and tourism.

## j. Population, Employment, and Regional Income

### Routine Operations

The primary potential direct effect of the cumulative case on population, employment, and regional income will be generated by the expected routine OCS oil and gas activity. Basic assumptions for the cumulative case analysis are the same as for the proposed action analysis. The cumulative exploration and development scenario for the South Alaska and Bering Sea Subregions are the same as those for the proposed action; consequently, employment and income for those areas are not different for the cumulative case. The cumulative exploration and development scenario for Arctic Subregion has greater activity than for the proposed action; consequently, employment and income for those areas are greater for the cumulative case. Greater activity for the Arctic translates to greater employment and income in the rest of Alaska and rest of United States. The quantitative estimate of employment and income for the cumulative case is illustrated in Table IV-20.

### Accidents

Consequences from oil spill accidents in the cumulative case are the same as those for the proposed action and alternatives.

### Conclusion

Potential effects on population, employment, and regional income from routine operations and oil spills are expected to be minor except for potential moderate local effects from a large oil spill.

## k. Sociocultural Systems and Subsistence

The cumulative analysis considers effects from past, present, and future OCS oil and gas activities. Also considered are other past, present, and future non-OCS oil and gas activities, such as oil and gas development onshore and in State submerged lands, as well as changes in commercial fishing patterns and maritime shipping. Limited industrialization unrelated to OCS activities may also occur, such as mining or other resource development (see Section IV.B.3.k).

The cumulative effects of OCS and non-OCS activities on sociocultural systems and subsistence practices would be community specific and, in most cases, would not be due to any new industrial (or other) activities. For example, The *Exxon Valdez* oil spill demonstrated that the rural communities of Prince William Sound are susceptible to sociocultural disruption from large-scale, time-compressed events, particularly when they seriously disrupt subsistence resource use. For OCS activities, most supply and support bases would be located near existing industrial infrastructure. Possible exceptions to this pattern may occur in the North Aleutian Basin Planning Area and the western Arctic Subregion (Chukchi Sea). Population and employment changes associated with industrial growth would also be community specific (see Section III.B.13). Industrial enclaves have, in general, reduced local community interaction with industry, and have effectively reduced social disruption. Because of past experience and current industry labor systems, much of the projected development is expected to fit this model and, to the extent that it does, effects would be minimized. The assessment of non-OCS cumulative effects is difficult since all sociocultural systems are in constant flux and change. One of the most serious concerns to subsistence-based communities in all coastal areas is an increased potential for oil spills due to potential construction and operation of new production platforms, pipeline landfalls, shore bases, and processing and waste facilities. Beneficial cumulative effects could come from the potential development of local offshore and onshore natural gas resources that could serve as a needed cost-effective local power source.

Increased industrialization could lead to increased exposure of local residents to social, health and well-being risk factors. Change associated with EuroAmerican contact, including industrial development, has been extensive and relatively compressed in time. More specifically, OCS activities could seriously affect subsistence and, thereby, affect sociocultural systems. Lease stipulations should mitigate many of these effects, as discussed in Section IV.B.3.k. Because subsistence is, to a large extent, the ideological idiom of Alaskan indigenous culture, this is a pivotal category for potential effects. Effects could result from routine exploration, development, and production activities, and more particularly from oil-spill events.

The disruption of marine mammal harvests (primarily walrus, beluga and bowhead whales and seals) could result from potential diversion of these populations' migrations or from other behavioral changes in reaction to regional OCS activities. Lease-sale stipulation measures directed at minimizing the effects of exploration and development activities (such as noise and vessel traffic) on subsistence resources and practices are expected to mitigate potential effects. Since no significant OCS activities have begun in the region, the need for, and effectiveness of, mitigation measures is still speculative. However, such potential development effects are likely to be effectively mitigated through such procedures as conflict avoidance (see Appendix C).

The importance of subsistence activities both in terms of household economy and cultural identity has been discussed in Section III.B.14. Potential direct and indirect effects of the proposed action have also been discussed. Significant cumulative effects on subsistence resource use are possible and likely.

New pipelines might change local subsistence use and could potentially increase competition for subsistence resources by providing access for other user groups. Pipelines and roads can deter subsistence users from using traditional harvest areas and encourage them to use different areas. The cumulative effects from the construction and operation of new offshore platforms, pipelines, pipeline landfalls, shore bases, causeways, docks, and processing and waste facilities could also disrupt but not displace local uses; the scope of this disruption might depend on the extent of meaningful local consultation in project design and location and in the development of appropriate mitigation measures.

An OCS-related oil-spill is not likely (see Table IV-17). However, the possibility of an oil-spill event from both a non-OCS source and an OCS source still poses the greatest potential for cumulative effects. During the 2007-2012 program, the cumulative impact of one or more important subsistence resources becoming unavailable, undesirable for use, or greatly reduced in numbers for a period of 1 or 2 years for one or more Alaska coastal communities is very likely. Thus, potential cumulative effects of OCS activities from a spill are a major concern. Except in limited areas near infrastructure, cumulative effects of OCS and non-OCS activities on subsistence in the region would be confined, for the most part, to oil-spill events.

Oil-spill events could have moderate to major cumulative effects for this region, especially for rural communities. Native communities would be more at risk than non-Native communities because of their dependence on subsistence resources and practices. The potential cumulative effects of large spill events can be extrapolated, in part, from the 1989 *Exxon Valdez* oil spill. Large spill events have the potential to produce major cumulative effects, as evidenced by the continuing aftermath of the *Exxon Valdez* oil spill. Aside from the potential effects of a spill itself, the cleanup effort would also subject the region to social disruption. Potential impacts could be major.

Because of rapid and long-term impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identity, and considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, subsistence-based communities could experience significant cultural stresses in addition to major impacts on population, employment, and local infrastructure. If subsistence livelihoods are disrupted, communities could face increased poverty, drug and alcohol abuse, and other social problems (Langdon, 1995; Peterson and Johnson, 1995; USGCRP, 2000; IPCC, 2001; Callaway et al., 1999; Arctic Research Consortium of the United States, 1997).

If the present rates of climate change continue, changes in diversity and abundance to local flora and fauna could be significant. Because marine and terrestrial animal populations would be particularly vulnerable to changes in snow cover and alterations in habitat and food sources brought on by climate change, rapid and long-term impacts on subsistence resources (availability), subsistence-harvest practices (travel modes and conditions, traditional access routes, traditional seasons and harvest locations), and the traditional diet could be expected (IPCC, 2001; NRC, 2003b).

## Conclusion

The possible cumulative effects of OCS activities on local sociocultural systems could vary greatly but are expected to be small. The cumulative effects of pipelines and associated service facilities on subsistence practices are of greatest concern under normal operations. However, these are expected to be mitigated by local consultation to develop appropriate mitigation measures. Effects from noise and increased vessel traffic could affect the harvest of subsistence resources. However, lease sale stipulations (seasonal activity restrictions) should adequately mitigate this potential effect. The overall cumulative impact of oil spills could be substantial.

## l. Environmental Justice

**Introduction:** The cumulative analysis considers effects from past, present, and future OCS oil and gas activities. Also considered are other past, present, and future non-OCS oil and gas activities, such as oil and gas development onshore and in State submerged lands, as well as changes in commercial fishing patterns, and maritime shipping. Limited industrialization unrelated to OCS activities may also occur, such as mining or other resource development (see Section IV.B.3.k).

The OCS activity is a small part of a petroleum economic sector which remains the major economic driver in the State of Alaska. Like most Alaskan natural resource extraction, petroleum-related activities occur primarily in rural, less populated parts of the State. The label "urban-rural divide" is often used locally to sum up the perceived differences between rural and urban Alaska on a wide range of measures, such as per capita income, quality of housing, level of education, the availability and quality of services, and disparities in health indicators. These differences raise environmental justice (EJ) issues because rural parts of the State are also predominantly Native Alaskan. Moreover, should OCS activities occur, their direct effects will be most evident in coastal areas where many rural Native settlements are located. The non-OCS activities would also be important contributors to these dynamics.

Many mitigation measures have been devised to address the types of impacts that raise EJ issues. Section IV.B.3.l discusses relevant mitigations that have been taken by MMS. Coastal impact assistance programs will continue to funnel Federal offshore lease revenues to local governments. The industry has also taken mitigation measures. Alaska local hire and Native hire preference programs have been implemented to ensure that those who are potentially most adversely affected by a development may also share in its economic benefits. Industry has also developed extensive local outreach programs, partially in response to lease stipulations developed by MMS in consultation with potentially affected local groups—for example, agreements to shutdown drilling operations when subsistence whaling is underway.

The importance of subsistence activities to household economy, cultural identity, and health has been discussed in Sections III.B.14 and IV.B.3.k. Potential direct and indirect effects of the proposed action have also been discussed, such as harvest disruptions due to noise or increased competition due to access roads. Significant cumulative effects on sociocultural systems and subsistence-resource use are possible and likely, as described in the cumulative effects discussion for sociocultural systems and subsistence (Section IV.L.3.k).

The OCS activities could contribute to cumulative effects in several ways. These activities have the potential to disrupt marine mammal harvests (primarily walrus, seals, and beluga and bowhead whales) by diverting marine migrations or by causing other behavioral changes such as increased wariness. The greater the degree of OCS development, the more probable and more pronounced such effects are likely to be. However, lease-sale stipulation measures directed at exploration and development activities should help minimize effects to subsistence resources and practices. No significant OCS production has yet begun in the region, hence, the need for and effectiveness of mitigation measures is still speculative. However, it is likely that such potential development effects can be effectively mitigated.

Oil-spill events in the region, and related cleanup activities, pose the greatest potential for cumulative EJ effects. While the probability of an OCS-related oil spill is low in the cumulative case, the probability of an oil spill from non-OCS and OCS-related sources is high. Thus, in the cumulative case, potential EJ cumulative effects from OCS activities could possibly be serious since spill events potentially affect natural resource harvests, which could cause disproportionate, highly adverse environmental and health effects on minority, low-income populations in the region.

Potential long-term climate change impacts on marine and terrestrial ecosystems are most pronounced in Arctic Subregion but could affect subsistence-based indigenous communities in South Alaska and the Bering Sea Subregions and should be seen as an anticipated additive contribution to cumulative EJ impacts.

**Human Health:** Cumulative effects on human health would derive from the socioeconomic and sociocultural consequences of onshore economic development (including petroleum and other industries), from OCS development, from long-term climate change, and from impacts to subsistence, degradation of air quality, and pollutant emissions that would come from these many sources. While many consequences will be possible (e.g., a tax base that supports health programs), EJ considers detrimental outcomes. Effects which should be considered would include:

- Increasing rates of diabetes and metabolic problems, and the resultant increases in cardiovascular and cerebrovascular disease, chronic renal disease and renal failure, and peripheral vascular disease. The degree to which these problems occur would depend on a complex interplay of sociocultural change and impacts in the cumulative case which may include (1) displacement of subsistence foods in the diet and (2) impacts from industrial activities and global warming on subsistence harvests.
- Displacing subsistence from its primary place in the diet. Public health professionals in Alaska worry that, given the prevalence of other risk factors for metabolic problems (including a likely genetic predisposition, high smoking rates, and relatively high rates of obesity), displacing subsistence from its primary place in the diet could trigger a severe epidemic of these problems; such as has been observed in many Tribes in the lower 48 States.
- Increasing social pathology. To a some degree, this would depend on the balance between positive aspects of development (including economic opportunity, improvements in infrastructure, employment and educational opportunity) and the adverse aspects, such as increasing economic disparity within communities, economic depression under the "boom and bust" cycle often associated with resource development in regions with little other established economic potential, and sociocultural impacts leading to acculturation stresses and importation of drugs and alcohol into the community.
- Increasing injury rates. If social pathology increases, we may see an increase in accidents and intentional injuries, reflecting more prevalent alcohol and substance abuse, as well as an increase in risk-taking behavior.
- Increasing respiratory problems related to incremental degradation of air quality near villages and around subsistence areas. This can best be addressed through a commitment to a strict adherence to the best available emissions control technologies and improved monitoring programs.
- Increasing rates of contaminant-related cancers, endocrine problems, and neurodevelopmental deficits. Current public health strategies rely on preventing exposure. This can best be accomplished through a combination of improved monitoring of health outcomes and pollutant levels in subsistence game, and requirements to minimize emissions through utilization of the best available control technology.

Ultimately, the most effective strategies to protect human health will depend on (1) developing a monitoring strategy which identifies and tracks important regional health indicators and (2) continuing to develop a more detailed understanding of the ways in which the determinants of health are impacted by development. In turn, this understanding may inform efforts to both refine existing mitigation measures and develop new measures which target health outcomes and health determinants specifically. The MMS is committed to pursuing effective strategies for mitigating impacts to human health in cooperation with the Tribes, the NSB, the Alaska Inter-Tribal Council, and other State and Federal Agencies and institutions.

**Conclusion**

In summary, OCS and non-OCS activities could have high adverse environmental and health effects if a large oil spill were to occur because oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Mitigation measures have been developed to help alleviate these effects and to avoid conflict with Native subsistence activities, but such risks and effects may never be completely eliminated. Because potential cumulative impacts on marine and terrestrial ecosystems in the region could affect subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities would be expected to experience disproportionate, highly adverse environmental and health effects.

## m. Archaeological Resources

The following analysis considers the effects of trawling, channel dredging, non-OCS construction projects, and activities associated with the proposed action, and prior and future OCS sales in the Alaska Region. Specific types of impact-producing factors related to OCS mineral development considered in this analysis include drilling rig and platform emplacement, pipeline emplacement, new onshore facilities, and oil spills. The effects of natural geologic processes such as ice gouging and thermokarst erosion on the archaeological resource base of the Alaska Region are also considered.

### (1) Prehistoric Resources

Offshore development could result in an interaction between a drilling rig, platform, pipeline, or anchors and an inundated prehistoric site. This direct physical contact with a site could destroy artifacts or site features and could disturb the stratigraphic context of the site. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts between northeast Asia and the Americas.

The MMS currently requires that an archaeological survey be conducted prior to development of mineral leases determined to have potential for prehistoric archaeological sites. Relative sea-level data, which are used to define the portion of the continental shelf having potential for prehistoric sites, are sparse in the Alaska Region; however, the data that do exist suggest that the portion of the continental shelf shoreward of about the 60-m isobath would have potential for prehistoric sites. It is assumed that the archaeological survey has effectively mitigated most impacts from routine operations related to OCS mineral exploration activities. However, impacts to prehistoric resources may have resulted from OCS routine activities prior to the implementation of the archaeological survey requirement, but the magnitude of this possible impact is impossible to quantify.

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified prehistoric sites. This direct physical contact with a prehistoric site could cause physical damage to, or complete destruction of, information on the prehistory of the region and North America. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites have been located, evaluated, and mitigated prior to construction. However, impacts to coastal prehistoric resources may have resulted from onshore construction activities prior to enactment of the archaeological resource protection laws, but the magnitude of this possible impact is impossible to quantify.

Trawling activity in the Alaska Region only affects the uppermost portion of the sediment column (Krost, et al. 1990). This zone would already be disturbed by natural factors relating to the destructive effects of marine transgression and continuing effects of wave and current action. Therefore, the effect of trawling on most prehistoric archaeological sites would be minor.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for prehistoric archaeological sites as they are usually associated with drowned river valleys, which are known to have a high probability for prehistoric sites. It is assumed that some of the archaeological data that have been lost as a result of dredging have been significant and unique; therefore, the impact to prehistoric archaeological sites as a result of past channel dredging activities has probably been moderate to major. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

Natural geologic processes such as ice gouging and thermokarst erosion have caused and will continue to cause a significant loss of prehistoric archaeological data in the Alaska Region. The largest ice gouges on the Beaufort Sea shelf can disturb sediments as deep as 4 m below the seafloor, but the average depth is about 0.5 m (Barnes, 1984). Coastal prehistoric sites are exposed to the destructive effects of thermokarst erosion. These natural processes would cause artifacts to be dispersed and the site context to be disturbed or even completely destroyed, resulting in the loss of archaeological information. Overall, a significant loss of data from submerged and coastal prehistoric sites has probably occurred, and will continue to occur, from the effects of natural geologic processes in the Alaska Region. It is assumed that some of the data lost have been significant and/or unique, resulting in a major level of impact.

An accidental oil spill could impact coastal prehistoric archaeological sites. Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, the Alaska coastline has not been systematically surveyed for archaeological sites.

Heavy oiling of a coastal area (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in $^{14}C$ dating, and, although there are methods for cleaning contaminated $^{14}C$ samples, greater expense is incurred (Dekin et al., 1993). The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant archaeological information could result from the contact between an oil spill and a prehistoric archaeological site, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities; therefore, the cumulative impact from oil spills to prehistoric archaeological sites would probably be moderate.

## (2) Historic Resources

Direct physical contact between a routine activity and a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

The MMS currently requires that an archaeological survey be conducted prior to development of mineral leases when a historic-period shipwreck is reported to lie within or adjacent to the lease area. It is assumed that the archaeological survey has effectively mitigated most impacts from routine operations related to OCS mineral exploration activities. However, impacts to historic-period shipwrecks may have resulted from OCS routine activities prior to the implementation of the archaeological survey requirement, but the magnitude of this possible impact is impossible to quantify.

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified historic sites. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites that would have been impacted have been located, evaluated, and mitigated prior to construction. However, impacts to coastal historic sites may have resulted from onshore construction activities prior to enactment of the archaeological resource protection laws, but the magnitude of this possible impact is impossible to quantify.

Trawling activity in the Alaska Region only affects the uppermost portion of the sediment column (Krost, et al., 1990). On many wrecks, this zone would already be disturbed by natural factors and would contain only artifacts of low specific gravity which have lost all original context. Therefore, the effect of trawling on most historic shipwreck sites would be minor.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for historic shipwrecks. Assuming that some of the data lost have been unique, the impact to historic sites as a result of past channel dredging activities has probably been moderate to major. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

Natural geologic processes such as ice gouging, and thermokarst erosion have caused and will continue to cause a significant loss of historic data in the Alaska Region. Ice gouges on the Beaufort Sea shelf can create a furrow up to 67 m wide and 4 m deep; however, the average ice gouge is about 8 m wide and 0.5 m deep (Barnes, 1984). If a shipwreck were to occur in an area of intense ice gouging, it would be destroyed. Coastal historic sites are exposed to the destructive effects of thermokarst erosion, causing artifacts to be dispersed and the site context to be disturbed or even completely destroyed. Overall, a significant loss of data from submerged and coastal historic sites has probably occurred, and will continue to occur, from the effects of natural geologic processes in the Alaska Region. It is assumed that some of the data lost have been significant and/or unique, resulting in a major level of impact.

An accidental oil spill could impact a coastal historic site, but the direct impact of oil on most historic sites would be temporary and reversible. The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant historic information could result from oil spill cleanup activities, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities; therefore, the cumulative impact from oil spills to historic archaeological sites would probably be moderate.

### Conclusion

Under the cumulative scenario, the potential impacts to both prehistoric and historic archaeological sites from routine activities in the Alaska Region should be largely eliminated due to archaeological surveys which are required prior to disturbance. However, routine activities that were approved prior to initiating the survey requirement may have impacted significant archaeological sites, but the magnitude of this possible impact is impossible to quantify. Of the non-OCS related factors that impact archaeological sites, channel dredging and natural geologic processes, such as ice gouging and thermokarst erosion, could damage both prehistoric and historic sites. The primary oil-spill impacts to both prehistoric and historic archaeological sites would result from cleanup activities. The incremental contribution of the proposal to the cumulative impacts on archaeological resources should be very small due to the archaeological surveys that are required prior to disturbance.

## n. Land Use and Infrastructure

Under the proposed action, localized site-dependent impacts to land use and existing infrastructure are anticipated as a result of the construction of pipelines, a dock/causeway, and oil and gas processing facilities, as well as the possible addition or expansion of shore bases and road networks (see Section IV.B.3.n). Impacts from these activities could include increased air and boat traffic, modifications to current land-use designations to incorporate new facilities, and infrastructure expansion to accommodate transportation, housing, and community needs. Similar activities are associated with current and planned OCS sales in the Alaska Region and would occur during the life of the proposed 2007-2012 program (Table IV-15). In the Arctic Subregion (Beaufort Sea and Chukchi Sea Planning Areas), the activities associated with the proposed action would represent approximately 25-100 percent of such OCS activities. In the Bering Sea Subregion (North Aleutian Basin Planning Area) and South Alaska Subregion (Cook Inlet Planning Area), the activities associated with the proposed action represent 100 percent of the cumulative OCS activities.

Non-OCS activities that are ongoing and expected to continue into the foreseeable future and that could have an impact on land use and infrastructure 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 vessel traffic (e.g., commercial shipping, recreational boating, military training and testing) (Section IV.L.1.b).

Non-OCS activities and proposed, current, and planned OCS activities are consistent with past activities and represent a continuation of existing onshore and offshore oil and gas construction trends in the Arctic and South Alaska Subregions. Substantial infrastructure for related oil and gas development exists in both of these areas, including platforms, exploration and production wells, pipelines to transport oil from offshore platforms to common-carrier pipeline systems onshore, and processing facilities. Depending on the location of proposed new platforms in these two areas, substantial land disturbance could result from the construction of up to 160 miles of onshore pipeline and associated access roads (ice roads and paved roads) and bridges in the Beaufort and Chukchi Sea

Planning Areas and up to 75 miles of onshore pipeline under the proposed action for the Cook Inlet Planning Area. Although this activity is consistent with the expansion of other oil and gas activity in the Arctic area, the new pipeline could create access into previously undeveloped lands used primarily for subsistence (see Section IV.B.3.k on subsistence). In the North Aleutian Basin Planning Area, the land is largely undeveloped, and there is no established oil and gas infrastructure. Therefore, development in this area is more likely to result in land-use and infrastructure impacts, such as the conversion of existing land use (e.g., undeveloped, residential, or commercial) to industrial land use to accommodate a shore base with associated dock and causeway, processing and waste facilities, and a new LNG facility; expansion of housing and community infrastructure to accommodate the new industry; and increased air, water, and land traffic for onshore construction and offshore development. However, in all four planning areas, location-specific impacts could be significant if transportation systems (ports, airstrips, and roads) and other infrastructure (utilities, housing, support services) become overstressed; if certain lands are developed and no longer available for other uses, such as natural areas used for recreation or preserved for wildlife habitat; or if infrastructure development creates new access routes (airstrips, ice roads, paved roads) that provide access to previously relatively inaccessible lands used for subsistence.

In addition, oil spills associated with OCS and non-OCS activities, as well as naturally occurring seeps, could also impact land use and infrastructure but would not likely result in long-term changes to these resources. The majority of the releases identified under the proposed action are anticipated to be small ($\geq$ 1 bbl and < 50 bbl). Potential cumulative impacts to land use and infrastructure resulting from spills include stresses of spill response on the community infrastructure, direct land-use impacts (e.g., oil contamination of a national wildlife refuge or recreational port), increased traffic to respond to cleanup operations, and restricted access to particular lands while cleanup is conducted. These impacts could be less in Cook Inlet and the Beaufort and Chukchi Sea Planning Areas, as existing port and other facilities and infrastructure developed for oil and gas development are available. New facilities would need to be established in the North Aleutian Basin Planning Area; otherwise, spill response would be remotely based without access to rapid containment and would further increase the potential for impacts of increased air and boat traffic in order to respond.

## Conclusion

Cumulative activities have the potential to affect land use and infrastructure. Alterations to land use in the Beaufort and Chukchi Sea Planning Areas would not necessarily be incompatible with current land-use activities, as the proposed activities are largely consistent with existing ones. While access to new areas could have an effect on subsistence practices, it would not prevent those practices from occurring. The North Aleutian Basin Planning Area would likely experience the greatest effects of land use change due to its relatively undeveloped status, the possibility of new onshore pipelines and infrastructures such as an LNG facility, and current lack of spill response facilities. Cumulative activities in the Cook Inlet Planning Area are not likely to result in large land-use changes and represent a continuation of existing land-use and infrastructure trends.

Oil spills could alter land use temporarily in all areas, but would not likely result in long-term changes. The magnitude of impacts would depend on the size and location of the spill. Impacts of the proposed OCS activities are likely to be a small increment above existing impacts from oil and gas activities already occurring in the Beaufort and Chukchi Sea and Cook Inlet Planning Areas. However, changes to land use and infrastructure in the North Aleutian Basin Planning Area would be noticeable since no similar infrastructure yet exists in that region.

## o. Tourism and Recreation

A number of activities associated with the proposed action could result in impacts to tourism and recreation in Alaska (see Section IV.B.3.o). These activities include platform, pipeline, causeway, and facility construction and vessel traffic. Impacts associated with these activities could include interference with water-based recreational activities (fishing, boating, sightseeing, cruise ships); limited disruption to land-based activities (hiking, picnicking, hunting, visiting Native communities, camping, wildlife viewing, and sightseeing), depending on the location of recreational activities relative to proposed development; increases in amounts of trash and debris from OCS activities; and possible competition between workers and tourists for local services, such as air transport, hotel accommodations, and other visitor services. Similar activities are associated with future lease sales on the Alaska OCS that would occur during the life of the 2007-2012 program (see Table IV-15).

Non-OCS activities that are ongoing and expected to continue into the foreseeable future and that could have an impact on tourism and recreation 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 vessel traffic (e.g., commercial shipping, recreational boating, military training and testing) (Section IV.L.1.b).

Non-OCS activities and proposed and future OCS activities represent a continuation of existing onshore and offshore oil and gas construction trends in the Arctic Subregion (Beaufort Sea and Chukchi Sea Planning Areas) and in the South Alaska Subregion (Cook Inlet Planning Area). Substantial infrastructure for related oil and gas development already exists in both of these areas, including platforms, exploration and production wells, pipelines to transport oil from offshore platforms to common-carrier pipeline systems onshore, and processing facilities; therefore, there should be little additional visual disruption for the tourists in these areas. Depending on the location of proposed new platforms in these areas, substantial land disturbance could result from the construction of up to 500 miles of onshore pipeline and associated access roads (ice roads and paved roads) and bridges in the Arctic and up to 75 miles of onshore pipeline in the Cook Inlet Planning Area. Although this activity is consistent with the expansion of other oil and gas activity in these areas, the pipeline construction would present a temporary disruption to tourism and recreation due to workers competing with tourists for short-term housing (hotels) and air transport; aesthetic impacts (visual and auditory) associated with construction sites; and possible temporary prevention of access to some recreational or wilderness areas. These impacts are more likely in the Cook Inlet Planning Area than in the Arctic Subregion because of the better established tourism and recreation industry in the former. In addition, the new pipeline in the Arctic Subregion could create road access into previously undeveloped lands used primarily for subsistence, creating a potential conflict between subsistence practices and recreational hunting or other possible tourist activities. In the Bering Sea Subregion (North Aleutian Basin Planning Area), the land is largely undeveloped, and there is no established oil and gas infrastructure. New development in this area for both OCS and non-OCS activities could affect the small tourism and recreation industry that is focused on wilderness recreation, fishing, and visiting Native communities. Influxes of temporary workers and construction personnel could temporarily monopolize many of the flights to the region and overstress community infrastructure (e.g., hotel accommodations, restaurants, emergency services) until new facilities are established. The impacts of these activities on tourism and recreation would depend on the timing, location, and duration of the proposed activities.

In addition, oil spills associated with OCS and non-OCS activities, as well as from naturally occurring seeps, could also impact recreation and tourism, and could result in both short-term and long-term effects, depending on public perception and reaction (see Section IV.B.3.o). Potential cumulative impacts include direct land impacts (e.g., oil contamination of a national wildlife refuge or recreational port); aesthetic impacts of the spill and associated cleanup; increased traffic to respond to cleanup operations; and restricted access to particular lands while cleanup is being conducted. These impacts could be less in the Arctic Subregion where there is a smaller tourist industry and where existing port and other facilities and infrastructure developed for oil and gas development are available to ensure quick response. These facilities also exist in the Cook Inlet Planning Area; however, the active recreation and tourism industry in this area makes the area much more sensitive to the aftermath of an oil spill. New facilities would need to be established in the North Aleutian Basin Planning Area, otherwise spill response would be remotely based without access to rapid containment and would further increase the potential for impacts to recreation (e.g., possible increased access restrictions, visual impacts for longer period of time, increased air and boat traffic).

### Conclusion

Cumulative activities have the potential to affect recreation and tourism. Proposed activities in the Beaufort Sea and Chukchi Sea Planning Areas are consistent and compatible with current activities, and the tourism industry is rather limited in this area. Introducing possible tourist access to new areas in this region by creating new road access along new pipelines could have an indirect effect on subsistence practices. The North Aleutian Basin Planning Area would experience some impact due to its relatively undeveloped status and current lack of onshore infrastructure including spill response facilities. Infrastructure changes in this planning area would be noticeable to the recreation and tourism community, as no similar infrastructure yet exists in that region, and competition for accommodations and air transport may slow tourism for a time. Cumulative activities in the Cook Inlet Planning Area are not likely to result in substantive impacts to tourism and recreation, as the proposed oil and gas activities there represent a continuation of existing trends and the growth of the tourism industry is expected to continue to outpace that of the oil and gas industry. Impacts of the proposed OCS activities are likely to be a small increment above existing impacts from oil and gas activities already occurring in the Arctic and in the Cook Inlet planning areas.

Oil spills could affect recreation and tourism temporarily in all areas, but would not likely result in long-term effects, depending on public perception and reaction. The magnitude of impacts would depend on the size, location, and timing of the spill. The greatest impacts would be expected to occur should a spill occur in popular tourist areas during the main tourist season.

## p. Fisheries

As identified in Section IV.B.3.p, impacts to commercial and recreational fisheries could result from activities or accidents that cause changes in the distribution or abundance of fishery resources, reduce the catchability of fish or shellfish, preclude access to viable fishing areas, or cause losses or damage to equipment or vessels. In considering the potential cumulative effects on fishery resources, the level of routine activities and the potential for accidental spills in OCS waters of the Alaska Region under the proposed action would represent an incremental increase in the overall level of activities associated with current and planned OCS sales that would occur during the 40-year life of the Proposed Program (Section IV.L.1).

As identified in Section IV.L.3.f, it is anticipated that routine OCS activities from ongoing, planned, and proposed actions within the considered areas would be unlikely to have detectable cumulative effects on the overall distributions, population levels, or catchability of fishery resources because of the limited timeframe over which most individual activities would occur and the small proportion of available habitats that would be affected during a given period. The relatively dispersed geographic distribution of activities among the three Alaska Subregions would also tend to reduce the potential for routine OCS activities to affect the same stocks of fishery resources in the different Alaskan planning areas. However, some highly localized effects on distributions, abundance, or catchability of some fishery resources within individual planning areas could occur from routine OCS activities such as construction, seismic surveys, and discharges (Section IV.B.3.p).

Some OCS exploration, development, and production activities have a potential to result in space-use conflicts with fishing activities. In some cases, fishing vessels could be excluded from normal fishing grounds for safety reasons during construction periods or after facilities are in place. In other instances, boat captains, fishery crews, or anglers could decide to avoid certain areas (e.g., seafloor areas where pipelines have been placed or areas where seismic surveys are being conducted) to reduce the potential for gear loss. Such conflicts can sometimes be avoided by conducting construction activities or seismic surveys during closed fishing periods or seasons. A potential also exists for loss of gear or loss of access to fishing areas when floating drill rigs used for exploration are being moved and during other vessel operations.

While compensation for loss or damage of commercial fishing gear attributable to offshore oil and gas operations may be available in some cases, the MMS cannot ensure that such reimbursements would occur. Most space-use conflicts would be avoided by compliance with existing navigation rules. In order to further address space-use conflicts, a stipulation for protection of fisheries has been implemented that requires lessees to review planned exploration and development activities with potentially affected fishing organizations and port authorities in order to prevent unreasonable fishing gear conflicts (Appendix C). Under this stipulation, there is also an ability to restrict lease-related uses, if deemed necessary, to prevent unreasonable conflicts with commercial fishing operations.

Offshore construction of platforms or artificial islands could infringe on commercial fishing activities by excluding commercial fishing from adjacent areas due to safety considerations. It is assumed that the proposed action could result in construction of up to 10 artificial islands in the Alaskan Arctic OCS, up to 2 platforms in the Cook Inlet Planning Area, and up to 6 production platforms in the North Aleutian Basin Planning Area (Table IV-15). If it is assumed that a safety zone of 500 m needs to be maintained by larger vessels around each structure (or an area of approximately 80 ha per structure), commercial fishing could be excluded from up to 1,440 ha of surface area within these areas. Drilling discharges associated with exploration activities would likely affect only a small area near drilling platforms or islands, and are not expected to interfere with commercial fishing. During development and production phases, potential effects of such discharges would cease because all muds, cuttings, and produced waters would be discharged into wells instead of being released to open waters. Potential effects of platform construction and operation are expected to be highly localized. Because only a very small area of the individual planning areas would be affected, interference with commercial fisheries is expected to be small.

Potential cumulative effects of OCS activities that could affect freshwater anadromous fish habitats (e.g., onshore pipeline construction) are discussed in Section IV.L.3.f. As identified in that section, compliance with existing permitting requirements by the State of Alaska and with various Alaska Coastal Management Program policies should reduce the potential for adverse effects in anadromous fish streams.

Various non-OCS activities, including State oil and gas programs, dredging and disposal of dredging spoils in OCS waters, logging operations, and commercial or sport fishing activities, could also contribute to cumulative effects on fisheries. These effects would be similar to those described in Section IV.L.3.f. Drilling of wells under State oil and gas programs would also require construction of pipelines and artificial islands or platforms in Alaskan waters. Potential effects on fishery resources and on space-use conflicts from State oil and gas activities would be similar to those described above for OCS oil and gas activities. Non-OCS dredging and marine disposal activities would involve excavation of nearshore sediments and subsequent disposal in offshore or nearshore areas, thereby disturbing seafloor habitats in some areas and burying benthic organisms that help to support fishery resources. Logging operations have a potential to contribute to cumulative effects on fishery resources by degrading riverine habitats that are important for salmon reproduction and the rearing of juveniles. It is anticipated that the potential effects of these non-OCS activities on fishery resources would be addressed through State and Federal regulations and policies.

As identified in Section IV.L.3.f, commercial fishing and, to a lesser degree, sport and subsistence fishing have a potential to contribute substantially to cumulative effects on the abundance of some fishery resources within Alaskan waters. The potential effects of such activities on fishery resources are controlled primarily through management actions taken by the Alaska Department of Fish and Game and the North Pacific Fishery Management Council of the National Marine Fisheries Service. In a sense, these agencies strive to address the potential cumulative effects of all activities that could affect the abundance of fishery resources by managing the duration of fishing seasons (including closing fisheries) and other harvest regulations in response to changes in stocks of fishery resources.

The proposed action would contribute approximately 67 percent of the spills assumed for the OCS cumulative scenario in the Beaufort Sea and Chukchi Sea Planning Areas and 100 percent of the OCS spills in the Cook Inlet and North Aleutian Basin Planning Areas (Table IV-17). It is anticipated that up to 170 small spills (≥ 1 bbl and < 50 bbl) could occur as a result of all OCS activities under the cumulative scenario, with up to 120 of these assumed to occur as a consequence of the proposed action. It is further assumed that up to 19 medium-sized (50 to 999 bbl) and up to 5 large-sized (1,000 to 4,600 bbl) OCS spills could occur under the cumulative scenario.

Non-OCS activities, such as State oil and gas development, domestic transportation of oil or refined petroleum products, and commercial shipping, may also result in accidental spills that could affect fisheries within the waters of the Alaska Region. As with accidental spills from OCS activities, it is anticipated that the majority of non-OCS spills would be relatively small. However, accidents involving tankers carrying large quantities of oil or oil products could release substantially more oil into Alaskan waters than is assumed for the OCS spill scenario identified above.

Fisheries resources could become exposed to oil as a consequence of accidental oil spills. Multiple small spills or a single large spill could cause declines in subpopulations of some species inhabiting the affected planning areas, although the level of effects would depend on a variety of factors. It is anticipated that there would be no long-term effects on overall fish populations in Alaskan waters as a result of such spills. However, even localized decreases in stocks of fish could have effects on some fisheries by reducing catch or increasing the amount of effort or the distances that must be traveled to obtain adequate catches.

Even if fish stocks are not reduced as a consequence of a spill, specific fisheries could be closed due to actual or perceived contamination of fish or shellfish tissues. Depending on the timing and duration of such closures, this could result in considerable loss of income for commercial fisheries. It is anticipated that most small to medium spills would have limited effects on fisheries because of the relatively small areas likely to be exposed to high concentrations of hydrocarbons and the short period of time during which oil slicks would persist.

In the event of a large spill, commercial, recreational, or subsistence fisheries for shellfish in nearshore subtidal and intertidal areas that become oiled are likely to be affected. Fisheries for shellfish that occur in deeper waters, where oil concentrations would likely be too low to cause direct effects on biota, are less likely to be affected. Regardless, even shellfish from deeper areas could become commercially unacceptable for market due to actual or perceived contamination and tainting.

Oil spills that enter nearshore waters could also damage setnet fisheries, as evidenced by the *Exxon Valdez* oil spill of 1989. While only a relatively small volume of weathered oil entered the lower Cook Inlet region as a result of that spill, the commercial salmon fishery was closed to protect both gear and harvest from possible contamination. Within the considered Alaska planning areas, a spill the size of the assumed largest OCS spill (4,600 bbl) could similarly result in temporary closures to commercial and subsistence setnet fishing until cleanup operations or natural processes reduced oil concentrations to levels considered safe.

Although pelagic fishes would be less likely to be affected than fishes in shallow subtidal or intertidal areas, spilled oil could contaminate gear used for pelagic fishing, such as purse seines and drift nets. A large oil spill before or during the season when such fishing gears are in use could result in closures of some short-period, high-value commercial fisheries in order to protect gear or harvests from potential contamination. Lines from longline fisheries for halibut, Pacific cod, black cod, and other fish species in the Cook Inlet and North Aleutian Basin Planning Areas could also be affected by oil. Some lines and buoys fouled with small amounts of oil could be unfit for future use. Although it is unlikely that a trawler would be operating in an oiled area, the trawl catches could be contaminated by oil and rendered unfit for consumption and unprofitable if passed through such an area.

## Conclusion

It is anticipated that the proposed action would represent a small increment to the potential for overall cumulative effects on fisheries in Alaskan waters. The MMS has implemented a stipulation that promotes protection of fisheries and requires lessees to review planned exploration and development activities with potentially affected fishing organizations and port authorities; this stipulation would limit space-use conflicts for fisheries. Because of the limited timeframe over which most individual activities would occur and the small proportion of available fishery areas that would be affected during a given period, it is anticipated that the OCS contribution to cumulative effects on fisheries associated with routine operations would be relatively small. Non-OCS activities, including State oil and gas development, commercial fishing, and sportfishing, could also contribute to cumulative effects on fisheries.

The level of effects from accidental spills would depend on the location, timing, and volume of spills, spill response activities, and other environmental factors. The proposed action would represent a small increment in the cumulative risk that an oil spill could (1) affect fishery resources as a whole, although the risk of large spills could increase substantially in some areas where oil and gas development activities are not currently occurring or are more limited (e.g., the North Aleutian Basin); or (2) result in closure of fisheries in Alaskan waters. Small spills that could occur under the cumulative OCS scenario are unlikely to have a substantial effect on fishing before dilution and weathering reduced concentrations of oil in the water; consequently, it is anticipated that small spills would not have extensive or long-term effects on fisheries in Alaskan waters.

It is anticipated that large spills, as assumed under this alternative (up to 4,600 bbl), would affect only small proportions of any given fishery resource population within Alaskan waters, although larger temporary effects on local stocks could occur if important habitat areas were contaminated. However, depending on specific conditions during a large spill, there could be substantial economic losses for commercial fisheries as a consequence of reduced catch, loss of gear, or loss of fishing opportunities during cleanup and recovery periods. Non-OCS sources of spills, including State oil and gas production, have a potential to cause similar effects. The occurrence of a very large spill, such as could occur from a tanker accident in southern Alaskan waters, could have substantially greater effects on fisheries.

# 4. Atlantic Region

## a. Air Quality

The cumulative analysis considers the impacts from all future OCS oil and gas development, OCS emission sources not related to oil and gas activities, and onshore emissions.

Onshore emission sources include power generation, industrial processing, manufacturing, refineries, commercial and home heating, and motor vehicles. Nationwide, emissions of nitrogen oxides ($NO_x$), sulfur dioxide ($SO_2$), volatile organic compounds (VOC), and particulate matter less than 10 microns in diameter ($PM_{10}$) have decreased steadily over the last few decades. Emission tabulations by State may be found at http://www.epa.gov/air/data/geosel.html.

The Norfolk-Virginia-Beach-Newport News-Hampton Roads area is classified marginal nonattainment for ozone ($O_3$). Emissions have to be reduced by control measures contained in a State Implementation Plan (SIP). The area is required to attain the $O_3$ standard by 2007.

The USEPA has promulgated a series of measures to reduce regional and nationwide emissions. These include emission standards for large industrial engines; commercial marine engines, small engines such as leaf blowers, lawn mowers, and tractors; nonroad diesel engines; offroad recreational vehicles; and recreational boats. In the year 2000, phase 2 of the Acid Rain Rule (Title IV) went into effect. Under this rule, emissions of $SO_2$ and $NO_x$ from powerplants in the eastern half of the United States are projected to continue a downward trend over the next decade. In 2005, the USEPA finalized the Clean Air Interstate Rule that applies to 28 States in the East, Midwest, and South and the District of Columbia. This rule will place additional limitations on $NO_x$ and $SO_2$ emissions from powerplants. The effects of these various regulations and standards would tend to result in a steady, downward trend in future air emissions. This trend should be realized in spite of continued industrial and population growth.

Existing visibility in the eastern United States is impaired due to fine particulate matter containing primarily sulfates and carbonaceous material. The absorption of water by the particulate matter makes them grow to a size that enhances their ability to scatter light and, hence, aggravates visibility reduction. The estimated natural mean visibility in the eastern United States is 60-80 miles (Malm, 1999). The observed mean visual range in the mid Atlantic coastal area is about 20 miles (Malm, 2000). More than 70 percent of the human-induced visibility degradation in the region is attributed to sulfate particles, while about 15 percent of the visibility degradation is from organic or elemental carbon particles. About 8 percent of the visibility impairment is attributed to nitrate particles (Malm, 2000; USEPA, 2001a).

In July 1999 the USEPA published final Regional Haze Regulations to address visibility impairment in the Nation's national parks and wilderness areas (64 FR 35714). These regulations established goals for improving visibility in Class I areas through long-term strategies for reducing emissions of air pollutants that cause visibility impairment. The Regional Haze regulations along with the rules on $O_3$ and acid rain should result in a lowering of regional emissions and improvement in visibility.

Exploration drilling, construction activities, and production platforms would result in a small increase in levels of $NO_2$, $SO_2$, and $PM_{10}$ in the nearest onshore areas. Concentrations would be within the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments. The potential effects on $O_3$ concentrations in the region would be very small because of the relatively low emissions from the proposed actionm, and emission sources within 25 miles from the State seaward boundary would be offset. Air quality impacts from OCS activities in the cumulative case would be the same as those for the 2007-2012 program.

Impacts from oil spills for the cumulative case would be also similar to those for the 2007-2012 program. Since impacts from individual spills would be localized and temporary, the magnitude of impacts would be no different from those associated with the proposed action.

### Conclusion

Air quality in the Virginia coastal area has suffered some degradation due to existing onshore emission sources, but some improvement is expected in the future as more stringent air pollution control requirements are being phased in. The contribution of OCS program activities to air pollutant concentrations would be very small and would not exceed any standards. Air quality impacts from oil spills would be localized and of short duration.

## b. Water Quality

### (1) Coastal Waters

As discussed previously, the primary contaminants of concern in mid-Atlantic coastal waters are nitrogen and phosphorus. In addition to these nutrients, high bacterial loads and potentially toxic organic chemicals and metals are significant concerns. The overwhelming majority (over 80%) of the contaminants found in coastal waters originate from land-based sources (U.S. Commission on Ocean Policy, 2004). Large quantities of contaminants originating on land are flushed daily into coastal waters from nonpoint source runoff and point source discharges. Additionally, atmospheric deposition of contaminants originating from land activities, including industrial operations, agricultural processes, automobile use, and natural sources such as forest fires and lightning, can have a large impact on coastal water quality.

Nonpoint source runoff consists of contaminants carried into coastal waters from precipitation events. Due to the high amount of land used for agricultural and urban uses in mid-Atlantic watersheds, non-point source runoff is the largest source of contaminants in mid-Atlantic coastal waters. Point source discharges into mid-Atlantic coastal waters come from wastewater treatment plants, industrial facilities, and animal feeding operations. The effluent from point source discharges can include nutrients, organic compounds, heavy metals, suspended sediments, and high bacteria loads.

Atmospheric deposition of contaminants in mid-Atlantic coastal waters includes deposition of emissions containing $NO_x$, $SO_x$, VOC and $PM_{10}$. Atmospheric deposition accounts for 10-50 percent of all nitrogen entering estuaries along the Mid-Atlantic Planning Area (U.S. Commission on Ocean Policy, 2004). Other major contaminants deposited from atmospheric origins include metals and persistent toxins.

The proposed OCS lease sale in the Mid-Atlantic Planning Area would contribute to land-based sources of coastal water contamination by the use of existing service, support, and processing facilities in the Hampton Roads area, and the construction of a new gas processing facility. These activities would contribute a small incremental amount of nutrients, bacterial loads, potentially toxic organic chemicals and metals via onshore point source and nonpoint source discharges, and atmospheric deposition into mid-Atlantic waters. The overall cumulative effect of these contaminants, in context with all other sources, would be negligible to minimal.

Atmospheric deposition of contaminants into coastal waters, especially nitrogen and sulfur, also occurs from marine vessels. In addition to atmospheric deposition of emissions, marine vessels discharge waste streams composed of untreated sewage and some toxic materials, bilge water, and oil releases from routine vessel operations and accidental spills. Approximately 80 percent of vessel emissions are estimated to occur within 200 miles of the coast (U.S. Commission on Ocean Policy, 2004).

Vessels of all types and sizes from ports all over the world call at Hampton Roads. Traffic consists of vessels involved in foreign trade, coastwise movements, and local activities. Vessel trips at Hampton Roads totaled 36,000 in 1995. In 1996, Hampton Roads became the second largest general cargo port on the East Coast, second only to New York (COE, 2000). The amount of commercial vessel trips in the Hampton Roads area is anticipated to stay at or about their present-day level in the foreseeable future; recreational vessel trips and cruise ship trips are both anticipated to increase in the future due to increased user populations in the area.

The U.S. Department of Energy estimates that crude oil imports arriving to the United States by tanker will be 11.36 MMbbl/day by year 2030. During the 40-year life of the proposed mid-Atlantic lease sale, it is assumed that 2 oil spills greater than 1,000 bbl could occur in the mid-Atlantic area from tankers carrying imported oil (Table IV-17). Import tanker spills occur most frequently when the tankers are approaching port. Therefore, the majority of import tanker spills estimated in the cumulative case would occur in coastal waters. Spills in the coastal environment have an increased potential to negatively impact water quality. Shallow water and increased wave action increases the potential for entrainment of oil in the water column. If the oil were to reach coastal wetlands or estuaries, in particular the environs of the Chesapeake Bay, water quality could be impaired.

The vessel and helicopter traffic to support OCS offshore oil and gas activities will be about 1-5 service vessel trips per week and 5-10 helicopter trips per week (Table IV-16). Tanker traffic transporting light crude and condensate to shore will occur irregularly because the assumed 0.05-0.08 Bbbl of liquid hydrocarbon produced over a period of 10 to 20 years will require several days of production to produce a tanker load. For example, in the Gulf of Mexico shuttle tankers and barges carrying OCS production to shore typically have capacities of 100,000-500,000 bbl (MMS, 2002a). Assuming the high range of production occurs, a barge/tanker operating offshore Virginia with a capacity of only 100,000 bbl will require 800 trips over the life of the platform. Assuming a 20-year production life, about one trip per week will be required. This traffic will be a small addition to the existing vessel and air traffic in the Hampton Roads area. The impacts from vessels and aircraft associated with oil and gas activities are expected to be small and short-term in context with impacts from existing and future commercial and recreational vessels in the area. Some of the oil spills assumed to occur as a result of offshore activities in the mid-Atlantic could occur in coastal waters from a tanker/barge accident during transit or during offloading. The cumulative impacts of oil spills from the proposed lease sale, in context with the risk of spills from other sources, would be short-term.

Major activities in coastal waters anticipated to affect turbidity include routine maintenance dredging of harbors and vessel routes, existing pipeline and cable maintenance, new pipeline and/or cable installations, and bottom trawl fishing activities. Turbidity caused by trenching operations to bury a natural gas pipeline under the proposed action scenario is anticipated to contribute temporary incremental impacts to coastal water quality. Water quality would return to background concentrations once construction activities were completed because of settling and mixing.

All drilling rig and/or platform installation activities would occur solely in marine waters and, due to the distance of these activities, are anticipated to have a negligible effect on coastal water quality.

### Conclusion

In the foreseeable future, existing impacts to coastal water quality in the mid-Atlantic are expected to either continue at their present-day level or increase slightly due to increased user populations and frequency of activities. The incremental impacts from routine OCS oil and gas activities related to one lease sale in the mid-Atlantic would be short-term and not result in degradation of water quality conditions in the area. Impacts from accidental spills in coastal waters would depend on the size and location of the spill. The most severe effects expected would occur if a tanker spill were to occur near the mouth of the Chesapeake Bay or a similarly sensitive environment.

## (2) Marine Waters

Water quality in the mid-Atlantic marine waters is primarily influenced by estuarine ebb flow plumes, ocean dumping sites, vessel activities, and natural sources and processes such as storm events and ocean floor seeps (MMS, 1992b). Coastal wetlands, estuaries, and sediments act as a natural filter and sink system for contaminants originating from land. Except for the rare occasions where ebb flow plumes result in a measurable impairment of marine water quality, contaminants entering coastal waters in the course of operating the support, service, and processing bases located on land would have negligible impacts on marine water quality. These activities would not contribute to a cumulative effect on marine water quality.

Ocean dumping of acceptable waste material is authorized under the Marine Protection, Research and Sanctuaries Act of 1972, as amended (MPRSA), and the Federal Water Pollution Control Act, as amended (the Clean Water Act). A variety of materials have been dumped in OCS waters, including dredge spoils, low-level radioactive wastes, obsolete munitions, and industrial and municipal wastes. The dumping of munitions, including undetonated explosives, chemical munitions, and radioactive wastes, has been prohibited since 1970. The Ocean Dumping Ban Act of 1988 prohibits the dumping of any municipal or industrial waste into the open ocean; therefore, the vast majority of ocean dumping today consists of dredged material. The USEPA has designated specific offshore sites in each of the USEPA Regions where this type of disposal can occur. In Region 3, which includes the mid-Atlantic States, there are two sites, both off the coast of southern Virginia (USEPA, 1998).

Only one of these sites, Dam Neck, is reported to have had any dumping activity in the last three decades. The Dam Neck ocean disposal site is located offshore the Virginia coast between Virginia Beach and the mouth of Chesapeake Bay. The site is 8 square nautical miles in size, is 3.3 miles or more beyond the shoreline, and ranges from 30 to 40 feet in water depth. Disposal at the site is limited to dredged material from the mouth of Chesapeake Bay (COE, 2006). While frequent dumping occurred here in the 1980s and 1990s, only 4 reported projects have been disposed of since 2000. Since 1981, 154,818,000 cubic feet of waste has been deposited at Dam Neck. All of these projects were civil works, channel dredging projects completed by the COE (Peter Kube, pers. commun., February 6, 2006).

In addition to civil works projects, private companies utilize offshore disposal for their dredged material. In this region, the bulk of dredged material is deposited on the Craney Island upland site, in Norfolk, Virginia. The only projects that use the Dam Neck disposal site are those that are out of the Craney Island designated area and are civil channel dredging projects (Peter Kube, pers. commun., February 6, 2006). Disposal of material at the Dam Neck site could have impacts on some of the same resources affected by the proposed lease sale, including water quality, marine organisms, and seafloor habitats.

While the Ocean Dumping Ban Act of 1988 prohibits the dumping of any municipal or industrial waste into the open ocean, the disposal of other wastes (vessel discharges, fish wastes, and human remains) is regulated by the MPRSA. In 2004, there were three naval vessels sunk off the coast of Norfolk, all between 350-380 nautical miles east, and east-northeast of Norfolk. No other dumping activity was reported off the coast of Norfolk for 2004 (USEPA, 2005b).

Both active and inactive ocean dumping sites on the inner shelf and OCS will continue to be sources of water quality impairment to marine waters for a number of years to come. Any new dumping activity will be more effectively regulated than in the past. The COE issues permits for disposal of dredge material subject to USEPA concurrence. A permit will only be issued if it is determined that dumping will not degrade water quality conditions (USEPA, 2006b). No bottom disturbing activities, including dredging or drilling activities, associated with the proposed lease sale in the mid-Atlantic, would occur in any designated ocean dumping site.

As discussed above, the service vessels and helicopters supporting the OCS offshore oil and gas activities, and tankers transporting oil produced in the mid-Atlantic lease area, would be very minor additions to the existing vessel and air traffic in ocean waters. The impacts from vessels associated with oil and gas activities would be a small addition to the impacts from existing and future commercial and recreational vessels in the marine environment.

Oil inputs into the marine environment are in large part due to natural seepage from the seafloor. Natural seeps occur when oil leaks from between geologic layers. In many areas, although the amount of oil leaked from natural seeps can be significant, the slow pace at which it is released into the environment allows for ecosystems to adjust to its presence (NRC, 2003a). Approximately 63 percent of all oil released into North American waters is from natural seepage, while 22 percent is attributed to municipal and industrial waste and runoff (U.S. Commission on Ocean Policy, 2004). Offshore oil and gas development and marine transportation contribute a combined estimate of 5 percent of oil released into marine waters each year (U.S. Commission on Ocean Policy, 2004). It is anticipated that some of the oil spills assumed in the mid-Atlantic would occur in marine waters. The impacts of a large oil spill ($\geq$ 1,000 bbl) would result in short-term degradation to local marine water quality in the vicinity of the spill. Because liquid hydrocarbons offshore Virginia will likely occur as condensate or light crude, much of the spilled oil will evaporate and degrade quickly.

Untreated waste stream discharges from vessels are not permitted in U.S. coastal waters and are, thus, often released by vessels into marine waters prior to their approach. Waste streams from marine vessels often contain high bacterial and nutrient loads. Of particular concern are waste streams discharged from cruise ships, though other commercial, industrial, and recreational vessels contribute significant amount of wastes as well. The cruise ship industry experienced a 10-percent growth between 2001 and 2002, with over 6.5 million cruise embarkations occurring per year at all U.S. ports (U.S. Commission on Ocean Policy, 2004). Growth in the ship industry is expected to continue to increase, although at a slower rate. Larger cruise ships discharge as much as 140,000-210,000 gallons of sewage and up to 1 million gallons of graywater (showers, baths, laundry, and dishwasher drainage) per ship during each week that they operate (U.S. Commission on Ocean Policy, 2004).

Routine discharges associated with deck drainage, sanitary and domestic waste, and the release of bilge waters would occur from the rig(s), platform, drilling and service vessels as part of normal operations during OCS offshore oil and gas activities. The impact of allowable discharges on water quality is expected to be low because of NPDES limitations on domestic, sanitary, and drilling discharges; the rapid dilution and dispersion of formation water and other wastewaters in the marine environment; and the relatively low toxicity of allowable discharges. In context with other marine discharges, most notably those from the cruise ship industry, the discharges associated with the proposed action would contribute a negligible amount to water quality degradation.

Activities resulting in an increase of turbidity to marine waters include OCS gravel, sand, phosphate, and manganese mining activities. Through an agreement with MMS, the City of Virginia Beach plans to use 2 million cubic yards of sand from Sandbridge Shoal for a planned beach nourishment project at Sandbridge Beach. Construction on the project is presently scheduled for September 2006. The borrow site will be the same area utilized for previous renourishment efforts and is located approximately 3-5 miles offshore Sandbridge Beach. For planning purposes, the City has alerted the MMS of the possibility of their requesting about 500,000 cubic yards of sand for Sandbridge Beach every other year. In addition to the Sandbridge Beach project, MMS is working with the COE to use a Federal ocean borrow site located approximately 3 - 4 miles offshore Virginia Beach, in the Cape Henry area, to place sand on a portion of the Virginia Beach resort strip. Approximately 1,000,000 cubic yards of Federal OCS sand will be needed for this project; construction is expected sometime during calendar year 2007.

Activities associated with the proposed oil and gas lease sale in the mid-Atlantic that would affect turbidity include the discharges of drilling muds and cuttings, and the discharges of produced waters. The effects of drilling muds and cuttings on water quality are anticipated to be short-term and limited to an area in the immediate vicinity of the discharge site. Bottom area disturbances, including installation and operation of new rig(s), a platform, and a pipeline, will also suspend bottom sediments and increase turbidity in the short term.

Dredging activities can also suspend heavy metals, organic compounds, radioactive material, garbage, and other materials found in marine sediments. The presence of contaminants in dredged sediment may have an adverse impact on the water quality after discharge in the overspill. Resuspension of contaminated sediment during the dredging operation would disperse the contaminants over the seabed; however, the anticipated impacts from suspended contaminants would be minimal. Studies from the mid-Atlantic and from oil and gas drilling in other regions indicate that effects on water quality from the discharge of drilling muds and cuttings are not expected to last more than a few hours and are limited to the general vicinity of the discharge point (MMS, 1992b).

### Conclusion

Existing impacts to marine water quality in the mid-Atlantic are expected to slightly increase in the foreseeable future due to increased populations and amounts of activities in the area. The incremental impacts from routine OCS oil and gas activities related to one lease sale in the mid-Atlantic would be short-term and not result in degradation of water quality conditions in the area. Impacts from OCS operations could result in localized short-term degradation in water particularly if a large spill were to occur.

## c. Marine Mammals

Impact producing factors and activities associated with oil and gas operations that may affect marine mammal species in the Mid-Atlantic Planning Area are described in Section IV.B.4.c. and include noise, vessel and aircraft traffic, seismic surveys, offshore structures, muds and cuttings discharges, oil spills, and pipeline installation. Other than accidental collisions between vessels and marine mammals, potential impact-producing factors from exploration, development, and production are sublethal. Additional non-OCS activities affecting marine mammal populations considered in this cumulative analysis include ocean dumping, beach renourishment, marine transportation, National Aeronautics and Space Administration/U.S. Department of Defense (NASA/USDOD) activities, land based coastal pollution, commercial fishing, and oil leaks from natural seeps.

Point source and nonpoint source pollution, as well as atmospheric deposition, have greatly impacted nearshore water quality. Marine mammals have been exposed to the multiple chemical compounds and trace elements introduced into the coastal and marine environments by human activities through runoff, dumping, leaking, and atmospheric transport. Most marine mammals are high order predators (except baleen whales and sirenians) that may be exposed to high levels of some contaminants through biomagnification (increasing levels of contaminants up the food chain). Chronic effects of chemical contamination are likely to include lesions, endocrine disruption, and immunosupression (Trent University, 1997; BIOCET, 2004).

Operational discharges from OCS oil and gas activities would release some wastes into nearshore waters. These waste fluids would be treated or monitored for relative levels of contaminants prior to discharge, and plumes of these released wastes would mix rapidly with ambient seawater and would be diluted. It is expected that cetaceans will periodically interact with offshore discharges; however, any effects are expected to be sublethal. Indirect effects via food sources are not expected due to offshore dilution and dispersion. It is expected that the incremental added impacts from OCS discharges would remain negligible as a result of the relatively low concentrations of discharged contaminants within the open-ocean environment.

Operational discharges would also be contributed by non-oil and gas activities, including dredging and marine disposal, municipal wastes, extraction activities, transportation, and NASA/USDOD activities. Coastal sources of contaminants (industrial and municipal effluents and agricultural runoff) will continue to degrade offshore water quality over time. Eutrophication of coastal waters from inputs of nitrogen and phosphorus will continue causing ecosystem changes. Increasing algal blooms and biotoxin poisoning in marine mammals appear to be direct results of degraded coastal water quality (NOAA, 2004c). The frequency and scale of unusual mortality events in marine mammals appear to have increased over the past 25 years. These mortality events have included manatees and bottlenose dolphins. In 2004, 107 bottlenose dolphins were stranded along the Florida Panhandle from March to April (NOAA, 2004c). The apparent cause of the bottlenose dolphin deaths was a toxic algal bloom. Contaminants may affect the mammals' immune systems making them more susceptible to bacterial, viral, and parasitic infections and biotoxins.

Commercial fisheries may accidentally entangle, drown, or injure marine mammals during fishing operations. The most susceptible species among endangered cetaceans is the right whale (Marine Mammal Commission, 2005). Other direct human interactions with marine mammals include an increasing number of commercial opportunities to view marine mammals (i.e., whale watching). While unintentional, these activities may cause animals to relocate from preferred habitat; result in injury from people wishing to touch or prod the animals; debilitate animals by feeding them inappropriate, contaminated, or spoiled food; or encourage the animals to interact with humans and engage in other activities and become pests. While no immediate injury may result, marine mammals may become habituated to people and boats, exposing them to risks they may not otherwise face.

Both commercial and recreational vehicles discharge large amounts of domestic waste products such as sewage, food waste, plastic debris and trash from human activities into ocean waters. Ingestion of, or entanglement with, solid debris can adversely impact marine mammals (Marine Mammal Commission, 2005). Mammals that have ingested debris, such as plastic, may experience intestinal blockage which, in turn, may lead to starvation, while toxic substances present in the ingested materials (especially in plastics) could lead to a variety of lethal and sublethal toxic effects. Entanglement in plastic debris can result in reduced mobility, starvation, exhaustion, drowning, and constriction of, and subsequent damage to, limbs caused by tightening of the entangling material.

Non-OCS activities that involve vessel operations include dredging and marine disposal, extraction activities (nonenergy minerals), transportation (domestic and foreign tankers), and NASA/USDOD operations), most of which occur at considerably higher frequency levels than vessel activity under the proposed action. While many of these operations are continuous, vessel activity in support of these operations may or may not be intermittent. Increased vessel traffic could increase the probability of collisions between ships and marine mammals, resulting in injury or death to some animals. Species which are particularly vulnerable include the right, fin, and humpback whales (Marine Mammal Commission, 2005; Laist et al, 2001). The risk of collisions between nonendangered and nonthreatened whales and support vessels is considered negligible due to the agility of these smaller whales. Most cetacean species in the Atlantic are distributed in deep waters, and the probability of collisions in these waters is higher. The extent of OCS service vessel traffic in the cumulative scenario is the same as that in the proposed action, and would most likely result in the incidental take of cetaceans through active avoidance behavior or displacement of individuals or groups. The extent of displacement will depend on the mammal’s age, sex, psychological status, physiological condition, and behavioral or social activity. The net result will depend on the percentage of the population affected, ecological importance of the area disturbed, and the mammal’s ability to accommodate the disturbance. Overall, effects are expected to be sublethal and constitute a short-term, temporary impact. The incremental increase in vessel activity from OCS oil and gas operations is small compared to vessel activity under the non-OCS cumulative scenario. Expected incremental impacts to marine mammals in the mid-Atlantic from OCS service vessel traffic would remain small.

Noise in the Atlantic originates from a variety of sources. The single largest contributor to sound in the ocean is ships. Vessel traffic as a source of transient noise is associated with several non-OCS activities, including dredging and marine disposal, extraction activities (nonenergy minerals), transportation (domestic and foreign vessels), and NASA/USDOD operations. Noise from such activities would far exceed noise from OCS activities in frequency and duration. Noise derived from OCS helicopters and surface vessels is transient; related impacts would be manifested primarily as a startle response or avoidance behavior by marine mammals (Gales, 1982). These effects are sublethal and of a temporary nature. Therefore, incremental impacts from noise generated by OCS transportation sources on marine mammals would be minor.

The effects of noise from seismic survey activities on marine mammals have been discussed in Section IV.B.4.c. The vast majority of seismic surveys use air and water guns to generate pulses, and it is assumed that these methods will be used in seismic surveys associated with the proposed action. The impacts to marine mammals from these seismic surveys are assumed to be temporary and minor as compared to noise from non-OCS activities. Extraction operations for sand to be used in beach renourishment and ship-based military training exercises (including underwater detonation of ordnance and surface firing of ordnance at a target) represent additional sources of noise. Noise generated by these activities may have physical and/or behavioral effects on marine mammals, such as hearing loss, discomfort, and injury; masking of important sound signals; and behavioral responses such as fright, avoidance, and changes in physical or vocal behavior (Richardson et al., 1995; Gordon et al., 1998). However, death or physical injuries on marine mammals are unlikely.

The effects of spilled oil on marine mammals from the proposed action have been discussed in Section IV.B.4.c. The number of small and large spills from OCS oil and gas operations are assumed to be the same in the cumulative case as for the proposed action. It is expected that most chronic operational spills or small oil spills will occur offshore. Because of the generally small quantities of hydrocarbons discharged, and because the spilled materials both evaporate and are dispersed by wind and wave action, it is not expected that small accidental spills would measurably affect populations of marine mammals. Two large oil spills from import tankers are assumed to occur in the cumulative scenario (Table IV-17). Species such as the humpback whale leave the OCS for deep waters in their annual migrations. Thus portions of the Mid-Atlantic OCS may not be routinely frequented by certain species, reducing their opportunities for impacts due to at least some of the assumed spills. Additionally, spills in State waters will contribute to the number and probability of shallow spills. Large oil spills resulting from import tankering, the proposed action, and State activities are still infrequent events that may periodically contact cetaceans. In addition, natural seeps leak a significant amount of oil in to the marine environment. Oil spills have the potential to cause acute and chronic (long-term, lethal and sublethal oil-related injuries) effects on marine mammals (Geraci and St. Aubin, 1988). The OCS oil and gas activities are likely to cause a minimal incremental increase in impacts from oil spills to marine mammals, although the overall cumulative effects are expected to be measurable.

Oil-spill response activities that may affect marine mammals, and their expected impacts, have been discussed in Section IV.B.4.c. Despite the increase in small spills associated with the proposed action's contribution to the cumulative case, oil spills and the use of chemicals and cleanup activities are expected to be localized and infrequent. Therefore, potential impacts to marine mammals resulting from the incremental addition of oil-spill response activities are expected to be small.

## Conclusion

Non-OCS oil and gas activities continue to impact marine mammals both directly and indirectly. Collisions with vessels represent the primary source of potential lethal impacts. Species which are particularly vulnerable include the right, fin, and humpback whales. Routine oil and gas activities would have small contributions to the potential for lethal and sublethal whale-vessel collisions. Non-OCS vessel traffic, which could also impact marine mammals, includes military and commercial shipping, fishing vessels, and a growing number of recreational craft. Aircraft-induced startle reactions due to private, military, and commercial flights are another source of potential impacts on marine mammals. Entanglement in fishing gear can also result in lethal and debilitating impacts. In addition to entanglement, commercial fishing activities may also be affecting marine mammal populations by direct competition and by physical alteration of habitat, in particular the community structure of whale feeding grounds. Chemical pollutants are known to contaminate tissues, and persistent debris also affects animals. The assumed oil spills in the cumulative case are not expected to result in measurable impacts to marine mammal populations on the Atlantic OCS. Taken separately, routine and accidental impacts from projected oil and gas activities are not expected to produce any measurable changes in the distribution, population size, or behavior of marine mammal populations on the Atlantic OCS. However, cumulative impacts from non-OCS and OCS oil and gas activities over the 40-year life of the Proposed Program, unless abated, could result in measurable diminishing of some marine mammal populations, particularly the right whale.

## d. Marine and Coastal Birds

The analysis of cumulative impacts takes into account the present population status and migratory habits of listed and nonlisted marine and coastal birds, and considers how the various activities may affect those populations. These activities include commercial and residential development; recreation and hunting; marine transportation; aircraft traffic; beach nourishment projects; and the oil and gas exploration, development, and production assumed to occur from the proposed action. Marine and coastal birds may suffer habitat loss as well as direct effects due to human intrusion and pollution from these activities, some of which have resulted in long-term adverse effects to coastal habitats within the Mid-Atlantic Planning Area.

Ecologists estimate that more than half of the region's original coastal wetlands have been lost because of human activities dating from pre-colonial times. The practices responsible for most of these losses include pond construction, canalization for mosquito control, urban and rural development, and dredging for marinas. Conversion to agricultural lands, along with natural processes such as rising sea level and coastal subsidence, have contributed to wetland destruction as well. Presently, about two thirds of the coastal wetlands are salt marshes colonized by salt-tolerant grasses and bushes. Much of the balance is tidal mudflats, areas that are exposed at low tide and are densely packed with shellfish, invertebrates, crabs, and other organisms. The remainder is freshwater marshes, forests, and shrublands.

Waterfowl, such as ducks, geese, swans, and other birds associated with the water, including herons, egrets, osprey, and eagles, are important living resources of mid-Atlantic estuaries. Many species are highly dependent upon wetlands and submerged aquatic vegetation for their survival, and alterations to these environments affect the populations of resident and migratory birds. Today, habitat alteration is probably the major factor controlling local bird populations. An example of the ongoing ecological effects of habitat loss and human activity on Chesapeake Bay bird populations is the competition between the black duck (*Anas rubripes*) and the mallard (*Anas platyrhynchos*). Whereas mallard populations are on the rise, black ducks are decreasing. Valuable black duck habitat is lost as wetlands are eroded and land is developed for human use. Black ducks tend to stay away from people and will abandon wetlands in close proximity to human development. Mallards, on the other hand, are more adaptable to the presence of people and are more likely to be found in developed areas. Monitoring the ratio between these two ducks will continue to be a good measure of how human presence and activity impact the coastal environment.

The mid-Atlantic region has experienced some of the most rapid population growth, industrial development, and intensive agriculture in the country. Not surprisingly, many organisms, including birds, relying on the estuaries of the mid-Atlantic have been negatively affected. Increased development and population growth in the area is expected during the life of the 2007-2012 program, resulting in continued stress on bird populations in the area.

Benthic organisms living in beach sands provide food for a variety of shorebirds. Fill material used for beach replenishment will temporarily remove this food source. A variety of marine organisms are potentially impacted by placement of fill material on intertidal or subtidal portions of the beach. In general, these organisms are able to persist in the dynamic beach environment because they have adapted to conditions such as high wind and wave energy and periodic burial. As with those living in borrow areas, benthic organisms are significantly impacted by beach renourishment activities (Van Dolah et al., 1992). These impacts, however, are considerably shorter in duration than impacts observed in offshore borrow areas because organisms living in beach habitats are adapted to living in high-energy environments and are able to recover more quickly. Because birds are highly mobile and can move to new food source areas during such times, and the food source is likely to recover, this is not a major problem. However, birds that use these areas for breeding and nesting can be more heavily impacted.

Bird species that use beaches and onshore habitats for breeding and nesting are more likely to experience significant impacts from beach nourishment activities than those species that only use such an area to feed or rest while migrating through the region. Beach-nesters are particularly vulnerable to human disturbance. Birds that could be affected by beach nourishment activities are the least tern, Caspian tern, gull-billed tern, sandwich tern, brown pelican, and Wilson's plover. All these birds are beach nesters that utilize a bare substrate for their nests. While timing of replenishment could lessen the impact, it is important to note that beach nesting birds have suffered a significant loss of nesting habitat on a regional scale due to loss of beach habitat to human development and activity (COE, 1998).

Bay grasses such as eelgrass and widgeon grass provide critical food, shelter, and nursery grounds for many species of waterfowl. The grasses also stabilize the shifting sediments and inject life-sustaining oxygen into the water. Unfortunately, this important resource is very sensitive to pollution. More than many other plants, bay grasses need plenty of sunlight to grow. High levels of nutrients are detrimental because they can stimulate extended blooms of phytoplankton that block light. Sunlight is further attenuated by runoff from farms and construction sites and by sediments suspended by storms and tides. Submerged aquatic vegetation originally colonized over 600,000 acres of the Chesapeake and coastal bays. Only one-tenth of that domain remains today. The losses in the Chesapeake Bay are blamed on phytoplankton blooms and nutrient over-enrichment, while the decline in the coastal bays is attributed to an excess of suspended sediments, in part associated with boating and construction.

Benthic organisms are important contributors either directly or indirectly to the food chain of many coastal birds. Approximately one-fourth of the area of the Chesapeake Bay contains bottom sediment habitats with poor benthic communities. Toxic contaminants are responsible for impacts in industrialized locations around the Bay. Small systems near Baltimore, Norfolk, and Washington, D.C. are areas where chemical contamination has affected the benthic communities. Overall, approximately one-fourth of the estuarine waters of the Mid-Atlantic Planning Area exhibit impacted benthic communities. Many occur close to urban centers.

Low-flying aircraft can disturb feeding and nesting birds, although wildlife refuges and other designated areas with important bird habitat often have flight restrictions that minimize these impacts. Aircraft noise can cause a startle response or temporary avoidance behavior among birds, but such impacts are not likely to measurably affect bird populations. Disturbance from helicopters supporting offshore oil and gas activities would be negligible because of the low number of projected flights, flight restrictions imposed by MMS, and the use of airfields in already developed areas, generally away from sensitive bird habitat.

Vessels with a wide variety of cargo call at Hampton Roads, which is the second largest cargo port on the east coast. Oil spills from vessel traffic into and out of Hampton Roads could affect birds directly or degrade their habitat if the spills come ashore. Based on historic tanker spill rates, it is assumed that 2 large oil spills greater than 1,000 bbl will occur from foreign tankers during the 40-year life of the Proposed Program (Table IV-17). In addition, for analytic purposes we assume that one 1,500-bbl spill will occur from OCS activity. Numerous small spills (< 999 bbl) are likely as well. Small spills assumed to occur from the proposed action are not expected to measurably affect coastal and marine birds. However, if oil spills of any size contact critical habitats for feeding, nesting, or resting (such as inshore, intertidal, and nearshore areas), sublethal effects are likely to occur.

A large spill that covers a broad area could have direct effects on birds on the water's surface by causing matting of plumage, which reduces flying and swimming ability and produces a loss of buoyancy; this loss of buoyancy prevents resting and sleeping on the water and a loss of insulation that can result in death by exhaustion. Waterfowl are particularly susceptible to direct oiling because of the considerable time they spend on the water. Diving birds such as loons, grebes, and cormorants are most likely to be directly contacted by an oil slick on the open ocean. Shorebirds and wading birds would be somewhat vulnerable to oil spills that enter nearshore and coastal waters and intertidal areas. Oil ingestion and accumulation of toxic petroleum hydrocarbons can lead to reproductive failure and increased physiological stress. Oiled adult birds can transfer oil from their plumage to unhatched eggs or chicks, reducing hatching and fledging success. The relatively small number of spills assumed over the life of the proposed action is not likely to have measurable effects on marine or coastal bird population levels in the region.

### Conclusion

Cumulative impacts could result in mortalities and possible population declines for some species, especially coastal birds. Important coastal bird habitats continue to be degraded from exposure to non-OCS related activity. The low level of oil and gas activity projected for the mid-Atlantic would contribute only incrementally to adverse impacts to marine and coastal birds.

## e. Fish Resources and Essential Fish Habitat

Along with the impacts associated with oil and gas activity, cumulative impacts on fish resources result from the following activities and events: commercial, industrial, and residential coastal development resulting in habitat loss and pollution in coastal areas; ocean dumping of dredge spoil; military activity; beach renourishment programs; commercial and recreational fishing; and large accidental hydrocarbon spills. Accidental spills may result from non-OCS tanker traffic involving transportation of domestic and imported crude oil and refined products along the Atlantic coast. Still another potential non-OCS impact in the mid-Atlantic is military activity.

Loss of estuarine and coastal wetlands to commercial, residential, and industrial development has, over the years, reduced nursery and spawning habitat of estuarine-dependent shellfish and finfish. Because of the complexity of aquatic systems, it is difficult to quantify the exact effect of the loss or degradation of a particular acre of wetland on a fishery as a whole. However, the life cycles of several fish and shellfish species are fairly well understood, and biologists have determined that wetlands play an important part in providing food, protection, and spawning areas for a number of species. For example, habitat destruction has affected striped base populations in the Hudson River, Chesapeake Bay, and Albemarle Sound, resulting in drastic declines in the mid-20th century (Hill et al. 1989). Another species of concern that can be impacted by coastal pollution and habitat loss is the listed shortnose sturgeon. Habitat alterations from discharges, dredging, or disposal of materials into rivers, and related development activities involving estuarine/riverine mudflats and marshes, are known threats to shortnose sturgeon. While Federal and State legislation in the 1970's and 1980's designed to protect wetlands has helped reduce this trend, development pressure will continue to impact this critical habitat. The onshore facilities needed to support the proposed OCS oil and gas operations would not add to that developmental pressure in any measurable way because existing industrialized areas can accommodate such support facilities.

The Ocean Dumping Ban Act of 1988 prohibits the dumping of any municipal or industrial waste into the open ocean; therefore, the vast majority of ocean dumping consists of dredged material. The COE oversees dredging of U.S. waterways for navigational purposes and grants permits for the disposal of dredged material. These permits are subject to review by the USEPA, which has designated two sites in the mid-Atlantic, both off the coast of southern Virginia, for dredge disposal. While the Ocean Dumping Ban Act has had a major positive impact in removing threats to the marine environment, the dumping of dredge material does have negative impacts both of a transitory and longer-term nature.

In high concentrations, suspended sediments may affect the gills of fish and impair photosynthetic processes in the water column. These effects are expected to be temporary, and it would be rare that decreased photosynthesis from turbidity would adversely impact the overall functioning of an ecosystem in any significant way (Lee and Jones, 1992). Finfish and other mobile organisms may temporarily migrate out of the zone of turbidity. Upon settling, the sediment can blanket or smother benthic organisms and block filter mechanisms. The speed of recolonization by benthic organisms depends on the depth and areal extent of the deposition.

Replenishing beach sand lost to erosion, tidal action, and storms is an ongoing activity along the mid-Atlantic coast. As an example, the City of Virginia Beach plans to use 2 million cubic yards ($yd^3$) of sand for renourishment of Sandbridge Beach from a previously used shoal approximately 3-5 miles offshore. The City may request about 500,000 $yd^3$ of sand for Sandbridge Beach every other year. MMS is also working with the COE to use a Federal ocean borrow site located approximately 3-4 miles offshore Virginia Beach, in the Cape Henry area, to place sand on a portion of the Virginia Beach resort strip. Approximately 1 million $yd^3$ of Federal OCS sand would be needed for this project.

The primary ecological impact of dredging sand from borrow areas will be the complete removal of the existing benthic community through entrainment into the dredge. In addition, excessive siltation and increased turbidity associated with the offshore dredging and nourishment process can result in impacts to marine organisms. Siltation and burial of benthic organisms and reef/hard bottom habitat is an issue of concern, and the increase in turbidity affects both filter-feeding organisms and fishes. However, the borrow areas being dredged will be recolonized by adult organisms from the surrounding area (Newell et al. 1998); thus, any negative impacts are expected to be short-lived. Only if a particular borrow area is used routinely would long-term impacts result.

Overfishing of a resource is a major environmental concern and is discussed in Section IV.L.4.o. However, there are two additional impacts from overfishing that will be discussed here as it relates to fish resources: bycatch and bottom disturbance by trawling.

Bycatch is the discarded catch of any living marine resource plus retained incidental catch and unobserved mortality due to a direct encounter with fishing gear. The bycatch of fishery resources, marine mammals, sea turtles, seabirds, and other living marine resources has become a central concern of resource managers, conservation organizations, scientists, and the public, both nationally and globally. A major problem occurring nationwide is the lack of accurate reporting of bycatch and the discarding of dead fish. For example, in the Atlantic sea scallop fishery, more than 90 percent of all vessels reported no discards in their logbook during the 2000 fishing year. Yet, at the same time, at-sea observers monitoring a scallop experimental fishery recorded millions of pounds of bycatch of groundfish and skates. While no estimates exist as to the extent of reporting noncompliance in the mid-Atlantic, it is likely that similar inaccurate bycatch reporting occurs to some extent in most of the mid-Atlantic fisheries.

In the mid-Atlantic, the trawl-dominated summer flounder fishery has been shown to negatively impact important seafloor habitat. Also, deeper seafloor habitats are exposed to large hydraulic clam dredges that vacuum tons of sediment from the ocean floor in search of long-lived ocean quahogs. Early research into the ecosystem impacts of bycatch focused on its effects to marine mammals. New research on impacts from bycatch and bottom habitat degradation is just beginning to understand the ramifications to other fish resources.

Norfolk and Newport News are major east coast ports for waterborne commerce. A high volume of commercial vessel traffic moves into and out of the Hampton Roads area, including container vessels transporting a variety of cargo as well as tankers carrying crude oil or refined petroleum products. Oil spills can and do occur as a result of this traffic. Oil spills can result from loss of cargo from tankers and barges, or from loss of fuel from bunkers in any type of large vessel. Vessels other than tankers that carry large quantities of bunker fuel pose a significant threat to the marine environment in the event of a vessel accident. The Oil Pollution Act of 1990 was drafted to address the risk of spilled oil in the marine environment and requires all tanker ships larger than 5,000 gross tons to have double hulls by 2015 to prevent oil spills. However, over 50 percent of the 4 billion gallons of oil transported every year in the Chesapeake Bay is done in barges smaller than 5,000 gross tons.

The cumulative case scenario assumes 2 large oil spills will occur from imported oil tanker traffic and one 1,500-bbl oil spill from OCS activity (Table IV-17). The impacts of a large spill on fish resources are discussed in Section IV.B.4.e. The service vessels supporting any offshore oil and gas activities and tankers transporting oil produced in the Mid-Atlantic Planning Area would be a small addition to the commercial traffic in the Hampton Roads area. Any impacts from vessels associated with oil and gas activities would be in addition to impacts from existing and future commercial vessels.

Whales, dolphins, and many fish species use sound to locate their prey as well as to communicate. However, noise pollution in the ocean is increasingly becoming a serious problem as more and faster ships ply waters of the mid-Atlantic. Water is an effective transmitter of sound, and SONAR echo location and seismic testing for oil and gas use sounds that can interfere with marine mammal and fish activities. The potential impacts on fish from this type of noise pollution in discussed in Section IV.B.4.e. In addition to the noise-producing activity ongoing in the mid-Atlantic, the U.S. Navy is proposing to build a massive SONAR testing range off the Atlantic coast with the preferred locations being in North Carolina, Virginia, or Florida. The range would cover a 500-square-nautical mile area of the ocean and would enable the U.S. Navy to train effectively in a shallow-water environment at a suitable location for Atlantic Fleet units. Any noise activity associated with OCS oil and gas activity envisioned by this proposal would be a small addition to current and future activities.

### Conclusion

The most serious impact-producing factors for fish resources will continue to be the byproducts of fishing activities (such as bycatch and seafloor damage as a result of bottom trawling) and the effects of wetland habitat loss. The major fish habitat at risk from oil spills will continue to be inshore estuarine nursery habitat, and the risk will come primarily from non-oil and gas offshore activity such as tanker traffic. Affected offshore and high-energy inshore areas would recover over time. Any impacts resulting from OCS oil and gas activity in the Mid-Atlantic Planning Area would be a small addition to the current impacts discussed above.

## f. Sea Turtles

Impact producing factors and activities associated with oil and gas operations that may affect sea turtle species in the Mid-Atlantic Planning Area include noise, vessel and aircraft traffic, seismic surveys, offshore structures, muds and cuttings discharges, oil spills, and pipeline installation. Other than accidental collisions between vessels and marine turtles, potential impact-producing factors from exploration, development, and production are sublethal. Additional non-OCS activities affecting marine turtle populations considered in this cumulative analysis include ocean dumping, beach renourishment, marine transportation, NASA and USDOD activities, land-based coastal pollution, commercial fishing, and oil leaks from natural seeps.

Capture and drowning in commercial fishing gear, particularly shrimp trawls, is the largest cause of death for sea turtles in the United States (NRC, 1990). Year-round use of turtle excluder devices on shrimp trawls from North Carolina to Texas was legislatively mandated in 1994 to decrease turtle deaths. Turtles are also incidentally captured in pelagic longline, paired trawl, gill net, and set-net fisheries, but these sources of deaths are not fully documented. Collectively, unattended nets set in shallow waters and fisheries other than shrimping are the second largest source of mortality to sea turtles (NRC, 1990). Sea turtle mortality associated with these fisheries varies in response to seasonal abundance of turtles and to the intensity and timing of the fishing effort. Another consequence of fishing operations is entanglement of turtles in discarded fishing gear. Entanglement reduces turtle mobility, increasing their susceptibility to vessel collisions, incidental capture, and predation. Entanglement can also result in drowning and constriction of limbs, leading to amputation and then death from infection.

Structure installation and removal, pipeline placement, dredging, and water quality degradation may adversely affect marine turtle habitat through destruction along nesting beaches and within live-bottom communities used by marine turtles. Dredge-and-fill activities, which occur in many of the nearshore seasonal habitats of marine turtles, range from propeller dredging by recreational boats to large-scale navigation dredging and fill activities for land reclamation. The physical integrity, species diversity, and biological productivity of topographic features and live bottoms where marine turtles occur are expected to suffer only temporary damage or disturbance.

Sea turtles frequent coastal areas, such as algae and seagrass beds, to seek food and shelter (Hendrickson, 1980). These nearshore areas are used by juvenile Kemp's ridley, green, loggerhead, and hawksbill turtles. Submerged vegetated areas may be lost or damaged by activities that alter salinity, increase turbidity, or disturb natural tidal and sediment exchange. Natural catastrophes, including storms, floods, droughts, and hurricanes, can also substantially damage sea turtle habitats and nesting beaches.

Construction, vehicle traffic, and artificial lighting are activities that could disturb marine turtles or their nesting beaches (Raymond, 1984; Witherington, 1997; Witherington and Martin, 1996), and are of particular concern for loggerhead turtle nesting areas in Virginia. Vehicular and foot traffic has the potential to damage buried eggs and harm pre-emergent hatchlings. Artificial lighting on nesting beaches disrupts critical behaviors, including limiting nest-site choice, nocturnal sea-finding behavior of both hatchlings and nesting females, and reduced nesting.

The main causes of permanent nesting beach loss are reduced sediment transport, a rapid rate of relative sea-level rise, coastal construction and development, and recreational use of accessible beaches near large population centers. Sand mining, beach renourishment, and oil-spill cleanup operations may remove sand from the littoral zone and temporarily disturb onshore sand transport, potentially disturbing marine turtle nesting activities. Beach renourishment replaces rather than maintains original nesting habitat. Properties of artificially nourished beaches that differ from the natural beach include sorting, moisture content, reflection, and conduction. These properties affect the architecture of the egg chamber, incubation temperature, gas exchange, and water uptake, resulting in reduced egg and hatchling survivorship.

Chronic pollution, including industrial and agricultural wastes and urban runoff, threaten sea turtles worldwide (Hutchinson and Simmonds, 1991). Some turtle species have life spans greater than 50 years, creating the potential for bioaccumulation of heavy metals, pesticides, and other toxins (Davenport et al., 1990; Lutz and Lutcavage, 1987). Chronic pollution from industrial or agricultural sources is linked with immune suppression in some marine mammals and would similarly be a source of concern for marine turtles in the Atlantic.

Collision between commercial, military, or recreational vessels and surfaced marine turtles would likely cause fatal injuries, unless marine vessel operators can avoid marine turtles and reduce potential deaths. Between 1986 and 1993, about 9 percent of sea turtle strandings identified by the U.S. sea turtle stranding network in the southeast United States and the Gulf of Mexico (Teas and Martinez, 1992; Teas, 1994) exhibited propeller or other boat strike injuries. This mortality rate may grow if fishing, recreational, and commercial vessel traffic continue to increase.

Operational discharges from oil and gas activities are diluted and dispersed within 1 km of the discharge point and are not known to be lethal to marine turtles. Suspended particulate matter in offshore operational discharges could reduce visibility and may displace prey items in the vicinity. Marine turtles within 1 km of discharge points are less able to locate prey for the short time period they would spend traversing discharge plumes.

Marine debris is a well-documented source of deaths and debilitation for marine turtles (NRC, 1990). Reports of debris ingestion exist for almost all sea turtle species and life stages. Pelagic sea turtles are most susceptible to debris ingestion because of their dependence on convergence zones where floating debris accumulates, and the indiscriminate nature of their feeding strategy. In addition to the trash and debris generated by activities in the Atlantic, marine debris is carried into the Atlantic via oceanic currents. The volume of nonbiodegradable materials contributed by these sources is unknown. Turtles that consume or become entangled in debris may die or become debilitated (NOAA, no date). Plastics and other materials may remain in the gut for at least 6 months and may interfere with digestion, growth, and other physiological processes. Ingestion of plastic and Styrofoam materials could result in drowning, lacerations, and reduced mobility, resulting in starvation (Lutcavage et al., 1997). The MMS prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, the USCG (MARPOL, Annex V, Public Law 100-220 [101 Statute 1458]) prohibits the disposal of any plastics at sea or in coastal waters. Despite these safeguards, marine turtles can become entangled in or ingest trash and debris produced by human activity in the Atlantic and elsewhere.

Because no additional oil and gas leasing is assumed in the cumulative case, noise from projected oil and gas activities (including helicopters, service and construction vessel traffic, seismic surveys, drilling rigs, and production platforms) would be the same as discussed for the proposed action (i.e., variable and transient, causing short-term behavioral changes, disruption of activities, departure from the area of disturbance). Vessel traffic as a source of transient noise is also associated with several non-OCS activities, including dredging and marine disposal, nonenergy minerals development, transportation (domestic and foreign tankers), and NASA/USDOD operations. While many of these operations are continuous, vessel activity may or may not be intermittent.

Some oil spills are likely to occur from accidents involving tankers carrying imported hydrocarbons. In addition, several small spills and one 1,500-bbl spill are assumed to occur from OCS activities

(Table IV-17). Oil spills can adversely affect marine turtles by toxic external contact, toxic ingestion or blockage of the digestive tract, disruption of salt gland function, asphyxiation, entrapment, and displacement from preferred habitats (Milton et al., 2003; Lutz and Lutcavage, 1987; Geraci and St. Aubin, 1987). When an oil spill occurs, the severity of effects and the extent of damage to marine turtles are affected by geographic location, oil type, oil dosage, impact area, oceanographic conditions, and meteorological conditions. Based on historical spill rates, 2 large spills could occur in the Atlantic during the 40-year life of the proposed action from foreign tankers transporting oil to mid-Atlantic ports (Table IV-17). In addition, natural seeps leak a significant amount of oil into the marine environment. Since marine turtle habitat in the Atlantic includes both inshore and offshore areas, marine turtles are likely to encounter a few OCS or import tanker spills. Although marine turtles may encounter these spills in their inshore and offshore habitats, primarily sublethal and minor effects are expected, although some deaths may occur.

Oil-spill response activities, such as vehicular traffic on beaches and vessel traffic in shallow-water areas, can adversely affect marine turtle habitat and cause displacement from these preferred areas. As mandated by the Oil Pollution Act of 1990, these areas are expected to receive individual consideration during oil-spill cleanup. Required oil-spill contingency plans include special notices to minimize adverse effects from vehicular traffic during cleanup activities and to maximize protection efforts to prevent contact of these areas with spilled oil.

### Conclusion

The assumed OCS and non-OCS related activities in the mid-Atlantic have the potential to harm marine turtles. The cumulative impact of activities in the mid-Atlantic on marine turtles could be greater than under the proposed scenario because the larger extent of non-OCS activities are likely to remove some animals from marine turtle populations and to temporarily displace marine turtles from feeding, reproduction, and resting habitats. Incremental impacts from noise generated by OCS activities would be small relative to impacts resulting from non-OCS cumulative activities. Deaths could result from oil spills, debris ingestion, or vessel collisions. Taken separately, impacts from the proposed action are not expected to produce any measurable changes in the distribution, population size, or behavior of endangered and threatened marine turtle populations on the Atlantic OCS. However, cumulative impacts over the assumed 40-year project life, unless abated, could result in measurable diminishing of some marine turtle populations.

## g. Coastal Habitats

### (1) Coastal Barrier Beaches and Dunes

As is the case with estuaries and wetlands, shorelines have been affected by a variety of natural and human causes. Sediment deprivation, poor sediment quality in coastal headlands, and rapid submergence have resulted in severe, rapid erosion of most barrier landforms. Beach stabilization projects (such as groins, jetties, and seawalls) and artificially maintained channels and jetties installed to stabilize navigation channels are also considered to accelerate coastal erosion.

Activities assumed for the proposed action that could potentially cause impacts to barrier beaches and dunes in the Mid-Atlantic Planning Area have been described in Section IV.B.4.g. Various OCS-related activities, such as the construction of a pipeline, can contribute to coastal impacts. Because of improved techniques of bringing pipelines to shore in nondisturbing ways, the contribution of the proposed action to the cumulative loss of beach environments along the mid-Atlantic coast would be very small. Oil spills reaching shore and grounding on sandy beaches can have significant impacts depending on the method of cleanup used to remove the oiled sand. Areas undergoing high rates of coastal erosion from natural and non-OCS-related causes can suffer short-term (up to 2-year) adjustments in beach profiles and configurations as a result of sand removal and disturbance during cleanup operations. The proposed action could contribute oil spills which could contact beaches and dune areas. However, based on historical spill rates, the number and size of spills from the proposal would be small when compared to the greater number of spills which could result from tankers importing oil to the Atlantic, some of which could reach coastal areas.

A major cause of shoreline impact has been sea-level rise combined with the attempts by man to control the resulting retreat of the shoreline. Methods used to control the erosion of the shoreline fall into two categories, shoreline hardening (construction of groins, jetties, seawalls, etc.) and beach nourishment (from offshore or onshore sand/gravel supplies). Presently, over 80 percent of beaches in the United States are experiencing moderate to severe erosion (Heinz Center, 2000). Development activities have destroyed some of the sand dunes and other features of the Atlantic coast which normally help prevent erosion. The net result of these activities is expected to be the permanent alteration of over 80 percent of the coastline.

Two larger oil spills are assumed that would result from import tanker traffic (Table IV-17). There is the possibility that oil from these spills would contact beaches on the Virginia coast or elsewhere in the mid-Atlantic. Small spills are assumed to occur as well, but these spills are not expected to measurably affect shorelines. Impacts on shorelines from the large (non-OCS) spills are expected to be mainly aesthetic. Disruption of the sand budget from the removal of oiled sand can cause erosion in the vicinity of the spill contact; beach replenishment would limit erosional problems to 1 or 2 years.

## (2) Wetlands and Estuaries

Wetlands loss along the Atlantic coast is well documented as it has been a major problem for some years. A major natural cause of wetlands loss or stress has been sea-level rise (Titus, 1988). Human-created stresses have included municipal waste discharges from sewage treatment plants and electric generating facilities, agricultural runoff (pesticides and fertilizers), emissions of $NO_x$, $So_x$, VOC, and $PM_{10}$, and dredging of ship channels. Development for recreational, residential, and commercial uses has also affected coastal wetlands.

Activities assumed for the proposed action that could potentially cause impacts to estuaries and wetlands have been described in Section IV.B.4.g. A new shore base would be needed to support the proposed action, but it would not be constructed in wetland areas. The maintenance of a navigation channel to the shore base already exists, and new onshore processing facilities required to process the resources developed as a result of the proposed action would be co-located with existing facilities at the Hampton Roads area. Construction of a pipeline in coastal areas can contribute to wetland loss. Wetland and seagrass contacts by oil spills can occur from a number of sources. Most spills are expected to occur offshore. Large oil spills could make contact with the coast. Should the oil come into contact with a stretch of wetlands not protected by a coastal barrier island, or should the spill occur in coastal waters, wetlands or seagrass beds may be contacted and affected, resulting in measurable impacts. The amount of wetland loss due to contact with oil spilled from OCS-related operations is expected to contribute only a small amount of the total wetland loss, with subsidence, erosion, and reduced sediment input from streams continuing to be major factors. The contribution of the proposed action to cumulative wetland loss would be small.

A major source of pollution of the estuarine and wetland environments is from nonhydrocarbon chemicals. These chemicals have resulted in chronic and long-term impacts. Acid rain falling on the upper reaches of Atlantic estuaries has been implicated in the decline in striped bass population (Kahn, 1985). Nutrient input from point sources (e.g., sewage outfalls) and nonpoint sources (e.g., urban and agricultural runoff) have caused anoxic conditions in some deepwater estuarine areas, making them uninhabitable for aquatic life. Eutrophication (i.e., increased nutrient levels and decreased oxygen levels) has also resulted in killing sea grasses, thus reducing the habitat for the larvae of many fish and shellfish species (Kemp et al, 1983). Some of the changes that have been noted in estuaries along the Atlantic coast are declines in fish productivity, anoxia-related fish kills, increases in fish diseases, changes in the distribution of aquatic sessile organisms, impairment of nursery functions, eutrophication, and habitat loss (Bricker et al, 1999). Closures of specific shellfish areas have been invoked because of pollutant levels. Passage of a series of amendments and new laws since 1970 has served to reverse the trend of pollutants reaching the estuarine areas along the coast; however, pollutant levels for most toxic substances have not yet dropped to levels measured in the early 1900's. With the difficulty in controlling nonpoint source pollution, it is expected that estuarine and wetland areas will continue to be affected by various pollutants. This will be especially true in highly urbanized areas and areas with extensive agricultural activities. In addition to being degraded by pollution, wetlands are continually being lost from draining, dredging, and filling to enable development of private and recreational facilities. Impacts from these activities can be very high in localized areas and are mostly irreversible. Additionally, much wetland area is lost to natural processes such as sea-level rise, subsidence, compaction, and wave action along with resultant coastal erosion.

Spills from tanker transportation of crude and refined oil and OCS oil production account for less than half of the oil in the marine environment (NRC, 2003a). Over 50 percent of the oil in the marine environment comes from municipal and industrial wastes and runoff. Based on the level of foreign imports over the next 40 years, it is assumed that there would be 2 large tanker spills that would not be attributable to OCS activities (Table IV-17).

### Conclusion

Impacts on estuaries and wetlands of the Atlantic States vary widely. Many areas experience no impacts while other areas are experiencing long-term, chronic impacts. In spite of efforts to reduce pollution entering estuaries and wetlands along the Atlantic coast, it is expected that many of these environments will continue to be degraded. Cumulative activities are expected to cause chronic impacts on estuaries and wetlands along the Atlantic coast. Ongoing sea-level rise and beach stabilization projects will continue to cause accelerated coastal erosion and submergence of wetland habitats. Proposed OCS activities are not expected to contribute measurably to these ongoing cumulative impacts on Atlantic estuaries and wetlands.

## h. Seafloor Habitats

Cumulative impacts to seafloor habitats could result from the combined effects of the direct and indirect impacts of OCS exploration, development, and production and the impacts of other activities occurring in and near the lease areas before, during, and after the lease period. Stipulations included in the OCS leases would reduce their impacts to a minimum level, particularly in light of the modest amounts of activity and petroleum discovery predicted for the lease area. Other natural occurrences or activities contributing to cumulative impacts would include natural petroleum seeps, ocean dumping, offshore non-energy mineral development, marine transportation, NASA/USDOD activities, land-based coastal pollution sources, and seafloor disturbances from commercial fishing.

Because there are currently no oil and gas activities in the mid-Atlantic area and none of the previous OCS lease sales resulted in a discovery of commercial quantities of oil or gas, the likelihood of such activities occurring beyond those projected for the current proposal would be highly speculative, and as a result the extent of such activities is not reasonably foreseeable. Therefore, for purposes of analysis, no oil and gas exploration or development activity is projected for the mid-Atlantic beyond the proposed lease sale, and the activities assumed for the cumulative case are limited to those identified for the proposed action (see Table IV-3).

Natural seeps of crude petroleum off the Mid-Atlantic coast occur where oil leaks from between geologic layers. In North America, approximately 63 percent of total crude oil inputs into marine ecosystems are from natural seeps (MMS, 2002a). In many areas, although the amount leaked can be significant, the slow pace at which it is released into the environment allows ecosystems to adjust to its presence (NRC, 2003a). More studies need to be done in order to accurately assess the cumulative impact of natural seepage with anthropogenic sources of petroleum (NRC, 2003a) but, given the small amounts of hydrocarbons projected from the proposed sales during the lease period and the absence of a known problem associated with seeps there, the likelihood of any cumulative impacts is very low.

Only one ocean dumping site relevant to the Virginia lease area is reported to have had any dumping activity in the last three decades (USEPA, 1998b). This site, the Dam Neck ocean disposal site, is located offshore the Virginia coast between Virginia Beach and the mouth of Chesapeake Bay (see Fig. IV-1). Only four reported projects used the site since 2000 and all were channel dredging projects completed by the Army Corps of Engineers (Peter Kube, COE, pers. commun., Feb. 2, 2006). In 2004, three naval vessels were sunk between 648-704 km (350-380 nautical miles) east, and east-north-east of Norfolk. No other dumping activity was reported off the coast of Norfolk for 2004 (USEPA, 2005c). Thus, while there is some limited potential for a tanker accident to interact with this ocean dumping, there would be no potential for other OCS activities, including pipelines, which would be routed around this area, and drilling and production activity, which would be located far offshore, to interact cumulatively with ocean dumping impacts to seafloor habitats.

Through an agreement with MMS, the City of Virginia Beach plans to use 1.53 million cubic meters (2 million cubic yards) of sand from Sandbridge Shoal for a planned beach nourishment project at Sandbridge Beach. The project is presently scheduled to begin September 2006. The borrow site will be the same area utilized for previous renourishment efforts, located approximately 5-8 km (3-5 miles) offshore Sandbridge Beach. The City plans to use about 382,300 cubic meters (500,000 cubic yards) of sand for Sandbridge Beach every other year.

In addition to the Sandbridge Beach project, MMS is working with the COE to use a Federal ocean borrow site located approximately 5-6.5 km (3-4 miles) offshore Virginia Beach, in the Cape Henry area, to place sand on a portion of the Virginia Beach resort strip. Approximately 764,600 cubic meters (1 million cubic yards) of Federal OCS sand will be needed for this project, which is expected to begin sometime in calendar year 2007.

These projects could have the potential for cumulative impacts on seafloor habitats and could conflict with construction of a gas pipeline to shore, should commercial quantities of natural gas be discovered and produced. However, under the hydrocarbon transportation stipulation, the pipeline could be routed to avoid these areas, and thus the likelihood of cumulative impacts would be negligible.

Vessels of all types and sizes from ports all over the world call at Hampton Roads. The service vessels supporting any offshore oil and gas activities and tankers transporting oil produced in the mid-Atlantic lease area would be a small addition to the existing vessel traffic in the Hampton Roads area. Any impacts from vessels associated with oil and gas activities would be in addition to impacts from existing and future commercial and recreational vessels. These could include some adverse impacts to seafloor habitats due to vessel discharges and accidental oil spills. However, the potential addition to cumulative impacts from OCS-related tanker discharges and oil spills would be extremely small. Moreover, during the life of the Proposed Program, it is assumed that only 2 oil spills greater than 1,000 bbl could occur in the entire mid-Atlantic area from tankers carrying imported oil. In addition, one 1,500-bbl OCS spill is assumed for analytic purposes (Table IV-17).

Both NASA and the USDOD use portions of the Mid-Atlantic Planning Area. The area surrounding Norfolk, Virginia is homeport for a majority of the U.S. Atlantic Fleet air and surface units. These and other units use warning areas W-386, W-72A, W-107, and W-108 (see Fig. IV-1). NASA operates a warning area offshore the Wallops Island Flight Facility, which is kept free of surface activity during rocket launches (see Fig. IV-1). However, due to the depth of the waters in these areas, and the fact that the USDOD and lessees will coordinate activities in these areas, the likelihood of cumulative impacts with NASA/USDOD activities to seafloor habitats is extremely remote. The military area stipulation would reduce the potential for cumulative electromagnetic emissions or physical damage impacts by reducing the use of electromagnetic emissions by OCS lessees in certain areas and by separating lessee operations and military activities in area and time.

Human and natural activities have resulted in substantial alteration or loss of coastal habitats within the mid-Atlantic region. Water quality along the Mid-Atlantic coast has been substantially impacted by both onshore and offshore activities. The development of gas processing facilities, pipeline landfalls, and petroleum transportation associated with offshore drilling would add a small increment to the area's impact on water quality and nearshore seafloor habitats. However, this contribution would be very small in relation to other pollution sources, and extremely unlikely to contribute to significant adverse impacts to nearshore seafloor habitats.

Bottom trawling is a fishing method that involves dragging very large, heavy nets over the seafloor to catch groundfish, prawns and other species. In the past, bottom trawls were used on fairly smooth seabeds in shallow water to catch species such as flounder and haddock. More complex deep-sea habitats were avoided because they were difficult to access, and there was a risk of snagging the nets. However, as coastal fish stocks became depleted, trawlers sought fish in deeper waters. Since the mid-1980s, innovations such as Global Positioning Systems have enabled access to deep-sea habitats, without risking damage to the nets.

Bottom trawling also has a major impact on the seafloor by removing or destroying the epifauna in the immediate area, especially on more sedentary areas such as live bottoms (National Academy of Sciences, Ocean Studies Board, 2002). Bottom trawling is not allowed in Virginia State waters, up to 5 km (3 miles) from shore, but is common in the Federal waters of the Mid-Atlantic. Scallops and demersal species are caught in this region by trawling methods. In areas where bottom trawling is altering seafloor habitats, OCS oil and gas activities that also disturb the seafloor, such as platform construction and pipelaying, would add to these impacts as well as pose use conflicts with bottom fishing. However, given the low level of OCS activity proposed for this lease sale, these contributions to significant adverse cumulative impacts would be very small.

The stipulation for protecting important or unique biological populations or habitats would require the lessee to modify operations to ensure that significant seafloor biological populations or habitats deserving protection would not be adversely affected. Compliance with this stipulation would greatly reduce the likelihood of direct and indirect impacts to seafloor habitats from OCS activities and, therefore, also minimize the OCS activity contribution to cumulative impacts.

### Conclusion

Non-OCS oil and gas activities, in particular bottom trawling, are expected to continue to be the main causes of impacts to seafloor habitats in the Mid-Atlantic Planning Area. As a result of the implementation of the lease stipulations and the modest projections for exploration, development, and production activities associated with this lease sale, incremental impacts from OCS activities would be small. If a large oil spill were to occur from an import tanker or a tanker carrying OCS oil, it is unlikely to contact ecologically sensitive seafloor habitat.

## i. Areas of Special Concern

### (1) National Marine Sanctuaries

The only marine sanctuary in the Mid-Atlantic Planning Area is the Monitor National Marine Sanctuary (NMS) offshore North Carolina. Norfolk Canyon, which was being designated as an NMS, is the only potentially protected marine segment within the proposed mid-Atlantic lease area. Because sanctuary designation for Norfolk Canyon is reasonably foreseeable during the 40-year life of the proposed action, this analysis considers it a marine sanctuary.

Natural seeps do occur off the mid-Atlantic coast. While little if any research has been performed to determine the impact of seeps on biological communities in the Atlantic Ocean, studies off Coal Oil Point in Santa Barbara County, California, have found that individual seeps are not always active. Fresh oil, which is the most toxic, tends to reach only small parts of any one biological community at a time. The production of some organisms, such as nematodes, appears to increase near seeps. Other species, including adult gulls, learn to avoid such occurrences. Plants and organisms along the ocean bottom are most affected, since that is where the oil is released (Dunaway, 2006). The environments of future marine sanctuaries in the study area may be similarly adapted to natural seeps.

Substantial air emissions attributed to commercial, recreational, and military vessels, occur near East Coast urban areas. Emissions of $NO_x$, $SO_x$, VOC, and $PM_{10}$ can enter the ocean environment. Phytoplankton in the surface waters can become damaged and cause algal blooms that limit the passage of light to deeper levels. Creatures ranging from zooplankton to birds have been known to swarm to such locations. Such occurrences may disrupt somewhat the ecological functions of marine sanctuaries, although the cumulative impact of potential damage due to air emissions is expected to be negligible.

Two large oil spills from tankers carrying imported crude oil, several small OCS spills and one 1,500 bbl OCS spill are assumed in the cumulative case scenario (Table IV-17). These spills may affect surface waters and biological resources present within the marine sanctuaries via water quality degradation, direct oil contact, and fouling of habitat. Effects of oil spills to marine sanctuaries could be long-term and wide ranging depending on spill location, season, local current and wind conditions, as well as oil-spill response, cleanup, and containment successes. The greatest potential for impacts to occur from oil spills would be from a seafloor pipeline accident near a marine sanctuary. The large OCS spill, however, would occur from a barge or tanker either on route to a shore facility or while offloading at the facility because the pipeline installed from the platform to shore will carry only natural gas.

The establishment of an undersea, warfare training range by the U.S. Navy off the coast of North Carolina, and other U.S. Department of Defense activities, could impair marine sanctuary resources. For example, the placement of underwater transducer devices or cables or other destructive activities could occur near the protected areas. Underwater noise may stress marine mammals and sea turtles that would otherwise find refuge in protected sanctuaries, thereby altering community dynamics. Visitor use by divers and fishermen could be reduced as well.

Bottom trawling, which does occur in the deep sea and therefore could impact Norfolk Canyon, is restricted in marine sanctuaries and does not pose a significant threat to them.

### Conclusion

The cumulative impact of oil and gas activity in combination with the impacts of other activities on marine sanctuaries in the mid-Atlantic is expected to be minor. If oil and gas activities occur near the future Norfolk Canyon NMS, air emissions, water discharges, and oil spills may contribute to localized, temporary impacts on habitat health. If a large oil spill from oil and gas activity and the two large spills assumed from import tankers occurred in the area of the sanctuary, impacts could occur to sensitive marine sanctuary habitats. These would be surface spills, and the sanctuaries would not be exposed to direct contact from the spilled oil.

## (2) Estuaries and Reserves

The Chesapeake Bay is federally protected as the largest and most biologically diverse estuary in the United States. Research experiments are continually conducted on the Bay to improve management of the environmental consequences of human activities. Chesapeake Bay Reserves in Maryland and Virginia are the only National Estuarine Research Reserves in the Mid-Atlantic Planning Area. National Estuaries in close proximity to the proposed lease area include Delaware Island Bays (Delaware), Maryland Coastal Bays (Maryland), and Albemarle-Pamlico Sounds (North Carolina).

When sand dredged at the mouth of the Bay is then dumped at the Dam Neck disposal site located offshore the Virginia coast between Virginia Beach and the mouth of the Bay, water and air quality, fish and other marine organisms, and seafloor habitats at the disposal site are temporarily altered. Similar impacts occur when private companies dump dredged material from civil works projects at Craney Island in Norfolk, Virginia, which is surrounded by Bay waters. In addition, scientists have speculated whether the loss or accumulation of materials on the ocean floor may affect the physical dynamics of the ocean (i.e., the degree of wave energy concentration) during storms, possibly resulting in more intense destruction to estuaries and other protected coastal resources during storm surges (MMS, 1997a).

Vessel traffic in and out of Hampton Roads, where over 41 million tons of civilian cargo is shipped annually, is a significant source of air emissions and water discharges to the Chesapeake Bay and possibly to other estuaries up and down the coast. Nitrogen and chemical contaminants from atmospheric deposition impair ecosystem function. Fecal coliform and pathogens from marine sanitation devices on recreational vessels, onboard wastes, and accidental oil spills are additional pollution concerns. Soil erosion caused by wave action along shorelines contributes to sediments that can smother bottom-dwelling plants and animals, prevent their exposure to light, and harm them if toxic.

Point sources of land-based pollution include municipal waste sites, industrial and sewage treatment plants, and industrial and electric generating facilities. Nonpoint source pollution results from agricultural and industrial runoff. The cumulative impact of land-based point and nonpoint source pollution impairs estuarine health and function. Extensive coastal development also results in habitat loss that can indirectly affect estuaries and reserves.

#### Conclusion

Oil and gas activity will result in few additional impacts on the estuarine environment. Major impacts could occur to estuarine resources if three large oil spills occurred over the 40-year life of the Proposed Program near the mouth of the Chesapeake Bay. As discussed in previous sections, the extent of impact on estuarine environments such as the Bay would depend on a variety of factors including the location, size, and season of each spill, and the effectiveness of cleanup strategies.

### (3) National Parks, Seashores, and Refuges

National Parks and Seashores in the Mid-Atlantic Planning Area include Assateague Island (Maryland), Cape Hatteras (North Carolina), and Cape Lookout (North Carolina). National Wildlife Refuges (NWR's) immediately adjacent to area of the proposed action include Chincoteague, Wallops Island, Eastern Shore of Virginia, Fisherman Island, and Back Bay, among others (Fig. III-49).

Sandbridge Beach is located just north of the Back Bay NWR. A proposed beach nourishment project for Sandbridge Beach would use dredged sand from the ocean floor at Sandbridge Shoal. Beach nourishment activities can affect sensitive habitat for birds and sea turtles onshore. If impacts of beach nourishment activities extend beyond Sandbridge Beach to the Back Bay NWR, the habitats of threatened and endangered species that visit the NWR (such as loggerhead sea turtles, piping plovers, peregrine falcons, and bald eagles) may be affected. However, it is doubtful that species and visitor use would decline by a measurable amount under a proper beach nourishment management scenario.

Other commercial and military activities that occur along the coast, such as rocket launches offshore at the Wallops Island Flight Facility, near the Wallops Island NWR, may indirectly impair natural resources and temporarily prevent recreational and species use of protected parks, seashores, and refuges.

#### Conclusion

The health of resources within mid-Atlantic areas of special concern is continually at risk due to the cumulative impact of numerous activities. However, the extent of impacts from oil and gas operations is expected to be minimal because no oil and gas exploration or development is projected beyond the limited activities from the proposed 2007-2012 program.

## j. Population, Employment, and Regional Income

The U.S. Census Bureau's low-range estimate for the increase in the national population by 2030 is 7 percent; its high-range estimate is 46 percent. Significant population growth within the Chesapeake Bay region is considered a near certainty, given current economic conditions.

Virginia's population residing in the Chesapeake Bay region is expected to grow from 4.7 million in 1990 to almost 6 million by 2010. The population in the Chesapeake Bay watershed alone is projected to grow about 25 percent from approximately 15 million in 2000 to nearly 19 million in 2030. This increase is due not so much to inherently high birth rates or low death rates, but to continued net immigration into the region and through domestic relocation in response to economic opportunities and a perceived high quality of life. Generally, the fastest growing areas are close to the Bay and its tidal tributaries: the Baltimore-Washington metropolitan region, Richmond and Hampton Roads, and the suburbs and exurbs surrounding these cities (Chesapeake Bay Program, 2003).

Population growth projections indicate that Hampton Roads, Newport News, and the Peninsula will all have significant population increases between 2000 and 2020 (Table IV-21). In addition, the Hampton Roads population is estimated to grow to 1,993,800 in 2030.

Hampton Roads has a labor force of over 750,000 people, replenished annually by 15,000 qualified, exiting military personnel. Approximately 35,000 people work in the maritime or distribution and logistics sectors. It is calculated that 6,000 such jobs are created every year. Total employment in Hampton Roads in 2005 was 769,000 (Table IV-22) and is expected to grow to 1,202,700 in 2030. By 2030 the gross regional product in Hampton Roads will be almost $115 billion, nearly doubling from 2000 (Whaley, 2004).

In addition to the military, the Hampton Roads economy is fueled by economic clusters that include the port, tourism, and senior industries.

The maritime industry has been a mainstay of the area's economy for several centuries. The area's status as an intermodal center emanates from the fact that it has a deep, ice-free harbor that is centrally located along the eastern seaboard. Because of its natural assets, the port has become one of the Nations most important.

The flow of commerce through the harbor has produced a significant benefit to the Hampton Roads economy. In fact, according to a recent study, the Port of Virginia, most of which is located in Hampton Roads, generated nearly 165,000 jobs in the Commonwealth and $584 million in wages. In Hampton Roads, the port generated 8,525 direct jobs, excluding the additional indirect jobs created through the multiplier effect. Projections of future port traffic suggest that a continuation of the port's rapid growth is likely. The port is likely to continue to gain market share in future years, because Hampton Roads may be the first region on the East Coast to provide the 50-foot channels required to accommodate the new generation of megaships (Old Dominion University, 2001).

A recently commissioned study by the Virginia Port Authority forecasts a container cargo average growth of 4.3 percent per year over the next 30 years. If these predictions prove to be accurate, then container traffic at the Port would quadruple over the next 30 years (Old Dominion University, 2001).

The tourist industry has also been a critical component in the regional economy for many years. In 1998 tourism accounted for over 5 percent of the area's gross regional product. In 2000, 42,000 workers employed in the tourist industry were paid $700 million in wages. During the 1990's, growth in local tourism expenditures surpassed both the State and national rates (Hampton Roads Planning District Commission, 2005a). A continuation of this growth appears likely since travel expenditures are projected to rise over the next several decades as the baby boomers retire and increase their expenditures on travel and other leisure-time activities. Additional growth in the region's cruise and convention businesses can also be expected.

Senior industries are those businesses that provide housing and services to retirees, especially those having above average incomes. Hampton Roads is already attracting affluent seniors in significant numbers from areas to the north. The flow of seniors to the region is a clear indication that Hampton Roads is a desirable location for retired persons with considerable financial resources (Hampton Roads Planning District Commission, 2005a).

As the above data clearly demonstrate, non-OCS related activity in Hampton Roads is expected to have a much more significant impact on demography and employment than the proposed action. While the incremental effects of the proposed action may result in the addition of a few hundred workers during certain phases of OCS exploration and development, their addition to a population that is already increasing at a rate many times that number will hardly be noticed. Likewise, the entry of workers from the proposed project will have little effect on the Hampton Roads work force. As many as 6,000 maritime and distribution jobs are estimated to be added each year to the Hampton Roads economy without any additional OCS activity.

### Conclusion

The population and economy of Hampton Roads are projected to grow at a steady rate over the next 30 years. The arrival of sufficient oil and gas workers to develop and maintain the OCS oil and gas activities is not expected to impact the population or the economy of the area.

## k. Sociocultural Systems and Environmental Justice

Executive Order 12898 on environmental justice for minority and low-income populations was issued in 1994. It specifies that "… 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" (59 FR 7629).

The amount of routine activities and accidental oil spills in the cumulative scenario is assumed to be the same as under the proposed action. Because of the uncertainties over the amounts and economic viability of oil and gas deposits offshore, Virginia it is not reasonably foreseeable at this time to project additional lease sales and exploration and development activities beyond the 2007-2012 program. If leasing and exploration/development takes place as a result of the one lease sale proposed for offshore Virginia under the 2007-2012 program, more geological and geophysical information will become available to support estimates of future amounts of activities. For this reason, the cumulative analysis of OCS impacts is the same as the proposed action analysis contained in Section IV.B.4.k.

Among all 50 States, Virginia saw the seventh largest increase in residents aged 65 and over between 1990 and 2000. Over the past several decades the Hampton Roads region's population has aged faster than the national population. Between 2000 and 2010, Hampton Roads will experience a major increase in its residents who are 55 and over. The net result of this trend will be a significant "graying" of the overall population (see Table IV-23). This above-average rate of community aging (expressed through the average age of the population) has been brought on by the decline in the number of military personnel in the region (largely young persons) along with the in-migration of retirees from other locations north and west of Hampton Roads.

Elderly populations, as well as others, are attracted to Hampton Roads because of its quality of life, including attractive climate, the presence of museums and recreational facilities, the scenic quality of its natural environment, house quality and prices, air and water quality, the presence of universities, and the local cost of living. Numerous residential projects have been constructed in the Hampton Roads area designed specifically for retirees, and many more are planned.

In the City of Williamsburg, for example, the population is highly concentrated within two age groups: the college age group (ages 18-24) comprises 46 percent of the total population, while approximately 12 percent are 65 or older. There has been a significant increase in the 45-64 age group from 1990 to 2000, indicating that the number of retirement-age residents is likely to show a marked increase in 2010. The proportion of permanent residents over the age of 65 is significantly higher in Williamsburg than in the surrounding region (13.9%), Hampton Roads (10.9%), or the State (11.9%). As the "baby boom" generation ages, the 65-and-over age group will continue to grow as a segment of the overall population. (City of Williamsburg, 2005)

As a whole, Hampton Roads has a larger proportion of black residents than either the State of Virginia or the Nation. Williamsburg remains predominantly white according to the 2000 Census. Whites accounted for approximately 78 percent of the total population in 2000, down slightly from 80 percent in 1990. African-Americans make up the most prominent minority group at 13 percent of the population while all other minorities account for nine percent of the total. Localities in the Hampton Roads region have similar racial mixes, each with a primarily white population. According to the 2000 Census, James City County has the largest white population in the region at 81 percent while upper York County has the largest African-American community at 20 percent of the total population. African-Americans make up the largest minority population in each locality.

Over two-thirds of Virginia's population change from 1990 to 2000 came from minority residents. In most of the cities of the Hampton Roads area, the white population declined between 1990 and 2000, despite a 6.7-percent growth rate, statewide. See Table IV-24 for a breakdown of the racial composition of the Hampton Roads area in 2005, as well as that of the State and the Nation.

A recent study of black-white integration in the fifty largest U.S. cities identified Virginia Beach as the city with the highest degree of residential integration. In Virginia Beach, 41 percent of the residents live on black-white blocks. In the Norfolk-Virginia Beach-Newport News Metropolitan Statistical Area (MSA), 47.7 percent of blacks live on blocks that are more than 20-percent white, and 10.3 percent live on blocks that are more than 50-percent white. Conversely, 32.4% of white residents live on blocks that are more than 20-percent black, and 1.3 percent live on blocks that are more than 50-percent black.

Compared to many other urban areas of the country, Hampton Roads has a high degree of black-white residential integration. Population trends indicate that segregation of blacks declined between 1980 and 1990, and continued to decline between 1990 and 2000. An indicator known as the "dissimilarity index" measures the percent of a group's population that would have to change residence for each neighborhood to have the same percentage of that group as the metropolitan area overall. The Norfolk-Virginia Beach-Newport News MSA, for example, had a "dissimilarity index" of 0.595 in 1980; 0.494 in 1990, and 0.460 in 2000. It is probably safe to assume that this trend will continue over time, and that neighborhoods in Hampton Roads will continue to be less racially segregated and more racially integrated. (Quinn and Pawasarat. 2003)

While some areas in the Norfolk-Virginia Beach-Newport News MSA are more than 80-pecent black, most of them are not concentrated in the harbor area where industrial development is taking place. In fact, most of the harbor area appears to be integrated, with small pockets of black-majority neighborhoods. (Quinn and Pawasarat, 2003).

While racial and ethnic characteristics are usually the primary considerations in environmental justice, the Hampton Roads case may be different. It appears that industrial areas are well-established, and expansions are controlled by both government and private-sector planning procedures that dictate racial considerations. In addition, there appear to be few neighborhoods in the industrial/maritime area that are home to a major minority population. The typical risk of locating industrial activities in neighborhoods where low-income minority groups reside may not be relevant.

Instead, a more likely endangered group may be the large (and rapidly increasing) population of elderly in Hampton Roads. Despite the presence of endangered groups, however, the likelihood that they will be affected by the proposed project is minimal. Both minorities and elderly in the area are much more likely to be affected by industrial development, in response to the demands for maritime and shipping facilities; gentrification of the inner city, in response to population pressures; and increases in construction activity in response to the growing tourism industry and population growth. In the unlikely event of an oil spill, these groups are no more likely to be impacted than others who live and work along the coast. Therefore, the issue of environmental justice is not relevant.

### Conclusion

The sociocultural systems of the Hampton Roads area do not appear to be vulnerable to the activities and impacts of the proposed project. In terms of environmental justice, concentrations of elderly residents, particularly low-income elderly, may be as much at risk as low-income minorities. However, this area is ethnically and racially integrated, and the risk from the proposed action is minimal, given other forces at work in the area. The proposal may have a low level of socioeconomic impacts on the Hampton Roads area; there would not be disproportionately high and adverse human health or environmental impacts on minority or low-income populations.

## l. Archaeological Resources

The following analysis considers the effects of trawling, sport diving, commercial treasure hunting, tropical storms, channel dredging, commercial shipping, and OCS activities associated with the proposed action in the Mid-Atlantic Planning Area. Specific types of impact-producing factors related to OCS mineral development considered in this analysis include drilling rig and platform emplacement, pipeline emplacement, anchoring, new onshore facilities, ferromagnetic debris associated with OCS activities, and oil spills.

### (1) Prehistoric Resources

Offshore development could result in an interaction between an inundated prehistoric site and a drilling rig, platform, pipeline, or anchors. Direct physical contact with a site could destroy artifacts or site features and could disturb the stratigraphic context of the site. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for eastern North America. Some of this information could be highly significant if very early sites (i.e. pre-Clovis) from postulated prehistoric European contact were damaged or destroyed by development activities.

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified prehistoric sites. Direct physical contact with a prehistoric site could cause physical damage to, or complete destruction of, information on the prehistory of the region and North America. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites have been located, evaluated, and mitigated prior to construction.

Because of the uncertainty about the occurrence of economic quantities of hydrocarbons offshore Virginia, we assume that there will be no additional exploration or development activity there above what is assumed to occur under the proposed action. Therefore, cumulative impacts from offshore oil and gas activities are the same as the impacts on prehistoric resources associated with the proposed action (Section IV.B.4.l).

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high probability for prehistoric archaeological sites as they are associated with drowned river valleys, which are known to have a high probability for prehistoric sites. It is assumed that some of the archaeological data that have been lost as a result of dredging have been significant and unique; therefore, the impact to prehistoric archaeological sites as a result of past channel dredging activities has probably been significant. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

The effects of trawling activities usually only extend into the uppermost portion of the sediment column (Garrison et al., 1989). This zone would already be disturbed by natural factors relating to the destructive effects of marine transgression and continuing effects of wave and current action. Therefore, impacts from trawling on most prehistoric archaeological sites are not expected to occur. Tropical storms and hurricanes have been a long-term impacting factor on coastal and shallow-water prehistoric sites in the mid-Atlantic region. Prehistoric sites in shallow waters or coastal beach sites are exposed to the destructive effects of wave action and scouring currents during these events. Under such conditions, it is highly likely that artifacts would be dispersed and the site context disturbed, resulting in the loss of archaeological information. Overall, a significant loss of data from nearshore and coastal prehistoric sites has probably occurred, and will continue to occur, from the effects of tropical storms. It is assumed that some of the data lost have been significant and/or unique, resulting in a significant level of impact.

An accidental oil spill could impact coastal prehistoric archeological sites. During the life of the 2007-2012 program, we assume that 2 oil spills greater than 1,000 bbl could occur from tankers carrying imported oil. In addition we assume 1 spill of 1,500 bbl from a tanker or barge, 1-2 spills of 50-999 bbl, and 5-10 spills greater than 1 but less than 50 bbl will occur from OCS development (Table IV-17). Archaeological resource protection during an oil spill requires specific knowledge of the resource's location, condition, nature, and extent prior to impact; however, the coastline of the Mid-Atlantic Planning Area has not been systematically surveyed for archaeological sites. Existing information indicates that, in coastal areas of the mid-Atlantic, prehistoric sites occur frequently along the barrier islands and mainland coast and the margins of bays and estuaries. Thus, any spill that contacts land would involve potential impacts to prehistoric sites.

Heavy oiling of a coastal area (Whitney, 1994) could conceal intertidal sites that may not be recognized until they are inadvertently damaged during cleanup. Crude oil may also contaminate organic material used in $^{14}C$ dating, and, although there are methods for cleaning contaminated $^{14}C$ samples, greater expense is incurred (Dekin et al., 1993). The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant archaeological information could result from the contact between an oil spill and a prehistoric archaeological site, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities.

## (2) Historic Resources

Direct physical contact between a routine activity and a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Because of the uncertainty about the occurrence of economic quantities of hydrocarbons offshore Virginia, we assume that there will be no additional exploration or development activity there above what is assumed to occur under the proposed action. Therefore, cumulative impacts from offshore oil and gas activities are the same as the impacts on historic resources associated with the proposed action (Section IV.B.4.l).

Onshore development could result in direct physical contact between the construction of new onshore facilities or pipeline trenches and previously unidentified historic sites. Federal and State laws and regulations initiated in the 1960's began requiring archaeological surveys prior to permitting any activity that might disturb a significant archaeological site. Therefore, it can be assumed that, since the introduction of the archaeological resource protection laws, most coastal archaeological sites have been located, evaluated, and mitigated prior to construction.

Most channel dredging occurs at the entrances to bays, harbors, and ports. These areas have a high potential for historic shipwrecks, and the greatest concentrations of historic wrecks are likely to be associated with these features (cf. Garrison et al., 1989). Assuming that some of the data lost have been unique, the impact to historic sites as a result of past channel dredging activities has probably been significant. In many areas, the COE now requires remote sensing surveys prior to dredging activities to minimize such impacts (Espey, Huston & Associates, 1990).

Trawling activities usually only affect the uppermost portion of the sediment column (Garrison et al., 1989). On many wrecks, this zone would already be disturbed by natural factors and would contain only artifacts of low specific gravity (e.g., ceramics and glass) that have lost all original context. Therefore, the effect of trawling on most historic shipwreck sites would be minor.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from shipwreck sites. While commercial treasure hunters generally impact wrecks with intrinsic monetary value, sport divers may collect souvenirs from all types of wrecks. It is assumed that some of the data lost have been significant and/or unique. The known extent of these activities suggests that they have resulted in a major impact to historic-period shipwrecks.

Tropical storms and hurricanes have been a long-term impacting factor on historic sites in the mid-Atlantic region. Shipwrecks in shallow waters and coastal historic sites are exposed to a greatly intensified longshore current and high energy waves during tropical storms (cf. Clausen and Arnold, 1975). Under such conditions, it is highly likely that artifacts of low specific gravity would be dispersed. Some of the original information contained in the site would be lost in this process, but a significant amount of information may also remain. Overall, a significant loss of data from historic sites has probably occurred, and will continue to occur in the mid-Atlantic coastal area from the effects of tropical storms. It is assumed that some of the data lost has been historically significant and/or unique, resulting in a significant level of impact.

In 2003, Hampton Roads was ranked eighteenth in U.S. ports with over 41 million tons of civilian cargo shipped annually (AAPA, 2003). This amount of ship traffic through the mid-Atlantic region has probably resulted in an accumulation of ferromagnetic debris on the seafloor concentrated in the vicinity of the major ship channels. Under the proposal, oil and gas exploration and development on the OCS will result in the deposition of some additional ferromagnetic debris on the seafloor. This modern marine debris will tend to mask the magnetic signatures of historic shipwrecks, particularly in areas that were developed prior to requiring archaeological surveys. Such masking of the signatures characteristic of historic shipwrecks increases the potential that significant or unique historic information may be lost. However, the MMS requires avoidance or investigation of any unidentified magnetic anomaly that could be related to a shipwreck site prior to permitting bottom-disturbing activities; therefore, the increase in impacts to historic shipwrecks from magnetic masking is probably minor.

An accidental oil spill could impact a coastal historic site, but the direct impact of oil on most historic sites would be temporary and reversible. During the 40-year life of the proposed mid-Atlantic lease sale, it is assumed that 2 oil spills greater than 1,000 bbl could occur from tankers carrying imported oil. This is in addition to the assumptions under the proposal for 1 spill of 1,500 bbl, and a mean number of 1-2 spills of 50-999 bbl, and 5-10 spills of greater than 1 but less than 50 bbl (Table IV-17). The major source of potential impact from oil spills is the harm that could result from unmonitored shoreline cleanup activities. Unauthorized collecting of artifacts by cleanup crew members is also a concern, albeit one that can be mitigated with effective training and supervision. Damage or loss of significant historic information could result from oil-spill cleanup activities, but it is unlikely that entire sites would be destroyed without any mitigation during cleanup activities; therefore, the cumulative impact from oil spills to historic archaeological sites would probably be moderate.

### Conclusion

Under the cumulative scenario, the potential impact to both prehistoric and historic archaeological sites from routine activities under the proposal should be largely eliminated due to archaeological surveys which are required prior to disturbance. The factors not related to OCS mineral resource activities that probably have had, and will continue to have, an impact on both prehistoric and historic archaeological sites are channel dredging and tropical storms. Commercial treasure hunting and sport diving may result in a loss of artifacts at historic-period shipwreck sites. The primary oil-spill impacts to both prehistoric and historic archaeological sites would result from cleanup activities.

## m. Land Use and Infrastructure

Virginia's coastal zone, roughly defined as the portion of Virginia east of Interstate 95, is home to the majority of the Commonwealth's population, largely in the highly developed areas referred to as the "urban crescent." Between 1990 and 2000 the population of Virginia's coastal zone increased by more than half a million people, accounting for more than 60 percent of the population growth in the entire State. Over the next 20 years, suburban development will convert hundreds of thousands of acres of Virginia's coastline from forest, wetland, and farm fields to urban and suburban land uses. If the population continues to increase as it did between 1990 and 2000, Virginia's coastal zone will add an additional 1 million residents by 2020.

Chesapeake Bay Preservation Act ordinances provide tools for local governments to manage land development along the vast majority of Virginia's coastline. The program requires Tidewater localities to prepare inventories of environmentally-sensitive land features, to designate Chesapeake Bay Preservation Areas based upon the findings of that data collection and analysis, and then to amend their local land-use management systems, including zoning and subdivision ordinances and comprehensive plans, in order to protect water quality.

Much of the coastline around Hampton Roads is dedicated to industrial and maritime activities. Three marine terminals located in Norfolk, Newport News, and Portsmouth serve the region as the second busiest general cargo port on the east coast. During the past 10 years, the amount of general cargo handled by the port has increased by more than 60 percent, and it is forecasted to further increase 300 percent by 2010.

Plans for a 15-year and $400 million expansion are expected to double capacity of the port. The Navigation Management Plan for the Port of Hampton Roads covers all navigation-related activities within the port, including commercial, military, and recreational boating. New construction elements include channel deepening for the Norfolk Harbor Channel, the Channel to Newport News, the approach channels, the Elizabeth River Channel, and the Southern Branch Channel; widening the turning area at the Sewell's Point Anchorage; and extending the life and potential port development of the Craney Island Dredged Material Area.

Plans call for a fourth terminal to be added on Craney Island at a cost of $1.8 million. The completion of this terminal would add 2 million containers to the port's capacity, nearly doubling its current capacity. Plans for the facility include a container terminal area of 700 acres, 600 acres for other storage, eight 1200-foot berths, and an inter-modal rail yard. The project is scheduled to be built in four phases between 2013 and 2028, with Craney Island becoming operational in 2016. The Craney Island expansion is expected to increase port capacity by 50 percent and provide room enough to handle the growth in cargo through the year 2035.

Despite plans to close or downsize military facilities around the country, the Pentagon plans to expand operations at the Norfolk Naval Shipyard, Norfolk Naval Station, and other facilities in South Hampton Roads. Today, Naval Station Norfolk occupies about 4,300 acres of Hampton Roads real estate on a peninsula known as Sewell's Point. Naval Air Station Oceana maintains and operates airfield and heliport facilities at Chambers Field, consisting of two heliports, four helipads, and an 8,000-foot runway. Chambers Field is also home to the Air Mobility Command Passenger and Air Cargo Terminal, which processes 12,000 passengers and more than 800 tons of cargo each month for military missions worldwide. Pilots perform approximately 100,000 flight operations annually at Chambers Field.

For the duration of the proposed action, a support base would be located onshore in the Hampton Roads area to provide supplies and equipment to offshore facilities. In addition, a pipeline landfall and pipe yard, as well as facilities for supply and crew boats, will be constructed. All of these construction activities will require acreage in the Hampton Roads industrial area. Supply boats require an all-weather harbor, wharf space, and a nearby repair and maintenance facility. Helicopters, which will make approximately 5-10 trips to the platform per week, will need a heliport. All of these facilities are available within the existing maritime infrastructure of Hampton Roads, and the airfield and heliport facilities of Chambers Field or other nearby airfields.

### Conclusion

Project needs for an undeveloped industrial site with water access, and for helipad facilities should be easily met within the Hampton Roads maritime and aviation infrastructure. Planned expansions contained in the Navigation Management Plan for the Port of Hampton Roads are of such a magnitude that the project needs should be easily accommodated in the same area, with minimum impact.

## n. Tourism and Recreation

The mid-Atlantic coastal region is a popular tourist destination because of the combination of historic sites, long stretches of oceanfront shoreline, numerous barrier islands, and wetland environments that provide recreational opportunities. Total tourism expenditures in some States along the coast is in the billions of dollars annually. The coastal recreation and tourism industry is continually working to sustain growth through promotional efforts. Sustained growth provides seasonal employment opportunities and tax revenues.

Commercial activities based out of Hampton Roads and the military presence throughout the area appear to go largely unnoticed by a majority of visitors, since the tourism industry in Virginia Beach has a positive economic outlook (House Joint Resolution 625, 2006). This suggests that most visual, audible, or natural impacts due to ocean dumping, offshore nonenergy mineral development, marine transportation, NASA and USDOD activities, land-based pollution, seafloor disturbance, and natural seeps are not currently major causes for concern. It is doubtful that the addition of oil and gas activity as proposed, a relatively minor operation in the scheme of activities, will result in a significant cumulative impact on tourism and recreation.

Past, present, and reasonable foreseeable future actions that may have the most direct impact on tourism and recreation include beach nourishment and impacts due to pollution. Based on historical spill rates, it is also assumed that 2 large spills ($\geq$ 1000 bbl) would occur from tankers carrying imported oil (Table IV-17).

The City of Virginia Beach has alerted the MMS that they may request nearly 500,000 $yd^3$ of sand for Sandbridge Beach every other year. This is in addition to the approximately 1,000,000 $yd^3$ of Federal OCS sand needed to replenish the Virginia Beach resort area. Beach nourishment is important to the tourism industry. Experiencing an adequate quantity and quality of sand is a main attraction to visitors who spend summer vacations at the beach from year to year.

Two large oil-spill events from import tankers, assumed in the cumulative case, could negatively impact the quality of sand dredged for beach nourishment if the spills occurred nearshore. Oil from spills may wash directly onshore. Either incident may result in visual degradation of the coastal environment and reduced access to public recreation areas. Coastal visitors may avoid the areas of oil-spill contact, thus causing economic losses to the industry. Resources that would otherwise be used for capital improvement at public recreation sites to enhance visitor experience and increase the number of tourists may be diverted to pay for cleanup activities. The 1 large oil spill assumed to occur, for purposes of analysis, from OCS oil and gas activity in addition to the 2 potential oil spills from import tankers, may result in amplified cumulative impacts (Table IV-17). However, the likelihood of all three spills affecting similar beaches to a similar extent within a span of a few years is very low.

Should commercial quantities of natural gas be discovered and produced, and should the construction of a gas pipeline to shore conflict with sand dredging on the Sandbridge Shoal, a significant impact may arise. Without sand from the shoal, Sandbridge Beach may lose sand and have difficulty accessing an additional sand resource at a comparable price. The loss of sand may reduce return visits by tourists. Also, if pipeline access for the oil and gas industry is ultimately approved, the Virginia Beach region could be negatively branded, causing adverse effects to tourism. Alternatively, tourists may be attracted to the site of the controversy. Any negative branding of the Virginia Beach area as a tourist destination due to the addition of oil and gas activity is expected to have a temporary and minor impact.

Placement of a platform as a result of the proposed 2007-2012 program may create visual impacts during the productive life of the platform, depending on the distance of the platform from shore. Regardless of platform location, there is a potential for visual impact by tourists arriving and departing on cruise ships out of Norfolk; however, there appears to be no detrimental impact on the cruise industry in other destinations, such as the Gulf of Mexico (House Joint Resolution 625, 2006). There is a potential for visual impact by recreational boaters who may not want any structures offshore. However, the production platform may actually serve as a visual point of navigation, communication, and search-and-rescue infrastructure, contributing to the overall safety of recreational and commercial boat traffic. The platform could also serve as a destination for recreational fishing, enhancing the recreational opportunities in the area.

Air emissions from vessels and other sources can contribute to regional haze, and scenic ocean vistas on a clear day can be drastically reduced. Wildlife viewing opportunities can be diminished. If beach closings, reduced visibility, and reduced wildlife viewing occur on a regular basis, visitors attracted to those features of the area may be tempted to vacation elsewhere.

### Conclusion

Marine vessels, dredging activities, and other existing activities that result in pollution harm the tourism industry to some extent. When water quality is seriously compromised, public beaches may be closed. However, even without oil and gas activities, government agencies regularly monitor the impacts of pollution and design and implement incentives to reduce significant impacts. Tourism and recreational resources are expected to not be diminished during the life of the Proposed Program as a result of cumulative impacts.

## o. Fisheries

Mid-Atlantic fisheries target a diverse array of coastal and estuarine species both commercially and recreationally. Identification, management, monitoring, and protection of essential spawning and nursery habitat for commercially and recreationally viable marine species are critical to the preservation and continued survivability of a harvestable stock. Along with the OCS oil and gas activity expected from the 2007-2012 program, non-OCS activities which are expected to impact commercial and recreational fisheries in the Mid-Atlantic Planning Area include dredging, coastal development, and overfishing.

Loss of wetlands through dredge and fill activities and coastal development pose a threat to fisheries. Some States, such as Maryland and Virginia, have implemented strict, “no-net-loss” regulations for wetlands that go beyond the Federal standards. These regulations are designed to prevent wetland loss either directly by prohibiting development, drainage, or alteration of these areas, or by requiring the creation of an equal area of wetlands for those areas destroyed. In recent years, the implementation and effectiveness of these regulations have been called into question. The primary concern regards whether the quality of the replacement wetlands actually matches the productive habitat potential of the wetlands destroyed. Also, while States have moved to prevent further loss of wetlands and other critical habitats, most States are succeeding only in slowing the rate of loss. It is likely that this trend will continue. Loss of habitat will result in diminished recruitment to the fishery and, consequently, diminished catches of recreational and commercial species.

Dredging projects have the potential to adversely impact key fishery resources and possibly the commercial fishing industry itself (Wainwright et al., 1992). Decimation of benthic community populations could result in a depletion of food source for commercial species such as red drum, weakfish, and silver hake. The fisheries most vulnerable to potential disruptions of commercial harvest from dredging activities are the shellfish and demersal fisheries. The most serious impact from offshore dredging is the loss to major commercial species of benthic shellfish such as surf clam (Nagui and Pullen, 1982). Other species of concern are the flounder, ocean quahog, Atlantic scallop, and the horseshoe crab.

In the Mid-Atlantic Bight, the five most common recreationally caught fish are summer flounder, Atlantic croaker, black sea bass, weakfish, and striped bass. These species accounted for approximately 63 percent of the total recreational catch by number in 1996 (Rountree et al., 1998). Of those, only the summer flounder might be potentially impacted due to habitat degradation as a result of dredging activities. The majority of recreational anglers that utilize private boats or charters tend to fish in areas that are not within areas being considered for dredge activities; therefore, the fishery should not be effected.

Additional seafloor impacts could occur from projected OCS oil and gas activity. The installation of one platform, one pipeline and the drilling of several exploratory wells will have a minimal footprint on the seafloor (Table IV-16). Impacts from OCS activity will be localized and not result in effects on the abundance or distributions of commercial and recreational fish in the area offshore Virginia. The presence of an offshore platform may have a positive effect on availability of recreational fishing opportunities. In the Gulf of Mexico, for example, approximately 20 percent of private boat fishing trips, 32 percent of charter boat fishing trips, and 51 percent of party boat fishing trips offshore Alabama, Mississippi, Louisiana, and Texas anchored within 300 feet of an oil or gas structure as the presence of structures aggregate pelagic and reef-associated fish species that are targeted by many recreational fishers (Hiett and Milon, 2002). A similar phenomenon could occur offshore Virginia.

The current burden of pollutants from existing sources poses a significant threat to commercial and recreational fisheries. Particularly vulnerable are spawning and nursery grounds in coastal areas, many of which are located in areas subject to anthropogenic pollutants. In many coastal areas, degraded water quality (usually high fecal bacterial colony counts from human wastes) has closed shellfish beds to harvest. A little over 8 million acres, or 81.6 percent of the total acreage classified for production in the Atlantic Region, were approved for shellfish harvest in 1980. By 1990, this figure had dropped to 6.9 million acres.

Approximately 75 percent of the Nation's commercial fish and shellfish depend on estuaries at some stage in their life cycle. About 78 percent of the commercial fish and shellfish in the Chesapeake Bay are dependent on estuaries and the wetlands that are an integral part of the estuarine ecosystems. Menhaden, striped bass, hard clam, and blue crab, which are important elements of the mid-Atlantic's commercial and recreational fisheries, are among the species that are dependent on the wetlands of this region. This tie to wetlands is so critical that the regional management plan for menhaden cites wetland loss as one of the principle threats to the fishery. Continued coastal wetland loss (along with fishing pressure) contributed to a 26 percent (pounds landed) decline in the menhaden fishery between 1983 and 1991 (Chambers, 1992), and this trend is expected to continued.

Most recreational fisheries occur inshore where the consequences of human activities are the most pronounced. In many coastal areas, runoff from municipal, industrial, and agricultural sources has resulted in contamination of estuarine and nearshore waters. With increasing population pressures along the Atlantic coast, combined with heavy burdens of contaminates presently bound up in the sediments, contamination of estuarine and coastal areas is expected to continue into the future, with or without any OCS oil and gas activity.

By far the greatest impact on commercial and recreational fisheries comes from the fishing industry itself. Scientists have recognized fishing as the most widespread form of human-caused disturbance on the North American continental shelf. Certain fishing practices, such as bottom trawling and dredging for finfish and shellfish, affect tens of thousands of square miles of seafloor each year, and damage and destroy sensitive seafloor habitat. With up to 70 percent of some harvestable stocks removed by fishing each year, most of the stocks of the historically desirable finfish are fully exploited, and many have declined in abundance. Increased fishing effort, with the resultant elevated fishing mortality, is probably the major cause of the drop in total commercial landings in the Atlantic Region from a peak in the early 1980's. The decline in landings has been accompanied by shifts in species composition, with previously less-desirable species now accounting for a greater proportion of the catches.

According to the USDOC's report to Congress on the 2001 status of U.S. fisheries (NMFS, 2002c), more than 40 percent of the Nation's federally managed fisheries (whose status has been assessed) are overfished, experiencing overfishing, or are approaching an overfished condition. Yet, due to economics, fishing methods and practices are likely to continue to follow current trends in commercial fisheries. High costs of fishing will force many fishermen to maximize their cash flow by fishing only for the most valuable species. This often leads to higher rates of discard of bycatch and less valuable species. These discards represent fish that were potentially available to the commercial fishery. Problems associated with fishing methods and practices are expected to continue or worsen as competition and fishing costs increase in the coming years. It is likely that heavy pressure will continue to be exerted on fisheries in the mid-Atlantic region as demand for fish products has increased over the past two decades and is expected to continue. Many of the commercial fisheries stocks are intensively fished and now depend on only 1- or 2-year classes to sustain the fishery.

Over the past several years, the number of recreational fishermen has increased along the Atlantic coast. For some species, recreational fishing exceeds commercial fishing and represents the primary source of mortality. As with commercial species, many stocks of recreational species are fully exploited. Assuming this trend will continue with the projected increase in population along the Atlantic coast, pressure on all fisheries can be expected to increase.

## Conclusion

Loss of fish habitat, particularly nursery and spawning grounds, is expected to continue. In combination with heavy fishing pressure, commercial and recreational fisheries can be expected to decline over the next 30 years. The two greatest threats to fisheries in the mid-Atlantic will continue to be coastal habitat destruction for residential and commercial development and the fishing industry itself.

# M. Unavoidable Adverse Environmental Effects

## 1. Impacts on the Physical and Biological Environment

Some unavoidable adverse effects on water and sediment quality would be expected to occur as a result of the proposed action. Operational discharges of drilling muds and cuttings, produced water, and small amounts of hydrocarbons into the water column during routine offshore oil and gas operations would lower local water and sediment quality. These discharges could raise the levels of some water quality and sediment parameters above normal within 100-2000 meters of the discharge point during drilling and intermittently/continuously during the production period.

An increase in emissions of air pollutants would be expected to occur, particularly in areas that do not already have extensive oil and gas activities. Emissions of nitrogen oxides and reactive hydrocarbons would increase ozone concentrations in the immediate vicinity of the offshore operations for intermittent periods during the term of the proposal.

Marine mammals would be adversely affected by noise and disturbances associated with routine offshore activities (seismic surveys, vessels, aircraft, drilling, and dredging) during relatively brief periods of time. Some marine mammals would exhibit, short-term responses to noises and disturbance, such as confusion or avoidance. Bowhead whales, for example, will exhibit avoidance behavior to noise producing activities. Should an oil spill contact marine mammals, some individuals would experience short-term effects, while a small number could die. An oil spill would also adversely affect local marine mammal prey resources in small areas affected by a spill.

Disturbances of terrestrial mammals by offshore-related aircraft, vehicles, facilities, human presence, and habitat alteration from construction activities are unavoidable. Disturbance of caribou, bears, and other animals in Alaska would be temporary and would not affect their overall distribution and abundance.

Marine and coastal birds would be adversely affected by noise and disturbances associated with routine offshore and onshore activities. Habitat alteration from the construction of onshore facilities would affect a small portion of the available habitat. Should an oil spill contact marine and coastal bird habitat, some birds would experience short-term effects, while some birds which feed in or rest on the water could be coated with oil and die. An oil spill could also adversely affect local marine and coastal bird prey resources.

Wetland and estuarine habitat alteration resulting from pipeline and other related coastal construction would have an unavoidable adverse impact on fish nursery areas; however, regulations are in place to minimize these impacts. An oil spill would have an adverse effect on local fishery stocks and food webs.

Although individual sea turtles may be injured or killed by support vessel collisions, population-level effects would be minimal. The most likely impacts from noise would be short-term behavioral changes such as diving and evasive swimming. If an oil spill were to contact sea turtles, some individuals might not recover from exposure, but sea turtle populations as a whole would not be threatened.

Adverse effects on seafloor habitats and associated organisms could occur from anchoring, drilling discharges, structure emplacement and removal, and pipeline emplacement.

## 2. Impacts on the Socioeconomic Environment

Commercial and, to a lesser extent, recreational fisheries will be adversely affected by loss of fishing areas occupied by offshore vessels, platforms, and exposed pipelines, particularly in areas where oil and gas activities are not currently occurring. Oil spills could contaminate, injure, or kill shellfish, finfish, eggs, and larvae in the vicinity.

Unavoidable adverse effects could be expected to occur to tourism and recreation areas from floating debris and oil spills that contact beach areas. Effects on scenic quality could also be expected to occur.

The proposed action with its ancillary activities will place increased demands on coastal communities, particularly in areas where oil and gas activities are not currently occurring. A large oil spill could disrupt their economies. Some unavoidable adverse effects on subsistence harvests in the Alaska Region may result from routine offshore oil and gas activities. These offshore and onshore activities could cause localized displacement or loss of small numbers of subsistence resources. If oil spills were to contact bowhead and beluga whales and walrus, there could be a reduction of total annual harvests of these species. Short-term loss of some subsistence resources and potential repercussions on the culturally significant sharing system would be unavoidable.

## N. Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The short-term uses of man's environment in relation to the OCS oil and gas program are the offshore and onshore activities needed to develop oil and gas resources to meet the energy needs of the Nation. The MMS makes every attempt to minimize the environmental effects from these uses. By adopting mitigating measures for OCS operations, MMS attempts to minimize long-term impacts and maintain or enhance the long-term productivity of areas in which oil and gas have been exploited. With proper removal of offshore oil and gas facilities, or their disposal in areas designed to enhance recreational fishing, offshore areas will continue to maintain fish resources and provide habitat for marine mammals, birds, and reptiles long after oil and gas operations have ceased. The onshore effects of the OCS program and the proposed action will contribute to the continuing alteration of nearby coastal areas, from biologically productive natural environments to urbanized and industrialized environments.

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 proposed action. The overall life of the proposed action is estimated to be about 40 years, with about 10 years of oil and gas exploration and delineation activity and about 30 years of resource development and production activity. Many of the effects discussed in Chapter IV are the result of short-term uses and are greatest during the exploration, development, and early production phases. These effects may be reduced by mitigation measures required by MMS.

Extraction and consumption of offshore oil and natural gas would be a long-term depletion of nonrenewable resources. Economic, political, and social benefits would accrue from the availability of these natural resources. Most benefits would be short-term and would delay the increase in the Nation's dependency on oil imports. The production of offshore oil and natural gas from the proposed action would provide short-term energy sources and perhaps additional time for the development of long-term alternative energy sources or substitutes for these nonrenewable resources.

Onshore facility construction (e.g., pipelines, processing facilities, service bases, etc.) causes definite short- and long-term changes, with localized long-term effects on coastal habitats along onshore pipeline corridors. Some biological resources, such as nesting birds, may have difficulty repopulating altered habitats and could be permanently displaced from the local construction area. Short-term biological productivity would be reduced or lost in the immediate onshore areas where construction takes place; however, the long-term productivity in some of these areas could be mitigated with habitat reclamation.

After the completion of oil and gas production, the marine environment is generally expected to remain at or return to its normal long-term productivity levels. To date, there has been no discernible decrease in productivity in U.S. offshore areas where oil and gas have been produced for many years.

In the Alaska Region, habitat destruction could cause a local disturbance to subsistence resources, which could threaten the regional economy and subsistence as a way of life. Road construction resulting from the proposed action will improve accessibility to primitive areas in the region. The wilderness values of the coast and along pipeline routes and associated access roads would decrease with increased human activity in these areas, particularly in areas that do not already have extensive oil and gas activities. Land-use changes would be noticeable at onshore facility sites and along pipeline routes. Short-term changes include a shift in land use from subsistence-based activities to industrial activities during the life of the proposed action. Areas adjacent to onshore facilities and pipeline corridors would probably be subject to hunting regulations. Land use in some localized areas would change from conservation to resource development. Long-term effects on land use may result if the infrastructure or facilities continued to be used after the lifetime of the proposed action.

Increased population, minor gains in revenues, and the consequences of oil spills all contain the potential for disrupting coastal communities in the short term. In Alaska, added incentive to shift from a subsistence-based economy to a cash-based economy, a reduction in subsistence resources, a decrease in subsistence activities, and other changes brought about by the proposed action could be factors in long-term consequences for Native social and cultural systems.

Archaeological and historic finds discovered during development would enhance long-term knowledge. Overall, finds may help to locate other sites; but destruction of artifacts would represent long-term losses.

# O. Irreversible and Irretrievable Commitments of Resources

## 1. Mineral Resources

The offshore oil and natural gas resources recovered as a result of the proposed action would be irretrievable once they are consumed.

## 2. Biological Resources

Offshore and onshore oil and gas activities, such as aircraft, vessel, and vehicle traffic; facility construction; and platform removal, could permanently displace some fauna and flora species from favorable habitats to unfavorable habitats. Displacement and habitat loss may result in the reduction of some local populations and become irretrievable if alterations to the environment were permanently maintained. However, the degree of displacement and amount of irretrievable habitat loss should represent a transitory and negligible effect on the overall populations of species.

An irreversible and irretrievable commitment of biological resources may occur where wetlands are impacted by dredging, construction activities, or oil spills. Dredging and construction activities can destroy wetland vegetation, which results in soil erosion and wetland loss. This loss would be greatest in areas where oil and gas activities are currently not occurring.

## 3. Land Use and Socioeconomic Resources

Land used for support of oil and gas development and processing would not revert back to its predevelopment characteristics; however, the land may become favorable to other urban or industrial uses.

## 4. Archaeological Resources

Irretrievable prehistoric archaeological sites and cultural materials may be lost through indiscriminate or accidental activity on known and unknown sites such as placement of a pipeline across a shipwreck. Loss of ground context in which artifacts are located is a very important factor in dating and relating an artifact to other artifacts. The orientation programs and the archaeological protection requirements should mitigate some losses.