Section IV

Environmental Consequences

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IV. ENVIRONMENTAL CONSEQUENCES

Preview of this Section

Earlier sections discussed administrative elements, alternative management strategies, and considerations affecting management decisions. This section examines how authorized activities, including oil and gas exploration and development, may impact the environment in and surrounding the Northwest NPR-A Planning Area.

- The types and levels of activities that are projected to occur in the Planning Area are described in Section IV.A. These activities include both non-oil and -gas activities and oil and gas activities. The scenarios also include estimates of accidental spills.
- The potential direct and indirect effects on important physical, biological, and social resources from the activities projected for the No Action Alternative and Alternatives A, B, and C are analyzed in Sections IV B through IV.E. (The potential impacts from activites projected under the Preferred Alternative are analysed in Section V.B.)
- The activities and potential impacts to important resources for the cumulative case are presented in Section IV.F.
- Specific aspects of the environmental consequences analyses--as well as analyses of two low-probability, potentially high-consequence scenarios--are presented in Sections IV.G. through IV.K.

After reading this section, you will understand the types and levels of activities that may occur in the Planning Area under all of the alternative management options and the potential environmental consequences of the projected activities.

A. Introduction and Basic Assumptions for Effects Assessment

This section examines how authorized activities, including oil and gas exploration and development, may impact BLM-managed lands in the Northwest NPR-A Planning Area. Activities other than oil and gas exploration and development are described in Section IV.A.1.a, while the activities that are associated with oil and gas exploration and development are described in Section IV.A.1.b. The potential effects of these exploration and development activities under the No Action Alternative and three leasing alternatives presented in the draft IAP/EIS are described in Sections IV.B though IV.E . The potential effects of exploration and development activities under the Preferred Alternative are described in Section V.B. The scenarios have been developed for varying levels of oil and gas exploration and development activities based on discovery and production of estimated ranges of crude oil under different sets of protective and restrictive measures. The analyses under Alternatives A, B, and C and the Preferred Alternative first focus on the potential impacts that may result from the first oil and gas lease sale under each alternative. This "first sale analysis" is followed by a discussion of the potential impacts from all lease sales--including the first sale--that may be authorized based on this IAP/EIS. Finally, cumulative impacts to important resources in the Northwest NPR-A are addressed in Section IV.F.

This section on environmental consequences should be read together with Section II, which explains the alternatives, and Section III, which describes the important resources and their occurrence and status within the Planning Area. The analyses of environmental consequences in this section build upon and relate to information presented in these earlier sections to identify which resources may be impacted and how and where impacts might occur under each of the alternatives. The maps, tables, and figures may be particularly useful to the reader's understanding of the potential impacts of each alternative upon the different resources that occur in the Planning Area.

Each of the alternatives includes mitigation in the form of stipulations and required operating procedures (ROP's). In the analyses that follow in Sections IV.C, IV.D, IV.E, and Section V the effectiveness of those mitigating measures is evaluated. A summary of the effectiveness of all of the mitigating measures proposed as part of the alternatives is provided in Appendix 12 . This list, however, is not a comprehensive list of all of the rules and regulations that lessen or mitigate potential effects. For example, there are State and Federal requirements that operators must have approved oil spill contingency plans. The State's oil discharge and contingency planning regulations contain requirements for wildlife hazing which could mitigate and lower adverse effects to birds, terrestrial mammals, and marine mammals if they are implemented during an oil spill.

The conclusions on the impacts of the various alternatives are compared in Appendix 2. The overall impacts under each alternative are summarized in Section II.D.

1. Ground-Impacting Management Actions

Ground-impacting management actions refer to those types of activities managed through BLM's regulatory and permitting processes. These activities may have some level of impact "on the ground" in the Northwest NPR-A Planning Area. For this IAP/EIS, ground-impacting activities have been divided into those that are not associated with oil and gas exploration and development and those that are associated with oil and gas exploration and development.

a. Activities Other Than Oil and Gas Exploration and Development

Other than oil and gas exploration and development, the BLM may undertake or authorize activities that could impact surface resources within the Northwest NPR-A Planning Area. This section describes the types of activities that may occur, their general locations, the time of year the activities would take place, and estimates of the frequency of such activities. The extent of some of the activities anticipated under each of the alternatives is summarized in Table IV-28. Standardized stipulations that would be commonly applied when non-oil and gas activities are authorized are presented in Appendix 13 .

(1) Aircraft Use

Light helicopters are commonly used to examine resources in a Planning Area, with light fixed-wing aircraft used less often and medium fixed-wing and medium helicopters used only occasionally. Heavy helicopters are extremely rare. These aircraft transport people, supplies, and equipment for fieldwork and fly surveys. Helicopters normally fly low and slow with a high level of noise. Fixed-wing aircraft typically produce less noise and usually fly higher and faster than helicopters.

Almost all aircraft activity takes place in summer. While aircraft would likely fly over nearly all of the Planning Area, some areas would experience greater traffic. Activities such as surveying natural resources and monitoring human use would concentrate along the primary river drainages within the Planning Area. Cultural and paleontological surveys would most likely involve the use of aircraft along the river drainages and the coast. Aerial wildlife surveys would occur most commonly during late June and early July over caribou and waterfowl areas.

(2) Excavation and Collection

Excavating and collecting archaeological, paleontological, geologic, and soil resources occur in summer. All excavation is by trowel or hand shovel and usually limited to an area of several square feet, rarely extending more than 3 ft below the surface. If an archaeological site is studied in detail or if a geologic section is mapped, then larger areas might be excavated. Excavations are backfilled, and in most cases, the vegetative layer is replaced atop the excavation. Most excavation would probably occur within the primary drainages of the Northwest NPR-A Planning Area.

(3) Ground Activities and Camps

Ground activities include small groups of scientists hiking across tundra or recreationists floating a river. Ground camps range from those with their own aircraft to camps with no more supplies than could be carried in a backpack. Larger camps include a fuel bladder of up to 5,000 gallons, or fuel in drums, and might have as many as 15 people. Smaller parties use "fly" camps that are set up and moved every few days by boat, raft, or aircraft, and have nothing more than stove fuel. Backpack camps have even fewer supplies than fly camps and tend to move every day.

Small camps might be located throughout the Planning Area. Larger camps would most likely be placed outside the Planning Area at the Inigok airstrip; the Lonely Distant Early Warning (DEW)-Line site in Sec. 17, T.18N., R.5W., Umiat Meridian; the Ivotuk airstrip in Sec. 13, T.11S., R.17W., Umiat Meridian; and a temporary camp on the Kiligwa River. Within the Planning Area, a likely spot for a temporary camp would be near the headwaters of the Meade River. All of these camps would have fuel facilities, and a fuel cache might be established at some sites, even if a camp were not present. Caches of jet fuel--commonly created to facilitate more economical aircraft use--must be equipped with spill cleanup material; and a cache of more than 50 gallons is required to be contained within a portable dike. Some solid wastes can be burned onsite and all non-burnable wastes are removed. Human waste at small temporary camps is disposed of as recommended in the National Outdoor Leadership School's *Leave No Trace*, Alaskan Tundra guidelines. Use of the Inigok airstrip and pad is likely to remain the same or increase slightly over the next few years to support Native allotment fieldwork and monitoring of endangered species.

(4) Hazardous and Solid Waste Material Removal and Remediation

Wastes--including those considered hazardous--are associated with human activity. A phased approach would be used to address hazardous- and solid-waste material in the Planning Area. This includes verification and site evaluation of uncontrolled releases of hazardous substances on BLM land. The process for hazardous waste removal is described below and is consistent with guidance and regulations from the Comprehensive

Environmental Response, Compensation, and Liability Act and the National Contingency Plan.

(a) Discovery, Site Verification, and Risk Assessment

Discovery and site verification initiate the removal and remediation process. Discovery is the realization or suspicion that a hazardous substance has been released or threatens to be released into the environment. This information can be brought forward by anyone.

In response to a discovery that a hazardous substance has been released or threatens to be released into the environment, trained personnel perform an initial incident/site examination. Land ownership is verified and the trained personnel confirm the release. This inspection and verification of discovery information potentially requires the use of helicopter or fixed-wing aircraft to move personnel to the site. This activity might require two to three weeks per field season. Actual time and extent of investigation depend on the number and types of reports or discoveries.

If a release is suspected or has occurred, a risk assessment determines whether the situation poses an imminent threat to either public health or sensitive environments. This assessment determines whether the situation warrants immediate action. If it does, an emergency response or removal action may be initiated.

A site evaluation should be conducted if the examination verifies either that the release of a reportable quantity of a hazardous substance (40 CFR 302.4) occurred, a threat exists, or a release is suspected and the situation does not warrant an emergency response. The evaluation process is concurrent with identifying potential responsible parties and cost-avoidance/cost-recovery processes. When the responsible party is identified, this party completes, under Federal and State oversight, all remaining evaluative and remedial actions.

(b) Site Evaluation

The first step in the evaluation is to document whether the released material is a hazardous substance and identify the potential targets of impact and the pathways for impact. This often includes collecting non-intrusive samples.

Site evaluation also determines the need and appropriateness of removal actions and whether expanded sampling is required. If required, further sampling and site characterization take approximately 2 weeks per site and often involve the use of shovels and hand augers.

Approximately 20 percent of sites will need more site characterization based on analytical results of the initial evaluation and the sensitivity of targets and pathways of concern. Drill rigs for deep sampling or hydropunches and backhoes for near-surface sampling can be used for studying groundwater and determining the extent of contamination. These advanced studies commonly require 3 to 4 weeks of field time. Approximately 80 percent of the drilled holes are backfilled immediately with the remaining borings usually becoming monitor wells. The recommendation that comes out of the evaluation may call for removal of contaminated material or other remediation measures.

Prioritization for removal actions would focus on areas of greater human contact or on biologically sensitive areas. Alternatives to removal might include in situ treatments such as fencing the site to secure it and to prevent contact by humans or wildlife, or capping the contaminated area with clean soil or gravel.

If necessary, contaminated materials would be excavated and removed for treatment and disposal. Excavation would generally not go deeper than 5 ft. Disturbed areas would be backfilled and leveled and erosion-control measures engineered. Removal activities might use heavy equipment, such as large and small backhoes, 988-size front-end loaders, bulldozers to the size of a D-9, dump trucks, pickups, and all-terrain vehicles. This type of equipment would be transported overland in winter. A barge might be used if the site is accessible by water.

For cleanup that can be accomplished only in summer, a gravel pad or road might be constructed for use during the operation to protect the underlying soil and vegetation. Such a pad could be removed after project completion.

If there is a need for further investigation of the site, a remedial site evaluation might be required to determine the relative significance of the site in terms of risk to targets. This stage also identifies cost effective and efficient permanent solutions for significant sites. These studies generally address more complex situations that require long-term treatments. There are required regulatory time frames for submitting remedial reports once the process has been initiated and sites are published in the Federal Register.

Most hazardous and solid material removal and remediation is a lengthy and expensive process--the exception being the occasional removal of fuel drums and scrap metal. Government parties who may be in the area for other purposes but who have a medium helicopter can use a sling to carry these items to appropriate disposal facilities. Removal of contaminated material that exceeds the scope of this small-scale removal by helicopter would require substantial funding.

(5) Overland Moves and Other Land Use Permits

The BLM issues minimum impact permits for overland moves and a variety of other activities in the Planning Area. Current management policy for the Planning Area allows only those activities that, with stipulations, would have a negligible impact on the environment. The poor soil conditions in the Planning Area limit the BLM's approval of most land use proposals for summer operations. Because of the fragile nature of thawed tundra during the summer, permit sites are restricted to durable areas such as gravel bars, beaches, or existing gravel pads. Permafrost underlies the entire NPR-A, and floodplains/wetlands cover the majority of the Planning Area. Vehicles used in overland moves would exert low ground pressure and be permitted to travel only over snow-covered ground that is frozen to a sufficient depth to minimize soil and vegetation impacts. Typically, overland moves originate in Prudhoe Bay or Oliktok Point with the primary destination of Barrow. Overland moves from Barrow to Atqasuk and Wainwright also occur. If conditions allow, travel takes place exclusively on offshore ice. If the ice were determined not to be sound, portions of the trip would be made overland, following the shoreline. For safety reasons, moves farther inland may also occur. Overland moves to Atqasuk would always be across the tundra. Overland moves usually begin in December when there is adequate snow cover and the ground is frozen. Generally, the end of April marks the end of the overland travel season. From 20 to 60 trains of 1 to 6 vehicles and attached sleds may engage in overland travel annually. Should oil and gas exploratory drilling and development increase general activity on the North Slope, the number of overland moves may tend toward the higher of these numbers. Overland moves from oil and gas exploration and development are discussed in Section IV.A.1.b .

The BLM may issue minimum-impact permits per 43 CFR 2920 for a variety of uses. For example, the NSB is authorized to maintain a wildlife observation cabin on the north shore of Teshekpuk Lake, accessed by airstrip or boat and used year-round. Similar permits might be authorized in the Northwest NPR-A Planning Area.

(6) Recreation

The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators, such as hunting and float-trip guides, who focus their activity along the Colville River. Typically, three of the permittees, accounting for up to five trips, float from the headwaters area to Umiat. These trips would be for hunting and would take place in August or the first week of September. A typical group would consist of four people. Given the small amount of the Colville drainage in or adjacent to the Planning Area, it is likely that no camping associated with this activity would take place there. A limited number of SRP's could be associated with other types of use. At least one permittee may operate with float-equipped aircraft, taking hunters to lakes or sightseers to the Colville River. These flights could result in camping within the Planning Area at a level similar to that of fly camps or backpack camps.

Floating parties along the Colville would carry enough fuel for a small stove and their boat engines. They would camp for no more than one night in any one place, and their camping practices and likely impacts would be consistent with those of fly camps or backpack camps described in Section IV.A.1.a.3 , Ground Activities and Camps.

b. Oil and Gas Exploration and Development Activities

(1) Introduction

This section describes the typical activities associated with oil and gas operations on Alaska's North Slope. Current technologies and project designs are used to define the scenarios for future petroleum development in the NPR-A. Petroleum-related activities include:

- conducting seismic surveys (winter);
- constructing ice roads for transporting equipment and supplies (winter);
- conducting exploratory drilling and testing (usually in winter);
- constructing gravel pads, landing strips, and roads that connect production pads (year-round);
- installing production facilities (winter);
- conducting production drilling and servicing wells (year-round);
- installing pipelines (winter); and
- conducting routine maintenance and operations associated with production (year-round).

The potential impacts of these activities will be discussed in later environmental analyses.

Because the timing and location of future commercial discoveries cannot be accurately predicted today, the activities described here apply only in a general sense. Future petroleum projects in the NPR-A are likely to encounter geologic and environmental conditions that require site-specific engineering. The goals are to maximize the safety and efficiency of profitable operations while minimizing the effects on the environment. New technologies and design concepts are expected to evolve to better realize these goals.

A general description of petroleum-related activities in northern Alaska is followed by a discussion of hypothetical development scenarios. Scenarios are predictions of future activities. The basic assumptions are that industry activities are related to the economic resource potential and that possible environmental impacts are proportional to the scale of the activities. It is not assumed that all of the petroleum in the area will be discovered and produced because much of it occurs in pools that are too difficult to locate or costly to produce. Only the economically recoverable resources are used to scale future industry activities and possible impacts. Leasing and exploration in Northwest NPR-A represent an investment opportunity for an industry that must employ sound business practices. Most companies interested in Alaska also have opportunities for oil and gas investments in other parts of the world. Consequently, petroleum activities in the NPR-A must compete with alternative investments while achieving the delicate balance between corporate profit and environmental protection.

This section offers many different scenarios. Estimates for activities are typically correlated to oil and gas prices, where higher prices result in more industry activities. Two assumed prices ($18 and $30) bracket the range of possible scenario activities. There is also a distinction between two leasing phases: the "first-sale" scenario and the "multiple-sale" scenario. The first-sale scenario defines activities resulting from the lease sale tentatively scheduled for 2004. This will be the third lease sale in the NPR-A in the past five years. In the early 1980's, four lease sales were conducted in the NPR-A without resulting in commercial-size discoveries. It is assumed that oil and gas production resulting from the 2004 lease sale would amount to 50 percent of the total economically recoverable resources in the area offered for leasing. This estimate is based on a typical situation where the largest fields are often discovered early in the exploration cycle. Because of geologic complexity and limited exploration data, it is unlikely that industry would discover all of the commercial-size pools as a result of a single lease sale.

The multiple-sale scenario estimates activities associated with recovering the remaining economic potential after a series of lease sales. The basic assumption is that a relatively large proportion (50%) of the commercial petroleum resources are discovered from the first lease sale and lower volumes would be discovered after each subsequent sale. Petroleum-related activities, and possible environmental impacts, are assumed to follow a similar trend where the scale of new impacts steadily declines. This could be because the later fields are smaller or because they could share infrastructure with previously developed fields. The overall scope of petroleum development on the North Slope, including the NPR-A, in the reasonably near future is discussed under the cumulative case.

(a) Resource Estimates

The National Environmental Policy Act (NEPA) requires that leasing on Federal lands consider the reasonable and foreseeable consequences of the proposed activities. Assessments of undiscovered, economically recoverable oil and gas resources are used to identify areas of high potential and to define reasonable development scenarios used in the environmental impact analysis. Development scenarios are hypothetical models for future activities. Although they are based on sound professional judgment, there is no way to evaluate the accuracy of these future scenarios today. There is no guarantee that the prerequisite conditions will be met; i.e., that a lease sale will be held, tracts will be leased, oil/gas pools will be discovered by exploration drilling, and discoveries will be economic to develop. Considering past exploration efforts in NPR-A that did not result in commercial production, the development scenarios offered here could be overstated.

Estimates of undiscovered resources are uncertain for numerous geologic, engineering, and economic reasons. An accurate accounting of all oil or gas reserves is possible only after the production cycle is completed, decades into the future. Geologic data is continuously collected and refined, and new concepts are revealed by ongoing studies and new interpretation technologies. Engineering evolves with innovation and experience. Economic conditions--such as the price of oil--are difficult to predict in the near term, let alone decades into the future. To account for these uncertainties, resource estimates are usually reported as a range of volumes to bracket the foreseeable economic conditions. Development scenarios are also provided as a range of activities that correspond to the estimated range of economically recoverable resources.

The petroleum resource estimates used to generate the development scenarios are bracketed by economic volumes corresponding to oil prices of $18.00 and $30.00 per barrel (bbl) and correlative gas prices of $2.56 and $4.27 per thousand cubic feet (Mcf) in constant 2002 dollars (2002$). These prices are long-term averages for real (inflation-adjusted) prices that include short-term price spikes lasting only a few years. The $18/bbl price level corresponds to average real prices experienced over most of the 20th century. The $30/bbl price is used for a high-side bracket. Although oil prices have spiked higher than $30.00 recently, most economists view this to be a short-term anomaly. Oil prices have not remained above the $30/bbl level for longer than a few years at any time in the past century. This high price level would be more realistically viewed as a representation of increased production made possible by future technology. The assumed price range is comparable to the Energy Information Agency (U.S. Dept. of Energy, 2001) forecast for market prices in 2010 (a reasonable production start-up time frame for the first fields in Northwest NPR-A), where their "low price" is $17.64 (adjusted to 2002$) and their "high price" is $30.01 (adjusted to 2002$).

This analysis does not attempt to predict oil and gas prices or the nature of future technologies. Industry decisions are probably based on prices of $20 per barrel (or less) because they focus on long-term projects and must be conservative when considering high-cost and high-risk investments. If petroleum prices remain below $18/bbl (2002$), minimal leasing interest and no future production from the Northwest NPR-A would be expected. Although it is unrealistic to assume that industry would base investment decisions on $30/bbl prices, it is possible that volumes of oil recoverable now at $30 could be recovered at lower prices using future technologies that are more efficient than current methods. However, the effects of future technology cannot be directly evaluated. Considering all of the uncertainties, these two price levels present a reasonable range on which to base future scenarios for oil and gas development in this area.

The mean, undiscovered, economically recoverable oil and gas volumes for the Northwest NPR-A Planning Area range from 0 at the $18/ bbl of oil and $2.56/Mcf of gas price levels to 2.1 billion barrels (Bbbl) and 7.3 trillion cubic feet (Tcf) at the $30/bbl and $4.27/Mcf of gas price levels. These estimates assume that the entire area is open to leasing with normal restrictions on exploration and development. Leasing alternatives that remove promising areas from leasing or impose costly restrictions on industry activities will decrease the likelihood of successful exploration leading to commercial development. Regulatory restrictions (or "mitigation costs") are factored into lower estimated levels of activities and future production for different leasing alternatives.

(b) Natural Gas

At present, there is no transportation system to carry natural gas from the North Slope to market. Proven gas resources are reported to range upwards of 38 Tcf, most of which is in the Prudhoe Bay unit (ADNR, 2000). Because there is no export system, gas resources were not evaluated by the economic model for the 1997 assessment of the Northeast NPR-A (USDOI, BLM and MMS, 1998, Final IAP/EIS for the Northeast NPR-A). However, options for commercializing the stranded resources on the North Slope are being actively discussed now by industry and government. A major gas transportation project seems more likely today than it did five years ago. If the project is eventually built, future gas discoveries in NPR-A could feed into this new transportation system.

Large scale gas export projects could involve a number of systems and routes to market. One group of conceptual projects includes large diameter pipelines installed in various routes to Midwest and West Coast markets. Another proposal calls for a large diameter gas pipeline from northern Alaska to a liquefied natural gas (LNG) processing plant in southern Alaska. Marine LNG carriers would transport the gas to markets in the Pacific Rim (Asia and West Coast). A third concept involves a new gas-processing technology, termed "gas-to-liquid" (GTL) in which natural gas is converted to high-purity liquid that could be transported through the Trans-Alaska Pipeline System (TAPS). Projects utilizing GTL technology have also been studied for plants near tidewater in southern Alaska. Ultimately, the choice of gas delivery system depends on economics and politics. It is possible that several gas export projects could be built to handle the huge gas resources stranded on the North Slope.

The gas development scenario for the Northwest NPR-A IAP/EIS accommodates all gas export options because it assumes only that natural gas will be delivered by pipelines to a new gas export hub near Prudhoe Bay. Beyond that point, any of the export options could be used. Oil production will continue to be the primary focus in northern Alaska, however MMS/BLM's geologic analysis indicates the NPR-A could hold large volumes of natural gas and become more gas prone in a western and southern direction across the area. It is unlikely that the first exploration efforts would target gas prospects in NPR-A. However, the richest oil play (Beaufortian-Barrow Arch, Table III-01) contains a large portion of the undiscovered gas in NPR-A. The ability to handle gas from pools in the Beaufortian play could become a constraint to oil development. Gas handling, combined with difficult logistics in this remote area, could delay some oil projects in Northwest NPR-A.

As the result of the first lease sale in the Northwest NPR-A Planning Area, one or more commercial oil fields are projected for development in the northern part of the Planning Area. Although potentially commercial quantities of natural gas are likely to be present, these fields would be initially developed for crude oil production. The natural gas associated with the oil in these fields would likely be reinjected into reservoirs to maximize oil recovery.

Gas production facilities would be co-located with oil production facilities and later gas-sales pipelines would be constructed along the same corridors as the crude oil pipelines--parallel to and offset 75 to 100 ft from the oil pipeline. It is assumed that overland gas pipelines would be buried in trenches approximately 5 ft deep, with a surface disturbed area 15 ft wide along the length of the pipeline route. Burial of natural gas pipelines is desirable for both safety and operational reasons. High-pressure gas lines pose a risk of explosion. Burial and offset from the oil pipeline mitigate the potential impacts if a gas explosion were to occur. High-pressure gas lines operate more efficiently when chilled, and permafrost is a good material in which to install dense-phase, high pressure gas pipelines that entrain natural gas liquids. River crossing methods would be determined by characteristics of the river; where elevated spans would be used across narrow, deep rivers, burial in trenches is likely to be used across wide, shallow rivers, and horizontally-drilled tunnels could be used across wide, deep rivers.

Under the multiple sales scenario, one or more large natural gas fields would be developed in the southern part of the Planning Area. The activities associated with the construction and operation of a natural gas production facility would be similar to those of an oil field production facility. The construction and operation of a natural gas pipeline in the southern part of the Planning Area would be similar to those of a natural gas pipeline in the northern part of the Planning Area. In the cumulative case scenario, a gas export pipeline system is assumed to be constructed from the Prudhoe Bay area to southern markets.

Keep in mind that future gas development in the NPR-A faces serious economic hurdles. Although a large volume of undiscovered gas resources (15.8 Tcf) has been assessed for NPR-A, the minimum viable market price of $4.27/Mcf is higher than historical gas prices in the North Amercian market (less than $3.00/Mcf). Development and transportation costs could be $1.00/Mcf higher (or more) from NPR-A than already proven gas resources producible through existing North Slope infrastructure. Economic recovery of natural gas from NPR-A is not viable at normal, historical prices because processing and transportation costs from Prudhoe Bay are estimated to be approximately $2.50 per Mcf. Without a major North Slope gas transportation system, future gas discoveries in NPR-A are likely to be "shut-in" for an undetermined period. Gas recovered as a byproduct of oil production could be used as fuel for facilities or injected back into reservoirs to increase oil recovery. Associated gas from oil reservoirs would have a better chance for economic viability because it could utilize existing facilities largely paid for by preceding oil production.

(2) Petroleum Operations in Arctic Conditions

(a) Past Experience

Oil and gas operations have been conducted in the North American arctic for over 80 years. Early exploration drilling in northern Canada resulted in the oil discovery at Norman Wells in 1920, a field that has been produced intermittently since then. The Umiat oil field, located in southeastern NPR-A, was discovered during exploration by the U.S. Navy in 1946 but remains undeveloped today. The South Barrow gas field was also discovered by the U.S. Navy program and began production in 1950 to supply government facilities and the community of Barrow. Extensive exploration in NPR-A was managed first by the Navy and later by the Department of the Interior (USGS/Husky) and ended in the early 1980's. Extensive exploration in the 1960's resulted in numerous oil and gas discoveries in northern Alaska and the Mackenzie Delta in Canada. The largest of the discoveries, Prudhoe Bay, was found in 1967 and has produced 13 Bbbl of oil. After the completion of TAPS in 1977, a number of oil discoveries on State of Alaska lands on the North Slope fed into TAPS, reaching a peak production rate of 2.0 million barrels per day in 1988. A leasing program in NPR-A was initiated in the early 1980's and restarted by BLM in 1999. A recent discovery--and undoubtedly the most important factor in the renewed interest in NPR-A--is the Alpine field in the Colville River Delta. Oil production from the Alpine field began in November 2001.

Information from decades of experience in arctic exploration, development, and production is contained in a variety of government and industry reports. No attempt is made here to cite all literature relevant to the NPR-A, but readers are directed to excellent documentation in the 105 Policy Analysis Reports generated for previous NPR-A leasing (USDOI, BLM, 1979a,b,c,d); an operational history of government-sponsored exploration in the NPR-A (Schindler, 1988); the *Draft Arctic National Wildlife Refuge (ANWR) Resource Assessment Report* for technology and operational aspects of the eastern North Slope (USDOI, 1986); the *Alpine Environmental Evaluation Document*, containing detailed descriptions of current project designs (ARCO Alaska, Inc., 1996); and the recently released *Cumulative Environmental Effects* report published by the National Research Council (2002).

(b) Technology Advancement

The following discussion is an update of the text previously provided in the Final Environmental Impact Statement for the *Northeast NPR-A Integrated Activity Plan and Environmental Impact Statement* (IAP/EIS) (USDOI, BLM and MMS, 1998).

It is important to recognize that numerous technological advancements have been made during the decades of operations on the North Slope that have allowed current development activities to proceed at a lower cost and with less environmental impact than previous operations. It has become apparent that lower levels of impact often translate into lower overall development costs. Some of these advancements are listed below and others will be discussed under subsequent headings of this IAP/EIS.

- Vehicles involved with seismic operations have been modified to reduce their ground pressure, thereby extending the season for overland travel with minimal impact to the tundra surface. Packed snow trails allow vehicles to move supplies into remote areas.
- 3-D seismic surveys and interactive workstations have improved drilling efficiencies, resulting in fewer dry exploration wells, more efficient facility placement, and higher recovery volumes.
- Drilling-pad footprints have been reduced over 80 percent from older pad designs by using closer wellhead spacing and by eliminating surface mud-reserve pits (tanks replace pits).
- Winter ice roads are used instead of permanent gravel roads to move heavy equipment and materials to drill sites. These seasonal roads melt in the summer, leaving minimal impact to the tundra.
- Ice pads are used for winter exploration drilling and airstrips. Some pads have been maintained over the summer, thereby decreasing the time to mobilize rigs for exploration drilling the following winter season.
- Spent drilling fluids and rock cuttings are processed and injected into subsurface disposal wells. Current practices allow no discharge of drilling fluids or dumping of drilling wastes on the land surface.
- Extended-reach wells can tap reservoir targets miles away from the surface pad. Fewer drilling pads are needed to develop subsurface reservoirs, leaving a smaller overall footprint for development facilities.
- A single well bore can be used to produce from multiple reservoirs to increase well productivity and reduce the number of surface wellheads. Fewer wellheads at closer spacing reduces the pad footprint.

A new modular drilling platform (built by Anadarko) is easily transportable and offers the possibility of year-round drilling in remote or higher-relief areas not suitable for constructing ice roads and ice pads.

(c) Timeframe for Activities

A generalized timetable for a typical project in a remote area of the North Slope is presented in Table IV-03. Discoveries could be announced at any time within a 10-year period (assumed primary lease term) following the sale. Delineation and development activities usually take from 3 to 6 years after discovery. Production activities continue year-round for 10 to 30 years, depending on field size. Field abandonment, including well plugging and site restoration, can take from 2 to 5 years after production ends. This general timeframe suggests that new oil production from leases in NPR-A are not expected for a minimum of 4 years following a lease sale. Considering the logistics of operations in the Northwest NPR-A Planning Area, it is more likely that 10 years will pass between the initial lease sale and the startup of oil production from new fields. Gas production from NPR-A lease sales would not occur until a transportation system is constructed from the North Slope. Considering the economic and political aspects of future project(s), gas production from the NPR-A could be delayed several decades.

(d) Logistics

The difficult logistics faced by operations on the North Slope typically result in long delays between leasing and production activities. Other than the basic materials (gravel, water and fuel), nearly all personnel, equipment, and supplies must be transported to the North Slope from elsewhere in Alaska or Outside. Heavy equipment, such as production modules, is usually fabricated near ports on the West Coast or in Cook Inlet and then transported thousands of miles to the North Slope by marine barge trains (sealifts). Although this mode of transportation is more economical than other means, sealifts are restricted to a short period during the ice-free summer months. The scheduling of fabrication and delivery of modules by sealift is critical.

Two jet airports and a haul road (the Dalton Highway extending 490 road mi north from Fairbanks) provide service to the oil-field infrastructure surrounding Prudhoe Bay. Although the airport and haul road are generally open year-round, the type of carrier (aircraft or truck) restricts load capacity, and both road and airport are frequently closed during winter storms.

Today, the North Slope infrastructure offers a variety of supplies and service-industry support. However, all of the materials and supplies needed for Northwest NPR-A operations must move at least 125 mi from the westernmost road-accessible base camp in the Kuparuk River Unit. Overland transportation is relatively unrestricted in the winter months (January to May), but temperatures are extremely cold (commonly -40^{o} F or colder) and "whiteout" conditions are frequent. It is completely dark for 2 1/2 months (late November-February). Low-ground-pressure vehicles (Rolligons, sleds) can travel on frozen tundra, and packed snow roads can be used by conventional trucks and earth-moving equipment. Ice roads are constructed to move very heavy equipment such as drilling rigs and production modules. Heavy equipment and production modules typically move slowly (2 miles per hour) on ice roads or permanent gravel roads.

Remote base camps can be established for year-round use and typically consist of facilities housed on gravel pads. These camps contain storage tanks for fuel, warehouses for supplies, housing for personnel, and permanent airstrips capable of handling large capacity aircraft, such as the Hercules C-130. Staging bases located on the coast also are designed as receiving terminals for sealifts and have docks and marine loading equipment. Barges can transport heavy equipment and supplies to coastal staging bases during the short summer months (mid-July to late-September) and materials are stockpiled for operations at remote sites during the winter. In winter months, materials and equipment are moved by temporary roads (ice or packed snow) or by aircraft to drilling sites. Remoteness is a significant factor adding time and cost to operations in the Northwest NPR-A Planning Area compared with similar activities in the Prudhoe Bay area.

(3) Exploration

Petroleum exploration has been conducted in the NPR-A for most of the 20th century, beginning with early prospecting and scientific field parties in the early 1900's. Between 1941 and 1981 Federally-sponsored exploration programs coordinated seismic surveys and drilling in NPR-A. Between 1974 and 1981, Geophysical Services Inc. (GSI), under contract to the U.S. Geological Survey (USGS), collected the first modern seismic data. During the past eight years--and prompted by the Alpine discovery in the Colville delta--an increased number of industry-sponsored, 3-D seismic surveys have been conducted in the Northeast NPR-A. In the Northwest NPR-A Planning Area, approximately 7,100 line-miles of 2-D seismic data and a limited amount of 3-D seismic data have been collected. Government-sponsored exploration drilling in the Northwest NPR-A Planning Area resulted in several gas discoveries (Barrow, Walakpa, Wolf Creek, Knifeblade, Meade). The Barrow gas fields have been supplying the community of Barrow since 1950. To date, 47 Navy-sponsored wells, 9 deep Husky/USGS wells, 32 wells on NSB land, and 1 industry exploration well (Arco, Brontosaurus) have been drilled in the Northwest NPR-A.

Future seismic surveys and exploration well drilling in the Northwest NPR-A Planning Area would probably occur during December to May. This schedule is controlled by the geographic characteristics of the area, (i.e., poorly drained tundra with abundant shallow lakes). Aerial photos of the coastal plain taken during summer show that there may be nearly equal proportions of dry ground to wet areas (lakes, rivers, lagoons). Travel over long distances during the summer is possible only by aircraft (fixed-wing or helicopter), although the use of hovercraft has been proposed. In contrast, in winter after the tundra is sufficiently frozen and snow cover is adequate, overland travel is relatively unconstrained. This is particularly important to seismic surveys that are set up on specific grid patterns in new locations each season.

(a) Seasonal Roads and Drilling Pads

Temporary roads are constructed during winter months to move equipment and supplies to staging areas and wellsite locations. Packed-snow roads are constructed quickly by leveling the snow surface for overland travel by low ground pressure vehicles, such as rolligons. To move heavy equipment such as drill rigs, ice roads are constructed by spreading water from approved lakes to build up a rigid surface. Typically, ice roads are designed to be a minimum of 6 inches thick, between 30 and 35 ft wide, and tens-of-miles long. Under favorable conditions, ice-road construction can average one mile per day. The maximum practical length of overland ice roads is constrained by the length of the winter operating season, now averaging slightly more than 100 days. Considering multi-agency permitting requirements, opening dates for tundra travel, ice-road construction time, and the seasonal window for winter drilling, a practical, maximum length for overland ice roads is thought to be about 50 miles. Ice roads constructed over nearshore, bottomfast sea ice could be somewhat longer, perhaps up to 100 mi, because there are no restrictions such as those related to tundra travel.

Water sources must be located along the proposed route to supply approximately 1.0 to 1.5 million gallons per mile of road. Some construction methods, such as using aggregate "chips" shaved from frozen lakes, significantly decrease both water demands and construction time for ice roads. For example, under very cold conditions, an ice road build-up rate using only liquid water is 1 1/2 inches high per day, whereas using aggregate chips could increase the buildup rate to 4 1/2 inches per day with a significant reduction in the volume of water required. Ice bridges over rivers and lakes are constructed by flooding and composite (aggregate chip) methods, where the ice thickness is built up so that the ice bridge rests on the bottom of shallow rivers or lakes. Floating ice bridges are used to cross deep rivers, such as the Colville River.

Ice pads are now commonly used as platforms for winter exploration wells. Ice pads are constructed the same as ice roads, where the tundra surface is flooded to build up layers of ice. As with ice roads, the use of aggregate chips speeds the process and decreases water demands. A typical ice pad is 6 to 12 inch thick, covers from 3 to 10 acres, and requires approximately 2 million gallons of water to construct. Water requirements vary, depending on the pad size and availability of aggregate chips shaved from nearby lakes.

New designs for ice-pad construction have created insulated pads that last over the summer months. This strategy saves both time and money because the pads can be reoccupied for drilling early the following winter. As ice-pad construction techniques improve with experience, it may be possible to construct ice pads to serve as year-round drilling platforms or for long-term production facilities. Obvious limitations for ice roads and pads are the availability of water and the slope of the terrain. Inland areas may have both constraints (lacking suitable lakes and slopes greater than a few degrees) and new strategies will have to be developed to provide temporary access to these areas.

(b) Seismic Surveys

Seismic survey work is likely to continue at present levels or increase in the Northwest NPR-A if oil and gas leasing is implemented. Seismic surveying would be limited to winter operations; the winter season to be determined each year by the AO. Seismic survey work would precede drilling, as collection of seismic data is required for evaluating subsurface geologic structures. Seismic survey data is fundamental information for mapping the subsurface geologic structure. Collection of new seismic data is warranted for several reasons:

1. to provide a closer grid spacing to resolve smaller subsurface traps;
2. to acquire 3-D data to better resolve subtle reservoir stratigraphy; and
3. to define fields discovered by exploration wells.

Many variations exist in seismic program design, including grid spacing with respect to the warranted level of cost-effective detail, and 2-D and 3-D collection methods allowing for different techniques for evaluating geologic features and illustration of subtle changes in stratigraphy. Seismic programs use an energy source focused into the ground where geophone sensors extended over the surface of the ground collect a data signal. The travel time and amplitude of the reflected signals provide information on the geologic layers below the surface. Seismic programs use vibrator equipment to generate energy into the subsurface. This technique provides high-quality data with minimal disturbance to the area. The energy source is created and directed into the subsurface to provide a reflectance value based on time and amplitude.

Seismic operations are assumed to occur under all the alternatives, with the exception of the no seismic option of the No Action Alternative. The number of surveys and, to some extent the type of survey, would differ under each alternative. The number of seismic operations, the area they cover, and the layout of the survey grid are all likely to be different from one year to the next. The following discussion recognizes these differences while stating some general assumptions for typical activities involved in impact analysis.

In all of the alternatives, for both the single-sale and multiple-sale scenarios, 2-D seismic would be collected for regional reconnaissance purposes to identify potential prospects for leasing. A 3-D seismic survey could be used for regional reconnaissance and also could be used on leased tracts to further delineate an oil or gas prospect for exploration or appraisal drilling. The number of seismic surveys given below is an estimate of the average number of surveys likely to occur in the Planning Area; the number of surveys might slightly exceed this number in any given winter.

- *No Action Alternative*: Under the seismic option of the No Action Alternative, it is assumed that one 2-D or 3-D seismic operation would occur in alternate winter seasons in the Planning Area.
- *Alternative A*: Under Alternative A, it is assumed that three 2-D or 3-D seismic operations would occur each winter season in the Planning Area.
- *Alternative B*: Under Alternative B, it is assumed that two 2-D or 3-D seismic operations would occur each winter season in the Planning Area.
- *Alternative C*: Under Alternative C, it is assumed that one 2-D or 3-D seismic operation would occur in alternate winter seasons in the Planning Area.
- *Preferred Alternative* : Under the Preferred Alternative, it is assumed that two 2-D or 3-D seismic operations would occur each winter season in the Planning Area.

While the winter operating period could be as long as 5 1/2 months (early December through mid-May), typical seismic operations for an individual survey last about 100 days. In a typical winter, 3 to 4 seismic crews are active on the North Slope, and 2 to 3 of those crews may be permitted to work in the NPR-A collecting data. A 2-D seismic party consists of 40 to 60 persons and can collect 5 to 10 line-miles of seismic data per day. A more closely spaced 3-D seismic program typically consists of 50 to 80 persons and can collect 2 to 4 mi^2 of data per day. Because this is winter activity, weather is a constant factor, affecting both visibility and crew safety, and time is lost in mobilizing crews, camp moves, and downtime during storms. Considering these logistical problems, one 2-D seismic crew could be expected to collect 400 to 800 line-miles of data in one winter season while a 3-D crew could collect 300 to 600 mi^2 of data in one season.

Seismic crews are housed in mobile camps that form "cat trains" of trailer sleds pulled by tractors. Seismic data collection operations are conducted using all-terrain, low-ground-pressure vehicles (both wheel and articulated-track designs). Camp supplies (food, fuel) are transported to the survey area by both ground vehicles and light fixed-wing aircraft.

Cat trains for both kinds of seismic operations likely would originate from the Kuparuk oil field. Each cat train would consist of survey vehicles and support camp modular units. A train would consist of the approximately 10 (2-D) to 15 (3-D) vehicles that would run the seismic testing (see discussion below), one or more fuel trucks, and strings of trailers composing the camp modular units pulled by bulldozers. A train typically would include 2 or 3 strings of trailers. A single bulldozer would pull each string, and each string would have 4 to 8 trailers. The bulldozers and modular units generally exert greater ground pressure than do the vehicles that run the seismic lines.

Once in the area of operation, camps are moved every few days to once a week. The fuel truck or trucks would make runs back to Kuparuk or other fuel supply depot during the course of the seismic operation. These fuel runs may occur daily or every few days, depending on a variety of factors, including the size of the operation and weather conditions.

A typical 2-D operation covers about 500 line-miles. The survey lines are in the form of a grid, with line-spacing of 5 mi by 10 mi. Each line of 2-D seismic requires about 10 vehicles. The vehicles run parallel to each other over an area about 200 ft wide. The exterior dimensions of each survey area are variable, but the example survey described above could cover a total of about 1,200 mi^2.

A typical 3-D seismic operation collects 450 mi^2 of data in a single winter season and might involve as many as 15 vehicles. A line-mile consists of a pair of linear areas, each about 100 ft wide, through which the vehicles drive. The grid patterns for 3-D seismic surveys are considerably closer spaced, with a typical line spacing of 500 ft by 2,000 ft. Although the exterior dimensions of 3-D survey grids are variable, a 30 mi by 15 mi survey area could contain about 5,625 line-miles of data. The techniques of setting up geophone arrays and shot points are very different (and far more efficient) than 2-D survey methods.

Future seismic surveys in the Northwest NPR-A Planning Area would probably occur during December to May. This schedule is controlled by the geographic characteristics of the area, (i.e., poorly drained tundra with abundant shallow lakes).

(c) Exploration and Delineation Wells

Drilling is the only reliable method of verifying the presence of oil in a prospect mapped using seismic data. It is also the only way to obtain direct information (logs and cores) needed to evaluate subsurface reservoir conditions. Exploration operations require moving a heavy drill rig and large amounts of materials (steel casing, drilling mud, fuel) to remote locations. Equipment and materials typically are moved to drill sites on ice roads or by aircraft to ice airstrips in January-February. Logistical support also must allow for regular crew changes and resupply. An exploration well crew could consist of 30 to 60 persons, working 1- to 2-week shifts, and transported to the site by aircraft. Large lakes (1 mi across or more) can be prepared for use as winter landing strips.

Exploration wells in the northern portion of NPR-A (the area of highest oil potential) are likely to range from 6,000 to 12,000 ft in depth. At these depths, most exploration wells can be drilled, logged, and tested within a single winter season. If a discovery is made, a second (delineation) well could be drilled from the same ice pad in a single season, depending on well depth, problems encountered during drilling operations, and considerations for rig storage ("stacking") between winter drilling seasons. Demobilizing and moving rigs out of NPR-A for the summer season shortens drilling time because the move must be completed before the spring thaw melts the temporary access roads or airstrips (usually in May). A typical winter operating season is approximately 4 months (120 days) and has been less than that in recent years because of unseasonably warm weather.

To define the limits of reservoirs after a discovery is made, several delineation/appraisal wells are usually drilled before a decision is made to plan for project development. Additional delineation wells near the discovery well are usually scheduled for the following winter, perhaps using a new ice pad. Because of high project costs, 2 to 4 delineation wells are often drilled to define the limits of the pool reachable from each production pad. For example, a typical development project consisting of 2 production well pads would require 7 wells (1 exploration and 6 delineation wells). Delineation-well drilling is likely to be coordinated with a 3-D seismic survey over the prospect.

After reservoir logging/testing is completed, the exploration wells are suspended. Cement plugs are placed in deep zones capable of flowing hydrocarbons and in the near-surface section to seal the well. Exploration wells may be re-entered and used as production wells by drilling out the cement plugs, but most exploration wells are considered "expendable" and are permanently abandoned. If a discovery is made, equipment and materials may be left at the site on insulated ice pads or on pilings (called "sleepers") to reduce mobilization time the following winter drilling season. Rock cuttings from delineation wells are either backhauled to existing disposal wells or processed (ground and treated) for subsurface disposal in the abandoned wells. No materials or drilling wastes (mud and cuttings) would be left at the site. Under most situations, after the completion of drilling operations all equipment and materials would be moved back to staging areas. However, at more remote sites it would be more practical to temporarily store heavy drilling equipment at the site and back-haul only the drilling wastes. This strategy would allow for a longer operating period the following winter season.

(d) Water Demand and Rock Cuttings

Drilling operations require large amounts of water for blending into drilling mud. Drilling also produces large amounts of rock cuttings. For example, a 10,000-ft well could require approximately 850,000 gal of water for drilling in addition to approximately 100 gal per day for each person in the drilling crew (for camp use). Over a typical 4-month drilling season, a one-well drilling operation could require a total of 1,650,000 gal of water obtained (if possible) from a source close to the wellsite. The use of melted snow could supplement this water requirement. Water requirements are much less for subsequent delineation wells than for the initial exploration wells, because approximately 80 percent of the drilling mud would be reconditioned and reused.

A typical 10,000-ft conventional well could use 630 tons of drilling mud and produce 820 tons of rock cuttings. However, the use of slim-hole drilling techniques for expendable exploration wells could greatly decrease the materials required and cuttings produced. For comparison, slim-hole wells have diameters of 3 to 4¾ inches, whereas conventional wells are drilled with bits ranging from 8½ to 26 inches. A second advantage of slim-hole drilling is that the rigs are smaller and therefore easier to transport by aircraft (fewer loads). Smaller rigs generally have shorter mobilization/demobilization times, thus they could expand the effective drilling period when allowing for demobilization out of the area before spring breakup.

(4) Development

(a) Field Layout

After a commercial-size oil/gas pool has been discovered and delineated by wells, construction activities for a permanent production facility would begin. A list of typical activities is provided in Table IV-03. The Alpine field is the most recent example of current North Slope field designs and it is assumed that this project layout will be generally followed by future stand-alone fields in NPR-A (Figure IV-01). To be economically feasible, the first development project in the Northwest NPR-A would need to be at least Alpine-sized. This project could consist of a single field with 400 to 500 MMbbl of recoverable reserves, or it could consist of several smaller fields (perhaps with different owners) that are gathered into a shared infrastructure. Because in the normal sequence of events, the largest pools are usually discovered and developed first, the present scenario assumes a single field. This field would contain 2 production pads designed to hold 100 to 150 wellheads; a pipeline gathering system to a central processing facility; a 3-mi in-field road; a crew support camp; and an airstrip integrated with the in-field road. The total surface footprint of such a development would be about 100 acres (Figure IV-01). A new oil-sales pipeline would carry oil production to the main Kuparuk River pipeline connecting to TAPS.

Smaller, surrounding "satellite" fields may be developed later and would connect to the facilities of the first stand-alone field. The first field would "anchor" development in a remote area by providing the necessary infrastructure and transportation systems, including a long, overland pipeline. For engineering feasibility, it is assumed that satellite fields would be located within 20 mi of the main field. Permanent in-field roads would connect production pads in a single field, and gravel roads could connect satellite fields to the main field.

The Northeast NPR-A IAP/EIS incorporated the concept of "roadless development" (perhaps more accurately described as "seasonal road development"), prohibiting fields in the Northeast NPR-A from being linked by permanent roads to the road network in the Prudhoe-Kuparkuk complex. For purposes of analysis, it is assumed that this road prohibition will continue in the Northeast Planning Area. Seasonal ice roads from the Kuparuk field to Northwest NPR-A are unlikely for both practical and economic reasons. Seasonal conditions typically limit ice-road construction to 50 mi overland and perhaps to 100 mi over nearshore ice. Winter ice roads could be used to connect central staging areas with remote sites within the Northwest Planning Area. The concept of roadless development does not apply to in-field roads.

(b) Staging Areas

All materials and equipment needed to develop a new field must be moved, stockpiled, and assembled at remote sites in NPR-A where transportation is constrained by seasonal conditions. Consequently, remote staging areas will play a vital role in the logistics of exploring for and later developing oil and gas resources in the Northwest NPR-A. A staging facility typically consists of gravel pads to hold stockpiles of materials, buildings for warehouses and crew quarters, tanks for fuel storage, and an airstrip capable of handling large aircraft (C-130 Hercules and perhaps 737 jets). Ideal staging area locations are on the coastline, where marine transport can be used to move heavy materials and equipment by barges in the summer, open-water season.

Considering the high costs of constructing a new staging area, it is more practical to reoccupy preexisting sites even if some refurbishing is necessary. Map 107shows several possible sites in NPR-A that could be used as staging areas for exploration and development in the Northwest NPR-A Planning Area. Camp Lonely, Barrow, and Liz-C (in Peard Bay) have been used as staging areas for past exploration drilling operations in Northwestern NPR-A. Additional sites, including Husky/USGS well sites (Inigok, Umiat), abandoned DEW-Line sites, or villages (Barrow, Atqasuk, and Wainwright), could also be utilized as staging areas. The general area of Cape Simpson is centrally located within the high-petroleum-potential area of Northwest NPR-A, and as such, it could be an ideal site to construct a new coastal staging facility. Oil-related activities have occurred sporadically in the Cape Simpson area for nearly a century, the most recent being the Husky/USGS program that ended in the early 1980's. Most of the high potential area could be reached by relatively short ice roads (less than 25 mi) from Cape Simpson.

It is likely that the first exploration drilling operations in Northwest NPR-A would be staged out of the Prudhoe Bay-Kuparuk area. This industrial complex has all-season airports, permanent road systems, and a marine loading dock (West Dock). Materials and equipment would be moved to new staging areas in NPR-A using barges (sea-lift trains) in the summer months, vehicles over packed-snow or ice roads in the winter months, and aircraft (to ice airstrips). To establish more permanent staging facilities, earth-moving equipment would construct gravel pads to hold a construction camp and an all-season airstrip.

After suitable conditions occur in winter, packed-snow or ice roads would be constructed to move materials overland from staging areas to remote drillsites. Large aircraft (C-130 Hercules) could also be used to move materials and would land on prepared ice airstrips. Many loads are required to move a drilling rig and supplies to a remote exploration site. Typically, it could require approximately 100 trips of a C-130 and 50 trips using Rolligons. After commercial discoveries are made, drilling equipment and supplies could be moved to the site by ice roads (winter) or aircraft. Production modules and pipeline construction materials would be moved during the final stages of development. Constructing a new staging facility could take 2 to 4 years, depending on the size and location of the facility.

(c) Gravel Requirements

Much of the initial work for a new project involves the construction of elevated gravel pads to hold wellheads and pipelines, production facilities and crew quarters, in-field roads, and possibly an airstrip. The development site must be level, stable, and elevated above the wet tundra surface. Because the tundra surface is unstable, subject to flooding in summer and ice-jacking forces in winter, pads are designed to be at least 5 ft above the tundra surface.

Gravel is the preferred material for pad construction and gravel borrow pits are relatively common east of the Colville River. For developments in the NPR-A, however, gravel is scarce. Sand and gravel are more common in river drainages. Sand and gravel mining is expected to occur during the winter months because extraction is easier when the ground is frozen and it is expedient to truck the gravel over ice roads to the construction site. Several alternative strategies have been used in past operations, some of which were: (1) reusing gravel from existing gravel pads; (2) defining new borrow sites within the NPR-A; (3) barging gravel to coastal staging areas; and (4) processing bedrock. Alternative strategies could include: year-round ice pads, composite pads, or facilities supported on pilings.

For permanent production facilities, pads made entirely of gravel are preferred, although composite pads are a proven alternative (Figure IV-02) (Kachadoorian and Frederick, 1988). Gravel requirements for typical "all-gravel" pads rising 5 ft or more above a wet tundra surface are made of approximately 8,000 to 12,000 cubic yards (yd^3) of gravel per acre of surface footprint. Gravel roads (typically 35 ft wide with a 2:1 slope) cover approximately 5 to 7 acres per mi and require 30,000 to 60,000 yd^3 per mi. Airstrips (typically 150 to 200 ft wide and 5,000 to 6,000 ft long) cover 20 to 30 acres and can take 140,000 to 300,000 yd^3 of gravel.

Site-specific conditions would dictate facilities designs and consequent surface footprint for new fields. Small fields, with a single production pad and an airstrip, could have a footprint of approximately 50 acres. Large fields, with multiple pads connected by service roads and a large airstrip, could have footprints of up to 200 acres. The average footprint for an Alpine-size field (300 to 500 MMbbl) is assumed to be approximately 100 acres (Figure IV-01), with a gravel requirement of approximately 1 million yd^3 .

Total gravel requirements for future NPR-A developments are estimated using the assumed amount of 10,000 yd^3 per acre and an average footprint for a mid-sized field (300 to 500 million barrels [MMbbl]) of 100 acres. For the maximum development case under the single-sale scenario, corresponding to oil resources of up to 735 MMbbl (5 oil and gas fields), gravel requirements could range up to approximately 5 million yd^3. This estimate assumes that the main fields would have a pad size and layout similar to the Alpine field development, and some fields would be satellites (single pad without processing facilities) connected to the main field by a gravel road 15 mi long (a 100-acre total footprint including roads).

Several types of gravel pads were used previously in NPR-A drilling; these alternate types are shown in Figure IV-02. Gravel requirements are reduced significantly in composite pad designs. Material for the lower portion of pads (a blended mixture of sand and silt) is common in surficial deposits throughout the NPR-A and could be extracted and blended during winter months from borrow areas near the development site. Using composite pad designs could reduce the overall gravel requirement to 33 to 50 percent compared to all-gravel-pad designs. The use of blended, sand-silt mixture for the lower portion of the composite pad would also enhance reclamation efforts after abandonment by providing a more natural substrate for revegetation.

For more distant sites in the Northwest NPR-A Planning Area, gravel could be mined from existing borrow pits east of the Colville River and then barged to coastal staging areas and stockpiled for later transport by trucks over winter ice roads. Sand and gravel also could be extracted from river drainages within the Northwest NPR-A Planning Area. For new sites, overburden removal and sand/gravel mining could impact areas of 20 to 50 acres, depending on the thickness of the deposit and amount of material extracted. Gravel also could be scavenged from previous USGS/Husky drill sites scattered throughout the NPR-A (Map 102). The BLM has not studied the economic feasibility of gravel transportation in the NPR-A, and it is premature to evaluate the possibilities without knowing the location or scale of future gravel-use activities. Decisions regarding gravel use would be made on a case-by-case basis according to site-specific conditions.

Gravel sources could be a problem for inland sites in the southern part of the Northwest NPR-A Planning Area. Surficial gravel sources are rare outside river corridors, so alternative materials are likely to be considered. Bedrock outcrops could be blasted and then crushed and blended with sand to make up suitable construction material. Unconsolidated sand and gravel deposits are available in river systems, but environmental considerations could cause restrictions on gravel extraction. The logistics of constructing suitable pads for long-term operations would add significantly to the cost of activities in most of Northwest NPR-A.

(d) Development and Production Well Drilling

Production well drilling is a major activity in the development of a new field. The number of production wells is influenced by characteristics of the reservoir, including thickness, permeability, and lateral complexity. Typically, subsurface drainage areas for oil wells on the North Slope range from 40 to 240 acres, where thicker, high-permeability reservoirs tend to have wider well-drainage areas. Thinner or more laterally discontinuous reservoirs normally require closer well spacing to achieve effective drainage. Horizontal wells with long lateral sections in the reservoir zone can replace several closer-spaced vertical wells, consequently horizontal completions have larger drainage areas.

Subsurface drainage areas tend to be larger for gas reservoirs. For example, if an oil reservoir required a drainage spacing of 120 acres, the same reservoir, if filled with gas instead of oil, could require a drainage spacing of 480 acres. As a result, gas fields have lower numbers of production wells than oil fields. During the life of a typical field, well numbers are increased by infill drilling to tap reservoir areas not effectively drained at wider well spacing.

Reservoir well drainage spacing should not be confused with the surface spacing between wellheads on production pads. The spacing between surface wellheads has been reduced from 120 to 160 ft (20 years ago) to 10 to 20 ft (at present) in North Slope fields.

In addition to production wells, other development wells are drilled to inject water or gas into the reservoir to maximize oil recovery. These wells generally are referred to as service (or injection) wells. Service wells are required for gas injection and waterflood programs that are routinely employed to manage reservoir pressure. The proportion of producer to service wells can be different for each oil field, but a typical ratio of producer to service wells ranges from 3:1 (25% of wells are service wells) to 1:1 (equal number of producer and service wells). Gas fields require a minimal number of service wells, mainly for drilling waste and produced water disposal.

The number of wellheads that could be contained on a single production pad is theoretically unlimited, as the pad size can be increased to hold additional wells. But from a practical standpoint, the maximum number of wellheads per pad is controlled by reservoir depth and well cost. Conventional wells can reach wider areas in deeper reservoirs, so fewer pads (with more wells) are needed to produce deeper reservoirs. In contrast, shallow reservoirs usually require more pads with fewer wells per pad, although extended-reach wells could be used to drain larger areas in shallow reservoirs. Possible variations in engineering for field layout is site-specific, and decisions are driven largely by economics and surface constraints.

Most production wells deviate from vertical to reach subsurface targets at some distance from the production pad (Figure IV-02). By informal definition, conventional wells have lateral departures (or "reach") out to approximately 1.5 times the vertical depth to the reservoir (or a departure ratio of 1.5). Extended-reach drilling (ERD) wells have departure ratios or 1.5 or greater.

Extended-reach wells are used to reach distant reservoir targets to minimize the number of pads and connecting roads or to avoid sensitive surface areas. Extended-reach drilling methods are rarely employed for exploration wells, because they are far more costly than vertical wells and are more difficult to log and core. Record setting ERD wells have reached lateral distances of nearly 7 mi with departure ratios of 6.0. However, drilling on the North Slope has only achieved a maximum lateral reach of near 20,000 ft and departure ratios approaching 2.5. The extended-reach record on the North Slope is currently the Niakuk NK-11 well, which achieved a reach of 18,219 ft (3.45 mi) at a departure ratio of 1.94. This ERD well was drilled to tap a reservoir several miles offshore, allowing development from an onshore site and eliminating the need for a offshore production platform.

Over the past decade, worldwide experience has progressively increased the technology of drilling extended-reach wells. However, there are physical limitations, including topside rig power (torque), drillpipe strength, downhole frictional forces (drag), and unstable formations (such as shales and coal beds) which limit the capability of extended-reach wells. The cost of extended-reach wells is considerably higher than conventional wells because of greater distances and times spent drilling, in addition to frequent problems involving well-bore stability.

Alternative field designs must consider the cost tradeoffs between fewer pads with higher-cost, extended-reach wells as opposed to more pads with less costly conventional wells. In most instances, it is more practical and cost effective to drill conventional wells from an optimum site, rather than to drill ERD wells from a distant site. A working assumption, based on experience and expected geologic conditions, is that the maximum practical limit for drilling ERD wells on the North Slope is 4 mi in reach and 2.5 in departure ratio (whichever comes first).

Because conventional wells are less costly to drill and complete than extended-reach wells, production pads are most efficiently spaced at distances from each other of approximately twice the reservoir depth. For example, a reservoir at 8,000 ft requiring two production pads normally would locate the pads approximately 16,000 ft apart (3 mi). Assuming an 8,000-ft reach radius, approximately 4,616 acres (7.2 mi^2) could be drained from each pad. If each well has a subsurface drainage area of 160 acres, and a 1:1 producer to service well ratio, the example production pad would hold 29 producer wells and 29 service wells, for a total of 58 wellheads. Infill drilling could utilize existing well bores to drill lateral branches ("side-tracks") into untapped reservoir areas. The use of ERD wells within practical limits (1.5 to 2.5 departure ratios) could increase the subsurface drainage area to between 10,385 to 28,848 acres (16.2 to 45.1 mi^2). However, at the same (160 acre) well-drainage spacing, the pad would have to hold 65 to 180 production wells. Adding the required service wells (33 to 100% more) would lead to an impractical number of wells on a single pad. This simple example illustrates one of the many considerations in field layout.

Assuming that typical production pads would be designed to hold 60 wellheads (without facilities), they would have surface footprints of about 10 acres and could drain a subsurface area 470 times larger (or surface footprint is 0.002 of the reservoir drainage area).

The time required to drill and complete a production well largely depends on the drilled (or measured) depth of the well. Current North Slope drilling takes approximately 22 days to drill and complete a 11,000 ft well (or an average of 500 ft/day). This equates to 17 wells per rig in a 12-month period. Safety considerations normally restrict operations to one rig drilling on each pad at a time. Using the above example--where 58 wells from each pad are needed for initial reservoir development--the first round of drilling operations would take 3.4 years to complete (see also Table IV-03).

Wells in new geologic settings usually take longer to drill, thereby extending the field development period. Seasonal restrictions on drilling operations would increase the time to develop a field and could adversely affect the economic viability of the project by extending the payout period. Other key considerations are the subsurface pressure conditions and fluid properties which control the flow dynamics of oil reservoirs. Once production begins, reservoir flow dynamics must be carefully managed to optimize oil recovery. Production shutdowns will disrupt the transient pressure conditions with adverse effect on ultimate oil recovery. In contrast to oil field flow dynamics, gas fields can be periodically shut in without adverse effects.

(e) Drilling Mud and Rock Cuttings

Drilling operations for development wells require large amounts of drilling mud and produce large quantities of rock cuttings. Estimates of drilling wastes given previously for exploration/delineation wells accurately represent the volumes for development wells to equivalent depths.

New techniques have been established during the past decade on the North Slope to efficiently dispose of drilling wastes (mud and cuttings) in existing wells. The steps leading to subsurface disposal of drilling mud and rock cuttings are shown in Figure IV-03. The goal of current North Slope drilling operations is zero surface discharge of wastes. Drilling wastes injected into shallow, high-permeability formations are depicted in Figure IV-04. Generally, dedicated disposal wells are used for injection of drilling wastes, although it is possible to inject wastes into shallow annulus portions of production wells while allowing oil production from deeper zones. Reconditioning and reuse of up to 80 percent of the drilling mud saves costs for both materials and disposal. Clean sand and gravel processed from well cuttings can be recycled and used for pad and gravel road maintenance.

Wastewater, spent fluids, chemicals, drilling solids, and drilling mud may be disposed of in Class 1 disposal wells approved by the EPA or Class II wells administered by the AOGCC (Alaska Oil and Gas Conservation Commission). Solid wastes are normally hauled to approved offsite waste disposal facilities. Garbage and other putrescible waste can be incinerated or composed. Regulations normally do not allow onsite burial of any wastes, including incinerator ash.

(f) Water Demand

Water is needed for both drilling operations and camp use. For the construction phase of the Alpine field development, water demand averaged 100 gallons per day (gal/day) per person (ARCO Alaska, Inc., 1996). With 350 persons working on the project, the potable water requirement would be 35,000 gal/day. Drilling water demand is estimated at 21,000 to 63,000 gal/day. The maximum water demand over one long winter season (mid-December to mid-May, or 150 days) could range from 8.4 to 14.7 million gal.

This volume of water is more easily visualized by comparison to the drawdown of a small lake. Assuming that the lake is circular and 1/2 mi across, its surface area would be 125 acres. A water demand of 12 million gal equates to 36.8 acre-feet, so the lake would have a drawdown of 3 1/2 in to supply this volume. Recharge of the lake is expected from snowmelt and surface runoff in the spring. Equipment called "snow melters" could be used to supplement water demands from surface water sources during winter months.

Potable water demand would drop after two to four seasons when the major construction phase is finished. About 20 to 40 persons would work in the field during the production phase, and potable water demand would be one-tenth of the development phase. Likewise, water demand for drilling (well workovers and infill) over the 20-year production life of the field will be less than the volume needed for the main development phase (20,000 gal/day compared to 80,000 gal/day).

(5) Production

(a) Production Facilities

A central production facility (CPF) serves as the operational center for long-term activities in oil and gas fields. In addition to oil production equipment, the CPF typically includes living quarters and offices, maintenance shops, storage tanks for fuel and water, power generators, waste treatment units, and a communications center. For many North Slope projects, most components of the CPF are constructed as transportable modules in other locations--perhaps outside Alaska--and then moved to the site over winter ice roads and assembled. All buildings are supported on pilings to accommodate ground settling or frost heaving in the gravel pad. An airstrip usually is located near the CPF to allow transport of supplies and personnel to the field site.

Oil production equipment includes:

- separators (oil, gas, and water are produced in the raw slurry from each well);
- gas conditioning (water and natural gas liquids are separated from produced gas);
- pipelines and pressure regulation systems; and
- well flow monitoring and control systems.

Oil from production wells is filtered (to remove sand) and processed (removing water and gas) before being piped through a sales meter and into the sales-oil pipeline system. Gas is processed (to remove liquids), pressurized (compressed), and reinjected into the reservoir through service wells. Likewise, water is processed (chemically treated) and then reinjected into the reservoir for pressure maintenance. Pressure maintenance increases oil recovery and normally occurs over most of the production life of the field.

(b) Production Rates

Individual well-production rates vary greatly depending on the characteristics of the reservoir and could range from 100 to 10,000 barrels per day (bbl/day). Generally, the highest rates occur in the first 1 to 2 two years of production and then decline over time.

When the production rate for a well drops to approximately half of the peak rate, an operation known as a "workover" is conducted to improve well productivity. These operations are designed to correct a variety of well problems (e.g., corrosion, plugged screens) and problems in the reservoir itself (e.g., migration of fines, mineral precipitation). Workover operations typically occur at intervals of 3-5 years. More severe downhole problems could require reservoir stimulation by pressure fracturing or acidizing methods.

Well workovers on the North Slope often involve drilling laterally (or "sidetracking") out of an existing well bore to a new bottom-hole location. Coiled tubing rigs now are commonly used to drill well sidetracks. Coiled tubing rigs are smaller, more mobile, and less costly to operate than standard drilling rigs. Coiled tubing also is more flexible, allowing tight steering of drill bits to reach small reservoir compartments. Drilling multiple laterals into a reservoir increases the total production rate at the wellhead.

Because production well drilling and completion are spread over several years (3 to 6 years for a typical field, see Table IV-03), the production profile for the field is broader than for any individual well. Production usually begins when a certain proportion of the wells is completed, and the production profile would then "ramp up" to peak production when most wells would be flowing. Typical ramp-up periods vary from 2 to 5 years, with plateaus at peak rate lasting 3 to 8 years. Declining production profiles could last another decade or more, with final shut-in when operating costs are higher than income from production.

(c) Waterflooding

Waterflooding is an important production practice that can significantly increase oil recovery. Injecting water into selected areas of a reservoir is designed to manage subsurface pressure and push oil toward the production wells. To maintain reservoir pressure, the volume of oil withdrawn from the reservoir must be replaced with an equivalent volume of water. For example, a field with a daily production rate of 50,000 bbl of oil would require approximately 2.1 million gal/day of water (1 bbl = 42 gal) for balanced waterflooding, given that volumetric allowances must be made for the fluids under subsurface conditions. For this example production rate, a full-field waterflood program would require approximately 760 million gallons (2,352 acre-feet) each year.

To meet water demands for waterflooding programs, a variety of water sources is considered. Potential sources could include surface water bodies (ocean or deep lakes) as well as subsurface aquifers. Restrictions could be placed on withdrawals from surface water sources that are vital to fish and waterfowl. Drilling water wells into aquifers below the permafrost layer (up to 1,500 ft thick) is costly if surface water sources are available. Fresh water must be treated so that it is chemically compatible with the formation water in the reservoir to avoid damage to the reservoir pore system.

When surface water sources are inadequate to meet the demands of a waterflood program, seawater is often used. Seawater is similar chemically to the formation brines present in most petroleum reservoirs and the supply of seawater is virtually unlimited. A waterflood system might include a seawater intake and treatment plant located on the coast and an insulated pipeline from the plant to the oil field. Waterflood programs are often used from the startup of production for most North Slope oil fields. As production continues the volume of formation water recovered with the oil (water cut) increases. At some point, injection water demands can often be met by produced formation water, and a seawater waterflood system can be phased out. The seawater capacity from the treatment plant is then available for use in a waterflood program for another field.

New oil fields in the northern part of the NPR-A could use treated seawater for waterflooding programs. Insulated seawater pipelines could be laid on the same vertical support members (VSM) that hold sales-oil and service pipelines. For remote areas, seawater intake and treatment plants could be fabricated on barges and moved into temporary locations along the coast. Because waterflooding greatly improves recovery efficiency, the economics of fields discovered near the coastline would be improved. However, the value of increased oil recovery would be balanced against the increased costs of seawater-treatment facilities and overland seawater pipelines. Remote fields could require expensive heat generators and pump stations along the pipeline to deliver treated seawater during the severely cold North Slope winter. Small or remote fields far from the coast may not be able to justify the costs of seawater waterflood programs.

(d) Abandonment

At some point in the life cycle of every field, the revenue from production is no longer enough to cover the expenses of operation. This economic condition nearly always occurs before all of the potentially recoverable oil is recovered from the reservoir. Factors leading to the decision to abandon a field may differ for each field, but declining production rates and oil/gas prices are usually the two key considerations.

Abandonment operations typically include removing all equipment, plugging all wells, restoring the site, and conducting final environmental studies. Abandonment operations can take place over several years, and revegetation and environmental monitoring studies could last even longer. A series of permitting, inspection, and approvals from many regulatory agencies will accompany field abandonment.

(6) Transportation

(a) Regional Oil Transportation

A regional oil transportation system for the North Slope oil fields was established in 1977 upon completion of the Trans-Alaska Pipeline System (TAPS). Oil is transported some 800 mi south through a 48-inch pipeline and 11 pump stations (6 are still active) to the ice-free port of Valdez, Alaska. From the storage tanks and marine loading terminal at Valdez, oil is loaded on tankers and transported to U.S. refineries.

TAPS is vital to current and future North Slope oil development. The maximum daily throughput design capacity of TAPS is slightly over 2.0 MMbbl/day (achieved in 1988). Currently, TAPS throughput is approximately 1.0 MMbbl/day. The minimum throughput for a viable TAPS operation has been widely debated by government and industry. A common perception is that a minimum throughput rate between 200,000 and 400,000 bbl/day represents mechanical and economic limits to operation. When TAPS will reach this minimum throughput rate is uncertain because of the possibility of new oil discoveries on the North Slope. However, based on the declining production trends of existing North Slope fields the operational limits of TAPS could be reached within the next 15 years.

The oil industry is very aware of the TAPS throughput issue, and aggressive efforts are underway by the North Slope producers to slow the production decline. These efforts include exploration for new fields, using innovative methods to develop satellite fields, and increasing the oil recovery efficiency from older fields. Renewed industry interest in the NPR-A is an important part of the strategy to help maintain the TAPS throughput above acceptable limits. Without this vital transportation system, continued oil production from the North Slope is unlikely. Consequently, all development scenarios assume that TAPS will continue to carry North Slope oil production for decades to come.

(b) North Slope Pipelines

The central area of the North Slope (State of Alaska lands) contains numerous oil fields connected by a complex pipeline gathering system to the TAPS Pump Station #1. Major new oil development projects in the NPR-A are likely to connect to the pipelines in the Kuparuk River Unit (KRU). The 24-inch KRU pipeline has a throughput capacity of approximately 350,000 bbl/day and currently is transporting 325,000 bbl/day. As the large fields (Kuparuk River, Milne Point, Alpine) feeding the KRU pipeline decline, excess pipeline capacity could be filled by new fields. The current KRU pipeline tariff of $0.21/bbl is more affordable than multi-million dollar costs for new pipeline construction across State lands to TAPS.

For the economic portion of this analysis, it is assumed that the sales-oil pipeline from the Alpine field will not be utilized by new oil development projects in Northwest NPR-A. The 14-inch Alpine pipeline was designed to carry approximately 100,000 bbl/day and could be operating at capacity in the foreseeable future. Satellite fields near Alpine could come on line in the future and would fill any extra capacity in this line as the main Alpine field declines. New fields in Northeast NPR-A could also feed into this line as capacity is available. It is more likely that fields closer to Alpine will be developed before fields in more remote areas (Northwest NPR-A), and nearby fields would be first to claim any available capacity in the Alpine line. Secondly, the first development projects in Northwest NPR-A will have to be very large (combined size perhaps equal to Alpine) to be economic, so production rates through a new overland pipeline would overwhelm the capacity of the present Alpine pipeline.

(c) Future NPR-A Pipelines

The locations of new pipelines that could be constructed in NPR-A depend on the location of commercial-sized discoveries. Today, there is no reliable way of predicting where or when new commercial fields will be discovered and developed. Fields developed first would have to establish the first pipeline corridors connecting new NPR-A fields to existing infrastructure east of the Colville River. Fields developed later would attempt to use the existing pipelines if excess capacity were available. It is likely that commercial-sized fields discovered by different companies would lead to an agreement for a common-carrier pipeline to transport oil from NPR-A to TAPS. The size and length of future pipelines in NPR-A would depend on the location of new discoveries and restrictions on potential pipeline corridors. In-field pipelines (flow lines) carry multiphase slurries (oil, gas, water) from wellhead manifolds to central processing plants. Return lines would carry gas or water back to injection wells on production pads. In-field flow lines are relatively small in diameter (4 to 10 inches). Somewhat larger sales-oil pipelines (12 to 16 inches) would carry metered sales-quality oil from individual fields to a mainline (16 to 20 inches). This main pipeline would then carry oil from several producing fields to the KRU pipeline (24 inches) for transport to TAPS (48 inches).

The geologic play potential was used to guide development of hypothetical pipeline routes for the scenario (Map 108). No implication regarding exact field location is intended. It is reasonable to expect pipelines to follow the shortest route to TAPS. Oil and gas development in the northern high-potential area along the Beaufort coast would have pipelines that run west-to-east, south of Teshekpuk Lake, and cross the Colville River near Nuiqsut. Oil lines would be installed above ground (because they are hot) and gas pipelines would be buried (because cold conditions are preferred) along the same pipeline right-of-way (ROW). If discoveries were to be made in the southern part of the Planning Area, the oil pipeline ROW would run west-to-east, crossing the Colville River at Umiat and then connecting to TAPS at Pump Station 2 (not currently active). A main gas pipeline route from the southern area would likely run through Inigok (former Husky/USGS drill site), crossing the Colville River near Nuiqsut before continuing to a new gas processing facility at Prudhoe Bay.

(d) Pipeline Construction

Pipeline construction techniques have evolved over decades of experience in the arctic environment on the North Slope. The following assumptions cover general engineering concepts for pipeline design and construction that could be adopted for future NPR-A projects.

- Pipeline crossings over large rivers, such as the Colville River, could use the horizontal directional drilling techniques used by the Alpine Field project.
- Relatively wide, shallow rivers could be crossed by trenching and burying insulated pipelines in the riverbed. These crossings would be constructed in winter at locations selected to minimize disturbance to overwintering fish habitat.
- Narrow streams could be crossed by elevated pipelines on suspension spans.
- Pipeline alignments will be routed to avoid crossing lakes.
- The new mainline route might require one pump station, depending on distances, pipeline diameters, and production rates. A pump station footprint can cover from 10 to 60 acres depending on transportation logistics (e.g., an associated airstrip would require more area), fuel storage requirements, and scale of operation designed for pipeline throughput. For this analysis, a pump station is assumed to occupy a gravel pad covering about 20 acres.
- Future pipeline routes and installation designs will depend on site-specific conditions evaluated by engineering studies.

Pipeline routes are normally laid out in straight-line segments (known as alignments) and oil pipelines are installed above ground on vertical support members (VSM) (Figure IV-05). This installation method is preferred for oil pipelines on the North Slope for the following reasons.

- Oil flows more easily and efficiently if the oil remains warm.
- Elevated pipelines are easier to insulate; construction time is less.
- There is less disruption to the land during installation.
- Elevated pipelines are easier to monitor and repair.
- The VSM system provides more flexibility for later modifications (add new pipelines).

The VSM's generally are spaced 55 to 70 ft apart and are installed with minimum bottom-of-pipe clearance heights of 5 ft above the ground to minimize disturbance to caribou herd movements. Pipeline clearance can be higher (up to 20 ft) over topographic lows (stream valleys) because engineering requires a nearly level pipeline route. VSM's might cross small, shallow lakes, whereas the pipeline would go around large or deep lakes with some setback.

In contrast to elevated, warm oil pipelines, trenching and burial are preferred for gas pipelines. Because heat causes gas expansion, chilled pipelines provide a more efficient means to transport gas, with the added advantage that natural gas liquids can be carried in the gas stream. High-pressure, chilled gas pipelines represent a new technology that significantly improves the economics of natural gas transportation. Trenching operations would occur in winter and disturb a surface area 15 ft in width or less along the buried pipeline route. Because they are buried, high-pressure gas lines are more costly to install and operate, they would most likely be used only on long overland segments. The shorter gas pipelines that connect satellite fields would be carried on the same VSM's as other aboveground pipelines.

Commercial oil discoveries would most likely occur in the northern coastal plain and would be connected to TAPS following the general oil pipeline corridor shown in Map 108. For the purposes of this analysis, it is assumed that natural gas would not be commercially produced as a result of oil development after the first lease sale in Northwest NPR-A. Eventually, when oil production nears depletion, natural gas may be produced through existing oil field facilities, and a trenched gas line could follow the same pipeline corridor. Approximate trenching and surface disturbance distances for such a pipeline would be 70 mi on State lands, 100 mi in Northeast NPR-A, and 25 mi in Northwest NPR-A--just under 200 mi. Gas development is more likely to result from the second (or later) lease sales in the southern foothills area where large, standalone gas fields might be present. It is assumed that this trenched gas pipeline corridor would run diagonally across the Northwest and Northeast NPR-A Planning Areas to connect to a future gas hub in the Prudhoe Bay unit (Map 108). Trenching and surface disturbance distances would be approximately the same as for the more northerly route described above.

(e) "Roadless" Development

One stipulation for leases in Northeast NPR-A is that future projects can not be connected to a permanent road system extending outside of NPR-A. Despite the term "roadless," most fields are connected by temporary winter roads to transport heavy equipment and supplies. These seasonal roads could be packed-snow roads or ice roads (or both) and are typically used for up to 6 months each winter (December-May). In addition to ice roads, remote fields are likely to have alternate transportation systems, such as marine barging and/or airstrips. Short gravel roads (in-field roads) usually connect production pads and facilities within individual fields, and could perhaps connect to satellite fields that would share the main infrastructure.

"Roadless" development is a recent (decade or so) North Slope strategy prompted by both economic and environmental reasons. Where there is limited availability of road construction materials (gravel and sand), or cost constraints, temporary winter roads have been used successfully. Smaller fields may not be able to support the high cost of long, permanent roads, and so they rely on winter roads to move supplies and equipment. New fields on the North Slope (Badami, Alpine, and Point Thompson) have adopted a "roadless" development strategy, and similar-sized fields in the NPR-A may not require the same level of access as the multibillion-barrel fields (such as Prudhoe Bay and Kuparuk) developed decades ago.

From a safety standpoint, permanent roads allow direct monitoring of pipelines and more rapid response time should repairs be necessary. Roadless development would not preclude access for pipeline inspection or maintenance; rather, the mode of transportation would change with the seasons. Over the winter months, visual inspections could be conducted via packed-snow or ice roads, by snowmobiles, and by aircraft. In summer months, visual inspections would be conducted almost exclusively using aircraft. Response to the need for pipeline repairs likely would use the same forms of transportation. It is possible that hovercraft could be used in some areas for emergency repair work, particularly during periods when the tundra is wet (as opposed to frozen). Should an emergency pipeline repair be necessary, an on-site coordinator would consider the tradeoffs for various transportation-related remediation strategies.

Pipeline flow monitoring on the North Slope is now done largely using remote instrumentation. Numerous monitoring and safety systems are installed to provide redundancy in these automated electrical and mechanical systems. For example, mechanical shutoff valves are being replaced by vertical expansion loops to provide a more failsafe method of controlling pipeline pressures and leaks.

The use of ice roads does have limitations. Construction of ice roads cannot begin until temperatures are cold enough and tundra conditions (snow cover and frost depth) will support heavy equipment. Construction of ice roads is a time-consuming process as the route must be surveyed, permits for water use obtained, and the ice built up layer by layer. The average rate of ice-road construction is approximately 1 mile per day under optimum conditions. The time taken to construct the road to the drill site reduces the time available for winter drilling activities. A practical limit for ice roads is 50 miles over land and up to 100 miles on near-shore ice. For production activities, an ice road would need to be constructed each year and alternate access would have to be established to support operations during the summer.

(7) Development Scenarios

(a) Resource Potential and Related Activities

A sequence of activities is associated with petroleum development, beginning with tract leasing and exploration drilling, and ending decades later with the abandonment of depleted fields and site remediation. A general timeframe for exploration, development, and production activities in northern Alaska is given as Table IV-02. For environmental impact analysis, it is assumed that the scope of activities and associated impacts are correlated to the economic resource potential that is available to industry. In practical terms, industry interest in leasing and exploring for new oil and gas reserves is driven largely by profit motives, and each company may view the geologic or economic opportunities of a particular area differently. Industry opinions can change quickly with new geologic data or economic conditions, and activities can be negatively affected by regulatory hurdles. The total volume of oil and gas recoverable from an area cannot be defined accurately until all of the commercial-sized fields are discovered and produced to depletion. Leasing is just the first step in the sequence of activities. There is no guarantee that later activities will occur.

As previously discussed in Section III.A.1.a and Appendix 7, the petroleum resource potential is evaluated using two assessment models. The conventionally recoverable (or "geologic") resources represent pooled oil and gas recoverable by current technology without regard to engineering or economic constraints. The conventionally recoverable estimates provide an optimistic view of an area's hydrocarbon endowment, but they do not reflect the realities of commercial operations. Engineering, economic, and environmental factors will determine the commercial viability of oil and gas discoveries. When these factors are considered, the number of undiscovered pools capable of supporting commercial production is significantly lower than the total endowment expressed by the geologic assessment. It is more accurate to base environmental impact analyses on economically recoverable petroleum estimates because they better represent the commercial potential.

A resource assessment including the Northeast and Northwest NPR-A Planning Areas was conducted by MMS and BLM in early 2002. The methodology and results of this assessment are discussed in Section III.A.1.a and in Appendix 7. The resource potential for the combined assessment areas were then divided into estimates for the individual areas (Table App7-02). The petroleum resource estimates for the Northwest NPR-A Planning Area were then used as a basis for the development scenarios analyzed in this IAP/EIS. Petroleum resource estimates for the Northeast Planning Area are generally discussed in the cumulative case, but detailed information is not supplied.

Because the location of future commercial-size pools is impossible to predict, one method to define the potential in smaller areas is to proportion the resources areally on a play-by-play basis. This method implies that commercial-size pools are uniformly distributed throughout the play area, which they are not. It is more likely that large pools would occupy only a few percent of the total play area and contain most of the economically recoverable resources. However, at the present time no one can precisely locate these commercial pools, so a general allocation model is reasonable. The resource allocations for each play analyzed in the economic assessment is summarized in Table App7-02.

The results of the economic assessment are described by a range in potentially recoverable volumes correlated to both probability of occurrence and average real commodity price. To simplify the analysis, only volumes associated with the mean, or expected, case (risked average of the distribution) are reported. Mean values can be combined in a straightforward manner, whereas other probabilities cannot. The economically recoverable volumes at the mean are further bracketed by price levels corresponding to $18 to $30 per bbl for oil and $2.56 to $4.27 per Mcf for gas in 2002 dollars. These prices are thought to represent average future market conditions.

Several conclusions are apparent from the economic analysis:

1. The Northwest NPR-A Planning Area has a much lower economic resource potential on a per-acre basis than the adjacent Northeast NPR-A Planning Area. The Northwest Planning Area is over twice as large (9.8 million acres compared to 4.6 million acres in the Northeast Planning Area), but it has estimated economic resources of less than half of the combined assessment area (more precisely, 31 percent of total oil and 46 percent of total gas). This is largely related to the remoteness of the Northwest Planning Area and proportionally higher operation costs.

2. The $18 per barrel price level does not support economically viable development for new standalone oil fields in the Northwest Planning Area. Considering that historical price levels have averaged below $18 per barrel (in constant dollars) over most of the 20th century, this means that any development project could be marginal as an investment opportunity. It is likely that industry will use conservative prices in their economic evaluations and not the price spikes above $30 per barrel seen recently. If this conclusion is true, future operations are more likely to involve only exploration activities (leasing, seismic surveys, and a few wells) rather than extensive field development, such as the Prudhoe-Kuparuk complex.

3. Within the price brackets most of the economic resource potential is contained in only a few geologic plays. The Beaufortian play (Play 8) contains 60 percent of the total economic oil resources and 36 percent of the total economic gas resources in the Northwest NPR-A. Two other plays in the southern part of the area (Brookian foldbelt, Play 14 and Fortress Mountain, Play 23) together contain 53 percent of the total economic gas resources in the Northwest NPR-A Planning Area. As most analysts agree on these high-potential plays, it is likely that future exploration will be focused on the recognized high potential area. Regulatory restrictions affecting operations in the high-potential area could undermine industry interest and reduce the likelihood that commercial fields will be discovered, developed, and produced.

(b) General Scenarios

As previously discussed, possible environmental impacts associated with future oil and gas activities are correlated to the economic petroleum estimates. That is, higher levels of development are likely to be associated with higher levels of impacts. However, there is no way to accurately predict when or how much of the theoretical (undiscovered) potential will actually be converted to future production. For a reference point, we assume that if the entire area is open to unrestricted exploration and development, all of the economic potential would eventually be converted to producing reserves. This may be an overly generous assumption. Industry groups could easily lose interest in exploration after a number of costly wells and sub-economic discoveries. However, using the full economic potential to scale impacts provides a conservative (worst-case) view of possible environmental disturbances.

The environmental analysis contained in this IAP/EIS is based on hypothetical development scenarios tied to estimates of undiscovered resources. There are many uncertainties regarding future events. It is acknowledged that other scenarios are possible. Given that environmental analysis and decisions regarding leasing must happen now, future activity estimates have been based on the available data and current trends. It is not reasonable to offer dozens of other speculative scenarios. The scenarios adopted for this IAP/EIS provide a common basis for environmental analysis within a broad spectrum of scientific disciplines.

The exploration-only scenario assumes that long-term oil prices average less than $18/bbl and that a new gas transportation system is not constructed from the North Slope to southern markets. It is also possible that limited exploration efforts will fail to identify commercial-size pools. At low oil prices, it would be difficult to design a profitable project in this remote, high-cost area. Under low-price conditions, industry could buy leases and drill exploration wells at a modest pace. Winter seismic surveys would probably concentrate on the high-potential area for 3-D survey work. Exploration drilling might be limited to prospects with good access logistics (near the coast or an all-season airstrip). If the exploration results in discoveries, it is likely that commercial development would be postponed in anticipation of higher oil prices or new technologies.

The development scenario includes economic conditions where average oil prices remain between $18/bbl and $30/bbl (2002$). Since 1990, North Slope crude oil has bounced between $14/bbl and $30/bbl (averaging $22.77/bbl in 2003), while the OPEC cartel has attempted to maintain oil prices in the $22/bbl to $28/bbl price range. It is not realistic to assume that long-term prices will average $30/bbl in real dollar terms. However, it is conceivable that future technologies will decrease oil/gas finding and recovery costs and increase the fraction of resources that can be economically recovered. Although the direct effects of future technologies cannot be addressed at this time, the higher oil price level ($30/bbl) can be viewed as a surrogate for higher recoveries aided by technology.

Two sets of development scenarios are discussed here. The first set includes estimated activities occurring as a result of the first lease sale in Northwest NPR-A, now scheduled for mid-2004. Although it is referred to as the "first-sale" scenario in the present IAP/EIS, it will be the seventh lease sale in NPR-A. All tracts leased in four previous sales (1982-1984) have been relinquished. Two lease sales (1999 and 2002) were held in the Northeast NPR-A. A relatively large proportion (50%) of the petroleum activities and production is expected to occur as a result of the first sale, with progressively lower levels of activities resulting from each later sale.

A second set of scenarios includes the total activities associated with all lease sales envisioned for the Northwest Planning Area. This is referred to as the "multiple-sale" scenario. For the development scenario, it is optimistically assumed that all of the undiscovered economic resources would be discovered and developed if many lease sales are held and industry actively explores the area.

A hypothetical activity schedule for the first commercial development in the Northwest NPR-A is represented in Table IV-02. It is assumed that initial development would involve only oil recovery, as gas recovery would be postponed until a gas transportation system is built from the Prudhoe Bay area. It is also assumed that gas handling would not bottleneck oil production and that the gas would be reinjected to increase oil recovery. In a normal sequence of events, the largest pools are usually discovered and developed first. Later fields would attempt to share this existing infrastructure to lower costs. The first field would "anchor" development in a remote area by providing the necessary processing and transportation facilities, including a long, overland pipeline connecting to TAPS. This would allow the economic development of a number of surrounding, small "satellite" fields. For this analysis, an Alpine-size field is used as an example of the first oil development in Northwest NPR-A. Later satellite fields could be tied to the main field if they are located within 20 mi. However, no attempt is made to estimate the timing of later satellite developments tied to the first large field. A schedule for future gas production is not included because it is difficult to predict when major gas sales will occur from the North Slope (pending construction of a new gas transportation system).

(c) Differences in Activity Levels for Leasing Alternatives

Four alternatives were analyzed in the draft Northwest NPR-A IAP/EIS, each with a different regulatory strategy to mitigate the environmental impacts and conflicts with subsistence activities that could potentially result from future petroleum activities. The Preferred Alternative (described below) was developed from the analysis of these four alternatives, review of public comments on the draft IAP/EIS, and additional discussions with affected stakeholder groups.

Regulatory strategies take two forms. One strategy (referred to as "prescriptive measures") places areas off-limits to leasing or occupancy by surface facilities. The other strategy involves "performance-based" goals that could vary according to site-specific conditions. The measures incorporated in the alternatives are stipulations, which would be applied to the lease and leaseholder activities, and required operating procedures (ROP's), which would be applied to all permitted activities in the Planning Area.

Regardless of the terminology used, all regulatory restrictions add some cost to commercial operations. Area closures or seasonal restrictions would reduce exploration opportunities and thereby decrease the likelihood that new fields would be discovered. The economic burdens related to regulations can be grouped into a general form called the "cost of mitigation." Individual components of the cost of mitigation cannot be defined exactly because they are site-specific, but the effects are additive for the components affecting a particular site. Cost of mitigation components could include: delays in permit approvals, modifications to projects, required biological or cultural studies, relocation of facilities from optimal sites, and lower oil/gas recoveries because of technology limitations or costs. In all cases, uncertainties surrounding mitigation cost would adversely affect industry interest and investment decisions regarding development.

Although the cost of mitigation cannot be precisely determined at present (because the locations of new fields are unknown), for purposes of environmental analysis it is assumed that the stipulations and ROP's would be enforced as written and exceptions (if granted) would provide comparable levels of protection.

The management objective for NPR-A is to protect surface resources from unnecessary disturbance while allowing opportunities for successful oil and gas operations. However, both industry and government are aware that all petroleum prospects in this remote area are marginally economic. The MMS/BLM resource assessment concluded that fields in Northwest NPR-A area are uneconomic at oil prices below $18/bbl (a price which represents an historical average). At this price level no activities--other than minimal leasing and rare exploration drilling--are expected to occur. Although the environmental analysis is made on extensive development activities projected from a higher price ($30/bbl), it is unrealistic to assume that companies would base their investment strategies on this anomalously high price level. The economics of petroleum development in Northwest NPR-A is therefore very sensitive to added costs or uncertainties associated with regulatory restrictions.

The No Action Alternative reflects current BLM management of the Northwest NPR-A Planning Area and does not provide for oil and gas leasing. Since no oil and gas leases would be offered, there would be no petroleum development or production. Under this alternative, there are two options with regard to seismic activity: one option would permit winter seismic surveys and the other option would prohibit such surveys. Under this alternative, summer aerial surveys and geologic field investigations would be permitted. It is reasonable to expect very low levels of petroleum activities without a firm schedule for leasing.

Alternative A would make all lands and submerged areas administered by BLM in the Northwest NPR-A Planning Area available for oil and gas leasing, exploration, and possible development. Under this alternative, no Special Areas, Wilderness Study Areas, or Wild and Scenic Rivers would be proposed. While all areas would be offered for leasing, petroleum-related activities would be conducted under comprehensive stipulations and ROP's (see Sec. II.C.6). The economic impact of the regulatory measures could range from negligible to significant, depending on site-specific conditions. Qualitative analysis of the overall cost of mitigation indicates that up to 30 percent of future commercial development opportunities could be lost as a result of regulatory restrictions and mitigation measures. Of this 30 percent "lost opportunity" estimate, 20 percent is attributed to the restrictive regulations in the adjacent Northeast Planning Area (through which most of the support for Northwest NPR-A operations must pass). The other 10 percent is attributed to unavoidable conflicts and project delays associated with subsistence activities or biologically sensitive areas.

Alternative B would offer 96 percent of Northwest NPR-A area for leasing. The proposed Kasegaluk Lagoon Special Area would not be offered for leasing, and no permanent facilities would be allowed in other lagoon and most nearshore areas. Stipulations and ROP's provide protective measures that include provisions for conflict resolution with subsistence groups, setbacks from large water bodies (rivers, lakes, and ocean), and seasonal restrictions on activities to protect biological resources and subsistence activities (see Sec. II.C.6). The economic impact of the regulatory restrictions could range from negligible to significant depending on site-specific conditions. Qualitative analysis of the overall cost of mitigation indicates that up to 40 percent of future commercial development opportunities could be lost as a result of regulatory restrictions and mitigation measures. Of this 40 percent "lost opportunity" estimate, 20 percent is attributed to the restrictive regulations in the adjacent Northeast Planning Area. Another 10 percent is attributed to unavoidable conflicts and project delays associated with subsistence activities and biologically sensitive areas, and the remaining 10 percent is attributed to technical limitations and economic burdens in the no-surface-occupancy areas (many of which are in the high-oil-potential area along the Beaufort Sea coastline).

Alternative C would make 47 percent of the BLM-administered lands in the Northwest Planning Area available for oil and gas leasing, but only 2 percent of the recognized high-petroleum-potential areas would be open. Eliminating areas of high oil potential would have a chilling effect on industry interest and negatively affect future development possibilities. Very restrictive mitigation measures (similar to the current regulations in the Northeast Planning Area) for the areas remaining open for leasing are likely to preclude effective commercial operations. Given the relatively low hydrocarbon potential of the areas remaining open for leasing, coupled with the regulatory restrictions, Alternative C is essentially equivalent to the No Action Alternative.

The Preferred Alternative attempts to achieve a balance between protection of the environment and subsistence traditions while providing opportunities for successful oil and gas operations. Of the BLM-administered land, 96 percent is offered for leasing, including all of the recognized high-oil and -gas-potential areas. Leasing would be deferred for 10 years in the western part of the Planning Area (low oil and gas-potential).The proposed Kaseguluk Lagoon Special Area (low oil and gas potential) would not be made available for leasing or petroleum exploration. In many ways the Preferred Alternative is similar to Alternative B (discussed above). Leases would be offered in Dease Inlet and nearshore lagoon areas, and the no-surface-occupancy restriction would be replaced by strict regulations and consultation requirements prior to the approval of permanent facilities (see Sec. II.C.6). Setback restrictions would provide no-development buffers along major rivers, deep lakes, and most shorelines. Extensive consultation steps would be required before approval of most activities, which could delay project approvals. Qualitative analysis of the overall "cost of mitigation" indicates that up to 40 percent of future development opportunities could be lost as a result of regulatory restrictions and mitigation measures. Of the 40 percent "lost opportunity" estimate, 20 percent is attributed to the restrictive regulations in the adjacent Northeast Planning Area. Unavoidable conflicts between proposed operations and subsistence account for a 10 percent reduction. The remaining 10 percent of "lost opportunity" is attributed to technical feasibility issues, project modifications, and long delays associated with required biological studies and consultations with natural resource agencies.

(d) First Sale Scenarios

The estimated petroleum potential and number of fields associated with the first sale under each leasing alternative are summarized in Table IV-04. The projected activity levels, infrastructure components, and estimated peak production for the first sale under each alternative are summarized in Table IV-05. There are no development activities estimated at the low-price level ($18/bbl of oil and $2.56/Mcf of gas) for any of the alternatives because in the economic model, low prices did not support viable commercial development in the Northwest NPR-A Planning Area. Even under the high-price ($30/bbl of oil and $4.27/Mcf of gas) scenario, Alternative C's area closures and restrictive measures is very likely to preclude viable commercial development. If a sale is held under Alternative C, it is possible that leases will be purchased and some exploration could target gas prospects in the southern part of the area. A number of fields are projected to be discovered and developed under Alternatives A and B at the high-price level. Although it is impossible to predict the specific locations and characteristics of future commercial discoveries, oil development is likely to occur first in the Beaufortian play (Map 102) in the northern part of the Northwest NPR-A. Later gas development could drive exploration and development efforts in the southern part of the area from the gas-rich plays present there (Map 103 and Map 104).

These activity estimates are based on the assumptions listed below.

- Industry will actively purchase leases and drill exploration wells in Northwest NPR-A, and this activity will lead to the discovery of commercial-sized oil and gas pools.
- There will be no long-lasting legal or regulatory impediments to exploration or development.
- Future oil production from the NPR-A will use TAPS to transport oil to outside markets.
- Development and production of natural gas will not occur until a gas-transportation system is constructed from the Prudhoe Bay area to outside markets.

(e) Multiple Sales Scenario

The basic assumption for the multiple-sale scenario is that the total economic resource potential in the Planning Area could be discovered and developed if industry is given the opportunity. However, based on past experience it is unlikely that industry will provide the funding required to discover and develop all of the resources in a frontier province. However, for purposes of environmental analysis, such a conservative assumption makes it possible to evaluate worst-case impacts.

As a rough estimate of exploration costs, historical evidence shows that "finding costs" (including all wells and seismic surveys, but not lease acquisition costs) could average $1.00 per barrel of oil produced. This means that discovering the full economic oil potential of Northwest NPR-A (2.1 billion barrels) could cost $2.1 billion. Assuming exploration wells average $15 million each and seismic surveys cost $5 million, with 10 wells drilled for each seismic survey (or $155 million incremental cost), this would translate into 135 wells and 13 seismic surveys. These estimates exceed all past exploration activities in the entire NPR-A.

Usually the best prospects (largest, easiest to map, involving proven reservoirs) are leased and tested by drilling. The largest fields enjoy the economy of scale for development, and smaller fields are harder to find and have higher per-barrel development costs. All of the hypothetically economic resources may not be worth exploring for, particularly if commercial fields are not discovered early in the exploration cycle. Many promising areas remain underexplored because of changing economic conditions or corporate strategies unrelated to the undiscovered resource potential. For example, as a result of four BLM lease sales held in the early 1980's, only one industry test well (ARCO's Brontosaurus prospect) was drilled in Northwest NPR-A.

The activities associated with the multiple-sale scenario are estimated using the full, undiscovered economic potential under each alternative. Several key assumptions are necessary to qualify this approach:

- an undetermined number of future lease sales will be held;
- industry will lease and drill tracts acquired in each sale in Northwest NPR-A;
- economic conditions (particularly oil prices) will remain favorable to development in northern Alaska (above $18/bbl);
- high-potential plays will not be condemned by future drilling;
- learning curves will improve operational efficiencies and technology advancements will lead to higher commercial success rates; and
- future petroleum production will continue to use existing North Slope infrastructure, most importantly the TAPS pipeline and a new gas transportation system.

With these qualifying assumptions clearly in mind, the estimates for the alternatives under the multiple-sale scenarios are provided in Tables IV-06 (petroleum resources) and Table IV-07 (petroleum activities).

The timeframes for development under the multiple-sale scenarios are not included because a future lease-sale schedule has not been established. While it is safe to assume that the development activities associated with multiple future sales would extend considerably beyond the schedule for a single project, it is not reasonable to assume that the activities associated with the first sale in the series would be replicated by subsequent lease sales. Historically, leasing and exploration interest drop during a series of lease offerings in the same area. The oil industry tends to evaluate its current lease inventory before leasing large numbers of additional tracts. A thorough evaluation of the petroleum resources in the NPR-A could stretch many decades into the future as new play concepts emerge and are tested.

(8) Possible But Unlikely Activities

This section has presented the most likely scenarios for oil and gas development that BLM projects are reasonably foreseeable under each alternative. Less likely or unanticipated activities might occur. Three notable variations of the scenarios are briefly presented below.

(a) Early Development of Natural Gas Resources

The development scenarios for Alternative A, Alternative B, and the Preferred Alternative indicate that gas resources would probably not be developed in the southern part of the Northwest NPR-A Planning Area as the result of the first lease sale, but that following a second sale, natural gas development might occur. While BLM believes this is a realistic scenario, the oil and gas industry might conceivably become unexpectedly aggressive about developing gas resources. If that were to happen, gas development in the southern part of the Planning Area might actually occur on lands leased in the first lease sale. If natural gas development were to occur in the southern part of the Planning Area as a result of the first lease sale, the activities and potential impacts would generally be the same types as those described under the multiple sale analyses for Alternative A (Section IV.C), Alternative B (Sec. IV.D), and the Preferred Alternative (Section V.B).

(b) Development Under Alternative C

Given (1) the marginal economics involved with development in the Northwest NPR-A Planning Area, (2) that under Alternative C some of the most promising areas for leasing would not be offered, and (3) the level of protection afforded surface resources that are offered under Alternative C, BLM does not anticipate any oil and gas development to occur under Alternative C. Consequently, this analysis of impacts from oil and gas activities under Alternative C generally indicates that BLM does not anticipate oil and gas development activities or any of the associated impacts. Nevertheless, oil and gas leasing in some parts of the Planning Area would be allowed under Alternative C. Unforeseen discoveries, advances in technology, or changes in oil field economics or market conditions could lead to development of any leases that might be let under Alternative C. The activities and potential impacts associated with that development would generally be the same types as those described for Alternative A (Section IV.C), Alternative B (Sec. IV.D), and the Preferred Alternative (Section V.B).

(c) Permanent Roads

The scenarios for the alternatives evaluated in this IAP/EIS assume that a permanent road connecting Northwest NPR-A Planning Area oil and gas fields to the coast of the Planning Area or to potential infrastructure to the east is unlikely. While BLM believes this is a realistic scenario, this IAP/EIS does not forbid construction of such roads within the Northwest NPR-A Planning Area. Permanent roads are considered economically unfeasible under current economic and technological conditions. Under the current IAP for the Northeast NPR-A, permanent roads connecting Northeast NPR-A facilities to outside infrastructure are prohibited, and no exceptions are allowed. However, the Alaska Department of Transportation and Public Facilities is working with the North Slope Borough to develop one of two possible routes for an all-season gravel road from the Dalton Highway corridor to the NPR-A via a bridge across the Colville River to Nuiqsut (*Petroleum News Alaska*, 2002). If the regulatory framework of the Northeast NPR-A Planning Area were to change and permanent roads within that Planning Area were to be built and connect to the proposed road to Nuiqsut, such a road system could theoretically support oil and gas activities in the Northwest NPR-A. New oil and gas discoveries, changing economics, developing technologies, material and time constraints on ice roads, construction of roads east of the Planning Area, and evolving regulatory framework are all factors that might influence the feasibility of "roadless" development versus the use of permanent roads. Consequently, the potential impacts of possible permanent roads are considered in Section IV.K.

2. Oil Spills

The oil-spill analyses in this IAP/EIS are based on three spill-size categories: 1) large spills--greater than or equal to 500 bbl and less than 120,000 bbl; 2) small spills--1 teaspoon to less than 500 bbl; and 3) very large spills--greater than or equal to 120,000 bbl. Large spills are not expected to occur at the $18/bbl price during the lifetime of the field. Large spills have some moderate chance of occurring during the lifetime of the field at the $30/bbl price. Small spills are expected to occur and a very large spill is considered extremely unlikely. The subsections within Sections IV and V where each spill size category is analyzed are identified in Table IV-17.

For analysis purposes, this EIS assumes no oil-spill cleanup occurs. The responses to a spill and amount of oil removed are variable and dependent upon the weather conditions, time of year, location, the size of the spill, and other factors. The amount of oil removed can cover the whole range from none to almost all of the oil. By assuming no cleanup, the estimated adverse effects to the resources would tend to be over estimated or greater than what would actually occur. Lessees are required to submit their oil spill contingency plans with their exploration and development plans, and the effects of those plans are evaluated as part of the environmental review and assessment of the exploration and development plans.

Operators are required to have oil spill discharge prevention and contingency plans for all approved exploration and development plans. Federal regulations 43 CFR 3160, Onshore Order Numbers 1, 2, and 6 deal with the prevention and control of oil spills and releases. Regulations 40 CFR 110 and 300 deal with responses to spills or releases of oil and gas. The State of Alaska (AS 46.04.020(a)) requires an oil spill to be contained and cleaned up immediately, except under certain specificed conditions, namely: (a) the Alaska Department of Environmental Conservation, in consultation with the U.S. Coast Guard or the U.S. Environmental Protection Agency, as appropriate, determines that containment or cleanup is not technically feasible; or (2) containment or cleanup would result in greater environmental damage than the spilled oil. In cases where an oil spill may reach open water, a facility operator must be prepared to contain or control the realistic maximum oil discharge within 72 hours (see AS 46.04.030(k)). The State's oil pollution prevention and response requirements are identified in (18 AAC 75) and they could help prevent and lessen the effects. For additional information about oil spill prevention and response requirements, see Section IV.A.4 below.

All of these requirements could mitigate and lower the effects of an oil spill, however, because of the variability and uncertainty about the amount of oil that would be removed, this EIS does not assume or estimate any level of cleanup or oil removal, which BLM acknowledges is a very conservative position and one that tends to overstate the adverse effects of an oil spill.

a. Large Oil Spills

Of major concern to stakeholders are the potential effects on the environment from oil spills. This section summarizes the key variables used in this IAP/EIS for oil-spill analysis. For details on any of these points, please refer to Appendix 9. Sections IV.B through IV.F discuss the effects of large oil spills on particular resource categories under each alternative as well as for the cumulative case.

Large oil spills are defined as greater than or equal to 500 bbl. Large oil spill information is based on large historical Alaska North Slope spills. This introduction summarizes the assumptions we use to analyze large oil spills. The assumptions about large oil spills are a mixture of project-specific information, modeling results, statistical analysis, and professional judgment. For details on any of these points, please read Appendix 9. We feel this is the basis for understanding discussions about the effects of oil spills on environmental, social and economic resources of concern in Sections IV.B through IV.F.

The estimated mean number of large spills assumed for each alternative at the $18 and $30 price (2002$) per barrel of oil are shown in Table IV-19. For the purposes of this analysis, no large spills are assumed to occur at the $18/bbl price and under the No Action Alternative at any price. It is unlikely that a large spill would occur under Alternative C, because development would be uneconomical and not likely to occur under that alternative. For information about the potential effects of oil spills under Alternative C, see discussion at Section IV.E. We assume no large spills occur at $30/bbl price for the No Action Alternative or Alternative C. One large spill is assumed to occur anywhere from the Northwest NPR-A gravel pad facilities or pipelines at the $30/bbl price for the Alternative A, B and the Preferred Alternative. This "what if a spill occurs" analysis addresses whether such spills could cause serious environmental impact.

As part of the analysis of the effects of a large oil spill, the chances of such a spill occurring are estimated. The estimated chance of one or more large spills occurring under the No Action Alternative and Alternative C with no resources and Alternatives A and B at the $18/bbl price is less than 0.5 percent. The estimated chance of one or more large spills occurring from the Alternative A, Alternative B, and the Preferred Alternative at the $30/bbl price is 38 percent, 33 percent, and 33 percent, respectively, over the lifetime of the project (Table IV-19). The most likely number of large spills for all alternatives is 0.

The consequences of a large oil spill are analyzed because it is an important concern to all stakeholders. The BLM uses the term "moderate" to characterize the relative chance of a large spill occurring, and it is based on familiarity with oil-spill rates and sizes. Multiple stakeholders have different interests and different analytical perspectives that shape the way they think about spill occurrence and identify a preferred policy response. For some stakeholders, a 33 to 38 percent chance of a large spill over the life of a field may be high. In this IAP/EIS, the term "moderate" means on the order of 33 to 38 percent over the life of the field.

The analysis of a large spill represents the range of effects that might occur from offshore or onshore spills of varying sizes at Northwest NPR-A facilities or pipelines. The analysis of these oil spills determines whether such spills could cause serious environmental impact.

The large spill sizes assumed for the analysis are listed in Table IV-19. The large spill scenarios involve a 500-bbl crude spill from a pipeline or a 900-bbl crude or diesel oil spill from a gravel pad facility. The spills are classified as follows:

- Crude oil
    - gravel pad facility, 900 bbl
    - pipeline, 500 bbl
- Diesel oil
    - gravel pad storage tank, 900 bbl

For further information on the derivation of the assumed spill sizes, please see Appendix 9.

A large spill from the Northwest NPR-A facilities or pipeline could happen at any time during the year. Scenarios are created in which a spill could reach any of the following environments:

- gravel pad and then the tundra, snow, or ice (gravel pad not assumed to retain any oil);
- open water (lagoon, lake, or river);
- broken ice (lagoon, lake, or river);
- on top of or under solid ice (lagoon, lake, or river);
- shoreline (lagoon, lake, or river); or
- tundra or snow and ice.

The estimated fate of crude oil is summarized as follows (from Table App 9-10 and Table App 9-11).

- After 30 days in open water or broken ice:
    - 23-40% evaporates;
    - 0-22% disperses; and
    - 38-77% remains.
- After 30 days under ice in a lagoon or lake, nearly 100% of the oil remains in place and unweathered.

The analysis of the effects of large oil spills is based on the following assumptions:

- One large spill occurs.
- The spill size is one of the sizes shown in Table IV-19.
- All the oil reaches the environment; the gravel pad absorbs no oil.
- The spill starts at the gravel pad or along a pipeline.

- There is no cleanup or containment.
- The oil chemistry is similar to Alpine oil.
- The spill could occur at any time of the year.
- A spill under the lagoon or lake ice from Northwest NPR-A facilities or its pipeline does not move much until the ice breaks up.

The timing and location of oil spill impact are analyzed from the location where it is most adverse when determining effects.

b. Small Oil Spills

This introduction summarizes the key points used for analyzing small spills. For details on any of these points, please refer to Appendix 9. Sections IV.B through IV.E discuss the effects of small oil spills on particular resource categories under each alternative.

The consequences of small spills of crude and refined oil are analyzed to address concerns about the chronic effects from numerous small spills. The small spills assumed for this analysis are shown in Table IV-20. No small spills are assumed to occur at the $18/bbl price for any alternative. No small spills are assumed to occur at $30/bbl price for the No Action Alternative and Alternative C. The assumed number and sizes of small spills occurring under the $30/bbl scenario for Alternative A, Alternative B, and the Preferred Alternative, respectively, are listed below.

Offshore or onshore crude oil:

- 97, 83, and 83 spills less than 1 bbl;
- 32, 26, and 26 spills greater than or equal to 1 bbl and less than 25 bbl; and
- 2, 2, and 2 spills greater than or equal to 25 bbl and less than 500 bbl.
- Total Volume: 393, 336, and 336 bbl.

Onshore or offshore refined oil:

- 323, 277, and 277 spills of 0.7 bbl each (29 gallons).
- Total Volume: 226, 194, and 194 bbl.

It is assumed that:

- Small crude spills can begin anywhere on the gravel pad facilities or along the pipeline.
- Small spills on gravel pads occur in contained areas or are cleaned up and do not reach the environment.
- Small spills from pipelines are likely to reach the environment.

Onshore or offshore refined-oil spills can occur along ice roads, from barges, from helicopters, airplanes, from gravel pad facilities, or from trucks along the road system. Most refined-oil spills are contained and cleaned up.

Typical refined products spilled on the Alaskan North Slope are aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills on the Alaskan North Slope are 61 percent of refined oil spills by frequency and 75 percent by volume.

c. Spills Associated with Gas-Only Development

No large oil spill is estimated to occur in association with natural gas production in the Northwest NPR-A Planning Area. Condensate, also called "natural gasoline," may be associated with wet gas. These natural gas liquids would be transported in the same high-pressure gas pipeline. A small quantity of condensate liquids could be released should a gas pipeline rupture. The effects would be the same as small refined-petroleum spills that are analyzed in the analyses of the alternatives in Sections IV.B. through IV.E and Section V.B.

d. Locations of Oil-Spill Analyses in this IAP/EIS

Listed below are sections of this IAP/EIS that include the analysis of oil spills and their effects:

- Analysis of large spills under each alternative-- Sections IV.B. through IV.E and Section V.B
- Analysis of small spills under each alternative--Sections IV.B. through IV.E and Section V.B
- Analysis of large spills in the cumulative case-- Section IV.F
- Analysis of very large oil spills-- Section IV.J
- Supporting documentation for the assumptions used in the oil-spill analysis-- Appendix 9

For more information on the analysis of large and small oil spills see Appendix 9 of this IAP/EIS.

3. Fate and Behavior of Oil Spills

This section describes the properties and behaviors of spilled oil that are important to the evaluation of the potential effects that the spilled oil may have in the various environments that occur in the Northwest NPR-A Planning Area.

a. Fate and behavior

The primary processes that affect the fate of spilled oil are spreading, evaporation, dispersion, dissolution, and emulsification (Payne et al., 1987; Boehm, 1987; Lehr, 2001). These processes--called weathering--dominate during the first few days to weeks of a spill, and, except for dissolution, can dramatically change the nature of the oil. A number of longer-term processes also occur, including photo- and biodegradation, auto-oxidation, and sedimentation. These longer-term processes are less important than the five listed above for the initial fate of spilled oil. Longer-term processes are more important in the later stages of weathering and usually determine the ultimate fate of the spilled oil.

The chemical and physical composition of oil changes with weathering. Some oils weather rapidly and undergo extensive changes in physical and chemical composition, whereas others remain relatively unchanged over long periods of time. As a result of evaporation, the effects of weathering are generally rapid (1 to 2 days) for hydrocarbons with lower molecular weights. Degradation of the higher weight fractions is slower and occurs primarily through microbial degradation and chemical oxidation. The weathering or fate of spilled oil depends on the oil properties and on environmental conditions. It is important to recognize the dynamic nature of spilled oil and the fact that the properties of spilled oil can change over time.

Spreading reduces the bulk quantity of oil present in the vicinity of the spill but increases the spatial area over which adverse effects from oil may occur. Thus, oil in flowing systems (as opposed to contained systems) will be less concentrated in any given location, but may cause impacts over a much larger area. Spreading and thinning of spilled oil also increase the surface area of the slick, enhancing surface-dependent fate processes such as evaporation, degradation, and dissolution.

Evaporation is the primary mechanism for loss of low molecular weight constituents and light oil products. As lighter components evaporate, the remaining petroleum product becomes denser and more viscous. Evaporation tends to reduce oil toxicity but enhance persistence. Hydrocarbons that volatilize into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as photodegradation, occurs rapidly in air, and the rate of photodegradation increases as molecular weight increases.

Dispersion of oil increases with increasing surface turbulence. The dispersion of oil into water may serve to increase the surface area of oil susceptible to dissolution and degradation processes and thereby limit the potential for physical impacts.

Dissolution of oil in water is not a significant process controlling the oil's fate in the environment. It is one of the primary processes affecting the toxic effects of a spill, especially in confined water bodies. Dissolution increases with 1) decreasing molecular weight, 2) increasing temperature, 3) decreasing salinity, and 4) increasing concentration of dissolved organic matter.

Emulsification is the incorporation of water into oil and is the opposite of dispersion. Small drops of water become surrounded by oil. External energy from wave action is needed to emulsify oil. In general, heavier oils emulsify more rapidly than lighter oils. The oil may remain in a slick, which can contain as much as 70 percent water by weight and can have a viscosity a hundred to a thousand times greater than the original oil. Water-in-oil emulsions often are referred to as "mousse."

Photodegradation of oil increases with greater solar intensity. It can be a significant factor controlling the disappearance of a slick, especially of lighter products and constituents; but it will be less important during cloudy days and may be nonexistent in winter months on the North Slope. Photodegraded petroleum product constituents tend to be more soluble and more toxic than parent compounds. Extensive photodegradation, like dissolution, may thus increase the biological impacts of a spill event.

In the immediate aftermath of a spill, natural biodegradation of oil will not tend to be a significant process controlling the fate of oil in water bodies previously unexposed to oil. Microbial populations must become established before biodegradation can proceed at any appreciable rate.

Overall, the environmental fate of released oil is controlled by many factors and persistence is difficult to predict with great accuracy. Major factors affecting the environmental fate include the type of product, spill volume, spill rate, temperature of the oil, terrain, receiving environment, time of year, and weather. Crude oil will weather differently from diesel or refined oil in that both diesel and refined oil will evaporate at a significantly faster rate than crude oil.

The characteristics of the receiving environment, such as type of land, the surface gradient, marine or freshwater, surface or subsurface, spring ice overflow, summer open water, winter under ice, or winter broken ice, will affect how the spill behaves. In ice-covered waters, many of the same weathering processes are in effect as with open water; however, the ice changes the rates and relative importance of these processes (Payne, McNabb, and Clayton, 1991).

The time of year that a spill occurs has a significant effect on the fate of the crude oil. The time of year controls climatic factors such as temperature of the air, water or soil; depth of snow cover; whether there is ice or open water; and the depth of the active layer. During winter the air temperature can be so cold as to modify the viscosity of the oil so it will spread less and may even cause it to solidify. The lower the ambient temperature, the less crude oil evaporates. Both Prudhoe Bay and Endicott crudes have experimentally followed this pattern (Fingas, 1996). Frozen ground will limit the depth of penetration of any spill. Ice will act as a barrier to penetration until it melts.

b. Spills on Tundra

Oil movement over the ground surface follows the topography of the land (oil flows downhill). In general, oil will flow until it reaches a surface water body or a depression, or until absorption prevents further movement. Oil flowing over land can infiltrate vegetation cover, soil and snow. The rate of oil movement and depth of penetration are dependent on a variety of factors. If released onto tundra, oil can penetrate the soil as a result of the effects of gravity and capillary action. The rate of penetration will depend on the season, nature of the soil and the type of petroleum product. In summer, spills penetrate the active layer and then spread laterally on the frozen subsurface, accumulating in local downturns. From there the oil can penetrate into the permafrost (Collins, Racine, and Walsh, 1993). Precipitation may increase penetration into thawed soils (Solntseva, 1998 as cited in Chuvilin et al., 2001). If groundwater becomes contaminated, contaminants generally remain concentrated in plumes. Because ground water moves relatively slowly, contaminants do not mix or spread rapidly. Contaminated ground water may eventually migrate and appear in surface waters.

In winter spreading is controlled by the snow cover or frozen soil. Snow cover can act as an absorbent, slowing the spread of oil or preventing the spill from reaching the tundra surface. During winter, oil spreads on the surface of the frozen soil and penetration of oil into the soil is generally limited. Pore space in the soils that is not filled with ice may allow spilled oil to move into the frozen soil (Yershov et al., 1997; Chuvilin et al., 2001).

Tundra relief on the coastal plain of the North Slope is low enough to severely limit the spread of spills. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches deep (Miller, Prentki, and Barsdate, 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to act as a boom, with both vegetation and peat functioning as sorbents that allow water to filter through, trapping the more viscous oil (Barsdate et al., 1980) and also making recovery of the oil more difficult. On the other hand, even small spills can be spread over large areas if the spill event includes aerial, pressured discharge. With the high-velocity, bi-directional winds on the North Slope, oil can be misted miles downwind of a leak. For example, in December 1993, an ARCO drill site line failed, and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott, 1997).

c. Spills into Marine or Fresh Water

Weathering processes generally would be similar in NPR-A freshwater and coastal marine regimes. Seasonal ice cover can greatly slow weathering in both regimes.

Oil spreading on the water surface (but not necessarily the transport of oil by moving water) would be restricted in most NPR-A waters. Because of the increased viscosity of oil in cold water, oil spills in NPR-A lake, river, and marine waters would spread less than in temperate fresh or marine waters. The exception to this would be a spill in shallow, marshy or ponded tundra or flooded lake margins in summer, which could spread similarly to a temperate spill. The exception is possible because these shallower waters can reach temperatures up to 18 ° F--warmer than other tundra waters (Miller, Prentki, and Barsdate, 1980), and warm enough to lower oil slick viscosity.

Oil spills spread less in cold water than in temperate water because of the increased oil viscosity. This property will reduce spreading. An oil spill in broken ice would spread less and would spread between ice floes into any gaps greater than about 8 to 15 centimeters (cm) (Free, Cox, and Shultz, 1982).

An oil spill under ice would follow the general manner described below:

1. The oil will rise to the under-ice surface and spread laterally, accumulating in the under-ice cavities (Glaeser and Vance 1971; NORCOR Engineering Research, 1975; Martin, 1979; Comfort et al., 1983).
2. For spills that occur when the ice sheet is still growing, the pooled oil will be encapsulated in the growing ice sheet (NORCOR Engineering Research, 1975; Keevil and Ramseier, 1975; Buist and Dickens, 1983; Comfort et al., 1983).
3. In the spring, as the ice begins to deteriorate, the encapsulated oil will rise to the surface through brine channels in the ice (NORCOR Engineering Research, 1975; Purves, 1978; Martin, 1979; Kisil, 1981; Dickins and Buist, 1981; Comfort et al., 1983).

The spread of oil under the ice may be affected by the presence of currents, if the magnitude of those currents is large enough. A field study near Cape Parry in the Northwest Territories reported currents up to 10 cm/sec were present. This current was insufficient to strip oil from under the ice sheet after the oil had ceased to spread (NORCOR Engineering Research, 1975). Laboratory tests have shown that currents in excess of 15 to 25 cm/sec are required to strip oil from under-ice depressions (Cammaert, 1980; Cox et al., 1980). Current speeds in the nearshore Beaufort generally are less than 10 cm/sec during the winter (Weingartner and Okkonen, 2001). The area of contamination for oil under ice could increase if the ice were to move. Because the nearshore Beaufort is in the landfast ice area, the spread of oil due to ice movement would not be anticipated until spring breakup.

Evaporation of oil generally correlates to temperature (Fingas, 1996). The lower the temperature, the slower crude oil evaporates. Both Prudhoe Bay and Endicott crudes have this pattern (Fingas, 1996). Oil between or on ice is subject to normal evaporation. Oil that is frozen into the underside of ice is unlikely to undergo any evaporation until its release in spring. In spring as the multi-year ice deteriorates, the encapsulated oil will rise to the surface through brine channels in the ice. As oil is released to the surface, evaporation will occur. Because freshwater and first year ice do not have enough salts to form brine channels, the oil would be released only as the ice surface ablated to the level of the encapsulated oil. For freshwater ice, this would be when the ice became porous within about 2 weeks of meltout, from May to July, depending on weather, ice thickness, and location of the oil in the ice. In multi-year ice, surfacing of the oil probably would not occur until August, and some oil would not be released until the following summer.

Dispersion of oil spills occurs from wind, waves, currents, or ice. Any waves within the ice pack tend to pump oil onto the ice. Some additional oil dispersion occurs in dense, broken ice through floe-grinding action. More viscous and/or weathered crudes may adhere to porous ice floes, essentially concentrating oil within the floe field and limiting the oil dispersion. Alaska North Slope crude oil will readily emulsify to form stable emulsions. Emulsification of some crude oils is increased in the presence of ice. With floe grinding, Prudhoe Bay crude forms a mousse within a few hours--an order of magnitude more rapidly than in open water.

The weathering processes acting on oil in and along streams or rivers are in most cases similar to those described above for freshwater or marine spills. The dynamics of a river or stream environment, however, have additional effects on the fate and behavior of spilled oil. Oil entering rivers and streams will begin to spread as in freshwater or marine spills, but the spreading motion will be rapidly overcome by the surface current, at which point an elongated slick will form. The oil will flow downstream at the speed of the current in the absence of wind effects. In general, oil will tend to accumulate in areas of quiet water or eddies at the inside of river bends on a meandering river or stream, or in other pools where velocities are slower. Pools of oil may also accumulate behind log or debris jams. Water near the center of a stream channel will flow faster than water near the banks or bottom of the channel where the retarding forces of friction with the channel are greater. This difference in current speed and the resulting shearing forces between water layers is typically the major mixing mechanism that spreads a slick out as it moves downstream. The resulting shearing of the oil distribution along the axis of flow controls the plume shape and size, and the distance over which the oil concentration will remain above a particular level of concern. The leading edge of the slick may move as a relatively sharp front (at the mid-channel current speed) however, mixing will continuously exchange water and oil between the slower, near-bank regions and the faster-flowing, center regions of the river. From a practical point of view, this means that, although it might be possible to predict the initial arrival of oil at a point along the river, it will be considerably more difficult to estimate when the threat is past, since the areas of slower currents may continue to supply oil to the main stream channel, even after the leading edge is past (Overstreet and Galt, 1995).

Shear-dominated flows cause another effect that characterizes river spills. Shear in currents along the banks and river bottom is typically the major source of turbulence in rivers, in contrast to surface-wave activity in oceans. Mixing and dispersion caused by the interaction of the shear and the turbulence can move significant amounts of oil below the surface (particularly if it is relatively dense, such as a heavy No. 6 oil; or if it is finely distributed as droplets). The shear-dominated river regimes tend to produce spill distributions having higher subsurface oil concentrations than would be expected in marine spills (Overstreet and Galt, 1995). This turbulence increases with increased velocity of flow and bed roughness.

d. The NPR-A Oil-Spill Experiment

On July 16, 1970, 5 bbl (Prentki, 1997, pers. comm.) of Prudhoe Bay crude was experimentally spilled in a 0.07-acre tundra Pond E in the NPR-A near Barrow (Miller, Alexander, and Barsdate, 1978; Barsdate et al., 1980; Hobbie, 1982). The general behavior of this experimental spill is instructive about what to expect for a small spill in the Planning Area during the summer or for a winter spill that melts out during thaw.

In this experimental spill, the oil spread over the water surface within a few hours to a 0.06-inch thickness. Within 24 hours, the slick thickened, as lighter hydrocarbons evaporated, and shrank into a 10- to 16-ft band on the downwind side of the pond. For about a month, the oil moved back and forth across the pond, shifting sides with changes in wind direction. Gradually, the oil worked part way into the pond's vegetated margins. By the end of summer, all of the oil was trapped along the pond margins either on the water's surface or on the bottom. No oil left the pond during the next spring runoff, despite significant water throughflow. Half of the oil was estimated to have evaporated or degraded within a year, but the rest of the oil remained with little change for at least 5 years.

4. Spill Prevention and Response

Each permittee operating on the NPR-A is required to have an "Oil-Spill-Response Plan," with trained personnel and cleanup equipment and supplies at each activity site to meet Federal, State, and North Slope Borough regulations. An activity site would be an exploration site, drilling site, or production site, each with its ancillary facilities. Federal regulations that need to be met are BLM oil and gas operating regulations 43 CFR 3160, Onshore Order Numbers 1, 2, and 6. These regulations deal with the prevention and control of oil spills and releases. Regulations 40 CFR 110 and 300 deal with responses to spills or releases of oil and gas. Spill response requirements would be thoroughly addressed when and if parcels are leased. For example, an Application for Permit to Drill would be evaluated for spill response regarding chemicals onsite and blowout prevention equipment. These requirements are addressed in Onshore Order No. 2. The Alaska Oil and Gas Conservation Commission (AOGCC) is responsible for H_2S planning for drilling operations. Onshore Order No. 6 addresses anticipated hydrogen sulfide releases. These conditions are all very site specific. The U.S. Coast Guard (USCG) regulations also may apply to the transportation and transfer of oil to or from barges or vessels. Alaska Statutes Title 46, Chapters 3 and 4 provide the Alaska Department of Environmental Conservation (ADEC), with authority to prevent and respond to oil pollution. In addition, AS 46.03 and 46.04 provide ADEC with civil, criminal, and administrative enforcement authorities. The ADEC regulations that apply to oil spill prevention, contingency planning, and response are found in Alaska Administrative Codes, Title 18, Chapter 75 (18 AAC 75).

A spill response plan includes an action plan and a list of contacts in State and Federal agencies with direct responsibilities in the event of a spill and private companies that can be called on for further information or assistance. The environmental obligations of operators on a federal onshore lease are described in BLM regulations in 43 CFR 3160, Oil and Gas Operating Rules. In addition, parts or all of several Onshore Oil and Gas Orders may apply, as necessary.

Regulations administered by BLM and the AOGCC require an operator to maintain well control at all times during drilling and production. The BLM is delegated the authority to ensure that a drilling well is under control. If control of the well is lost (blowout), the BLM oversees all actions needed to bring the well under control. The BLM has the authority to cite the operator and bring civil and/or criminal charges. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or participating area, BLM has the authority to cite the operator and direct cleanup. However, cleanup will be done in cooperation with other Federal or State agencies.

The BLM requires that all spills or other undesirable events be reported to the authorized officer (AO) within 24 hours of the event. The BLM oversees the work of the lessee or operator to ensure that all spills or undesirable events are appropriately cleaned up in accordance with all applicable laws and regulations. Undesirable events are defined in Notice to Lessees (NTL)-3A as spills or releases of petroleum fluids or chemicals used in the petroleum industry. The State of Alaska also has requirements for reporting spills of oil and hazardous substances. Those requirements are found in 18 AAC 75.300.

The ADEC is responsible as the On-Scene Coordinator (OSC) for spills on most lands within the State. The U.S. Environmental Protection Agency (EPA) serves as the OSC for spills that reach inland waters. The USCG is responsible for directing spill cleanup in tidewater areas and on the seas. The OSC must ensure compliance with all Federal and State laws. The intent of the applicable laws and regulations is to prevent, as much as possible, hazardous materials from entering water and to ensure the rapid removal of these substances from areas where there is a danger of contaminating water. The OSC, in coordination with the surface-land manager, monitors and documents the operator's actions and determines when the cleanup is satisfactory. The OSC instructs those responsible for the spill as to what additional measures are to be taken.

An exploration or production facility operator is required to include plans for the control and containment of spills, including blowouts, in their ADEC-approved contingency plan. The ADEC requires that all oil-spill prevention and contingency plans rely on control, containment, and cleanup of spills as the primary response tools. In situ burning is a spill response technique that would be considered and may be used, upon approval, in approriate circumstances. The 1999 U.S. Coast Guard Caps Review recognizes in situ burning as "the only effective countermeasure for broken ice conditions. Recovery on broken ice is possible, but again in situ burning is preferred."

Alaska statutes and ADEC regulations require that an operator of an oil exploration or production facility, a terminal facility (storing 5,000 bbl of crude oil or 10,000 bbl of noncrude oil), an oil tank vessel or oil barges, a nontank vessel of more than 400 gross tons, or a crude oil pipeline have an oil discharge prevention and contingency plan approved by ADEC before beginning operations (AS 46.06.030 and 18 AAC 75.400). The ADEC also requires operators of facilities that must have an approved contingency plan and operators who drill for shallow natural gas (3,000 ft below ground surface or less) to provide acceptable proof of financial responsibility for the cleanup of oil spills. Facilities that must have an ADEC-approved contingency plan must meet oil pollution prevention requirements found in 18 AAC 75.005 - 75.090. Under these State requirements, operators must plan to contain or control an oil spill within 72 hours and to clean up a spill in the shortest possible time, consistent with minimizing damage to the environment. Two measures to reduce the potential for oil spills that the State has employed in the past are winter-only drilling and seasonal drilling restrictions.

B. No Action Alternative

1. Soils

a. Effects of Non-Oil and Gas Activities

Ground-impacting management actions within the Planning Area that may affect soils under the No Action Alternative include aircraft use (landing and take-off), OHV use, and other ground activities. If the vegetative cover remains unaltered during any land use, activities generally would have only a small impact. However, where these activities concentrate surface disturbance (e.g., foot traffic around a landing site or repeated snow machine crossing of a drainage channel at the same site), there could be damage to the soils. If the insulating vegetative cover is disturbed or the surface organic mat is removed or worn, soil erosion is likely to occur. Until details of project designs and results of local soil surveys are known, site-specific impacts and recoveries are difficult to predict. Soils naturally thaw during the warm months resulting in an "active layer" to a depth of 10 to 18 in with variation based on location, aspect, vegetation type, soil makeup and amount of contained water. Generally, disturbance of vegetation alters the thermal balance, and those soils containing ice may lose volume when there is thawing. Subsidence, or thermokarsting, and gullying may follow. Removal of the surface organic mat exposes the mineral portion of the soils to erosive forces. Wind and water would transport sediment from these soils, and this sediment may be deposited in sensitive areas. Any soil excavation and removal activities estimated at no more than one acre annually under the No Action Alternative may destroy the soils involved. In these instances, the impacts are local and probably not widely distributed. In other instances, with soils containing large amounts of ice, the impacts can be much broader. When warmed, dominantly ice-rich permafrost soils may slump and release melt water that would pond. The ponded water may absorb more radiant energy and increase the area of warming soils. The process of warming, melting, and slumping can continue well beyond the area of initial disturbance and may take several years to stabilize.

b. Effects of Oil and Gas Activities

Seismic operations may affect soils primarily through the action of on-the-ground travel. As with any activity using heavy vehicles, preventing disturbance to the insulative vegetation layer is fundamental to the protection of frozen soils. During the summer months, soils may be more susceptible to disturbance, as the active layer may contain large amounts of melt water and the saturated soils may not be capable of resisting the forces of vehicle traffic. In areas such as the foothills--where soils are thin, or soils are well drained, or vegetation is otherwise underlain by materials containing less water--vehicle travel has occurred in summer months with little disturbance. Generally winter months--when soils are frozen and capable of supporting the weight of heavy vehicles--are the only times safe for vehicular activities.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Control and cleanup of spills (see ROP A-6 for Alternative C) would protect both vegetation and soils. Measures equivalent to Stipulation C-1b for Alternative C would restrict operations to those conditions when soils are capable of withstanding overland travel without effect. Measures equivalent to ROP's C-1c and C-1e for Alternative C would provide the AO with control over the kinds of vehicles operated as well as provide guidance for the protection of the insulative vegetation.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Soil stability depends on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to soils from management actions under the No Action Alternative would involve either disturbance or destruction of relatively small areas. The duration of these impacts may range from several years if the vegetation is disturbed up to many decades if the soils are destroyed. The overall impact to soils of the Northwest NPR-A Planning Area from the No Action Alternative would be minor (with seismic) to negligible (without seismic).

2. Paleontological Resources

a. Effects of Non-Oil and Gas Activities

Under the No Action Alternative, some paleontological research and excavation would be conducted annually by permit within the Northwest NPR-A Planning Area. While excavation is a destructive activity, it is necessary for the recovery of scientific data. Excavation and collection normally occur during the summer. Excavation may also be done for geological and archaeological research. Geological and archaeological researchers are trained to recognize and properly deal with paleontological resources. Most paleontological material is buried considerably deeper than cultural material and therefore not regularly encountered by chance. Some Pleistocene-age animal remains may be recovered in archaeological deposits, if the deposit is old enough. In such situations, the remains would represent subsistence use of the animal(s) by humans, and the faunal material would be considered part of the archaeological record and would belong to the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact relatively small areas. Therefore, such camps and the activities that are associated with them--such as aircraft use, on-the-ground survey and reconnaissance, hazardous- and solid-material removal and site remediation, and recreation--are not expected, in and of themselves, to have any significant effect on paleontological resources.

b. Effects of Oil and Gas Activities

Under the No Action Alternative option that allows seismic activity, there are only two types of activity that have the potential for causing measurable impacts on paleontological resources: 1) excavation and collection (see above) and 2) seismic data gathering operations. Because seismic data gathering activity would be permitted only during the winter using low-ground-pressure vehicles such as rolligons, there is little chance that significant impacts to paleontological deposits could occur. Although a remote possibility, some impact to paleontological resources could occur along streambank exposures from the passage of vehicles. In such cases, impact would be isolated and minimal.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to Stipulation C-1b and ROP C-1e for Alternative C would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Under the No Action Alternative, impacts to paleontological resources would be minimal whether or not seismic activity is allowed.

3. Water Resources

a. Effects of Non-Oil and Gas Activities

Non-oil and gas management actions within the Planning Area that may affect water resources include ground activities such as resource inventories, paleontological and cultural excavations, and research and recreational camps--all of which might occur during summer or early fall. The other principal activity is overland equipment movement, which occurs during the winter on snow-covered, frozen tundra.

Temporary tent camps would be located on existing pads or on well-drained soils on river terraces or uplands, sited back from the stream or lakeshore and with minimal surface disturbance. Excavation and collection activities would be by hand shovel or trowel over several square feet, with replacement of the vegetative layer. Recreational activities permitted by BLM are required to follow the National Outdoor Leadership School's *"Leave No Trace, Alaskan Tundra"* program in minimizing impacts to vegetation, wastewater, human waste, and solid waste. Few, if any, impacts to water resources would occur.

Winter occupation or moves would use low-ground-pressure vehicles and trailers (rolligons) at transitory locations when adequate snow cover exists. All fuel, waste, and hazardous materials would be stored onsite according to ADEC guidelines and removed seasonally. Graywater and human wastes would be handled in accordance with ADEC regulations. Few, if any, impacts to water resources would occur.

b. Effects of Oil and Gas Activities

Seismic survey activities have been ongoing during most winters, even though there has been no leasing in the Planning Area since 1984. Seismic surveys involve seasonal occupation and transport of equipment and camps using sledge-drawn trailers (wanigans) at transitory locations when the snow cover accumulation is sufficient to insulate the tundra and after lakes and rivers are frozen. Historically, the principal effect of seismic activities on water resources has been diversions of shallow water tracks and limited ponding in places where track depression compresses the organic mat sufficiently to alter the thermal regime, melt surficial ground ice, and alter the native vegetation (Emers and Jorgenson, 1997). More recently, modern seismic lines, with newer low-ground-pressure equipment have less impact on the tundra than older, outdated types, but impacts to the tundra are still likely to occur during the camp move (WesternGeco. 2003). While a 2D operation covers less line miles, the camp moves virtually every day. A 3D seismic operation covers more line miles, but the camp moves less often (WesternGeco 2003). While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction are still in evidence (Jorgenson et al. 2003). Adequate protection of the tundra requires a uniformly distributed snow pack with a hard surface crust. Often, the less than ideal snow conditions on the north slope, particularly where the snow pack is influenced by wind scour and drift, could expose tussock tundra to surface disturbance (Walker et al., 1987). Varying levels of disturbance have been documented even where the snow depth exceeded two feet (Felix and Raynolds 1989).

While observations by BLM and others (National Research Council, 2003), indicate that short-term transitory impacts, such as surficial compaction, diversions of shallow water tracks and limited ponding, are estimated at about 1 percent of the proposed seismic lines per season (Section IV.A.1.b.3.b.), newer, low-ground-pressure equipment could reduce this significantly, to about four acres. Since the tundra vegetative mat has been shown to recover in from seven to ten years where damage is not severe (Abele et al., 1984; Jorgenson et al., 2002), the long-term impacts due to thermokarst erosion, such as permanent diversions of shallow water tracks and limited ponding, are estimated at only about 1 percent of the short-term impacts, or less than a tenth of an acre affected seismic operations. These impacts are strongly influenced by snow depth and distribution, as noted above, and may only happen when seismic activities occur under less than ideal snow conditions (National Research Council, 2003). Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987).

Bermed and lined storage areas would contain small fuel spills, and there would be sufficient absorbents and petroleum containment and removal equipment onsite. No large spills are expected to occur under the No Action Alternative, since only small amounts of fuel would be stored onsite.

Because only minimal potentially surface-disturbing activities are expected under the No Action Alternative, there probably would be no significant long-term effect on water resources. However, there may be some sites that require remediation from earlier exploration or military activities.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to Stipulation C-1b and ROP's C-1a through e for Alternative C would protect water resources by minimizing impacts to the surface by overland moves and seismic activities.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Under the seismic option of the No Action Alternative, impacts to water resources would be minimal. Short-term impacts, such as diversions of shallow water tracks and limited ponding, are estimated at about 7 acres from a 2-D seismic survey and about 30 acres from a 3-D seismic survey. Long-term effects on water resources of less than an acre would be caused by a 2-D seismic operation and less than 3 acres by a 3-D seismic operation. Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated. Without seismic activities, impacts to water resources would be negligible.

4. Freshwater Quality

a. Effects of Non-Oil and Gas Activities

The only types of non-oil and gas activities in the NPR-A that might affect freshwater quality are ongoing subsistence and recreational activities everywhere. Although these activities have involved unregulated long-term campsites and cabins (all without adequate sewage disposal), adverse effects on freshwater quality appear to have been negligible.

b. Effects of Oil and Gas Activities

Seismic trails would be the only potential impacting factor for water quality under the No Action Alternative. Other ground-impacting industry actions within the Planning Area would not affect water quality.

The seismic option under the No Action Alternative would allow seismic operations to continue in winter (starting in late fall after the top foot of the active layer freezes and half a foot of snow cover builds up). Seismic operations are discussed in detail in Section IV.A.1.b.

Carefully regulated seismic operations conducted in ANWR from 1984 to 1985 resulted in damage to vegetation in some tussock tundra and moist sedge-shrub tundra, but not to lower, moist sedge and wet tundra (Felix et al., 1989). Raynolds and Felix (1989) found damage occurred in vegetated river terraces, in more bumpy terrain (such as high-centered polygons or tussocks), and in areas with little snow cover. An example of a high-impact area that was found would be a swath denuded of vegetation 33 ft wide and up to 160 ft long. Wetter, flatter, and more vegetated sites were not impacted. Recovery of damaged seismic tracks takes many years (Walker, 1996).

Observations by BLM and others (NRC, 2003) indicate that short-term impacts, such as diversions of shallow water tracks and limited ponding, are estimated at about 1 percent of the proposed seismic lines per season (Section IV.A.1.b.3.b.). Newer, low-ground-pressure equipment could reduce this to about four acres. Thermokarst erosion and effects on water quality could occur in high-impact areas if damage were persistent. Although thermokarst erosion of damaged winter seismic trails made under current practices has not been generally observed, such erosion is possible when snow cover is minimal (as probably occurred in the ANWR operations). If it is assumed that 1 percent of the persistent high-damage area results in thermokarst erosion, then less than about 0.1 acre could be affected. Thaw settlement also would affect long-term local hydrology, including downflow water quality, perhaps over twice this area, with the total area affected being < 1 acre.

Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations. Measurements in a small stream near Barrow--undergoing thermokarst erosion and meeting such conditions--showed an increase in turbidity/suspended-sediment concentrations. To get such high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils; and the mineral soils also must be fine grained. These conditions rarely occur together, even where tracked vehicles are used in multiple summer passes. Thus, thermokarst erosion causing the state turbidity standard to be exceeded--within and in the downflow of thermokarst features--would be confined to rare cases over small areas, likely on the order of no more than a fraction of an acre total. These impacts would not occur under the no seismic option for the No Action Alternative.

Other ground-impacting management actions within the Planning Area would not affect water quality. Excavation and collection activities would be by hand shovel or trowel over several square feet, with replacement of the vegetative layer. These activities are required to protect streams and lakes from siltation and to avoid or minimize disturbance to vegetation. No fuel spills are anticipated under The No Action Alternative. Stipulations or required operating procedures protect rivers, lakes, or streams. Recreational activities permitted by BLM are assumed to require the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" program in minimizing impacts to vegetation, wastewater, human waste, and solid waste.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Stipulations and required operating procedures to protect and reduce impacts to vegetation or to prevent fuel spills from entering rivers, lakes, and streams would be effective in reducing potential adverse effects to water quality.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Long-term water quality over a total of less than a fraction of an acre (negligible impact) could be affected by biannual seismic programs under the No Action Alternative. Without seismic activities, impacts to water quality would be negligible.

5. Estuarine Water Quality

a. Effects of Non-Oil and Gas Activities

The non-oil and gas activities in the Northwest NPR-A that might affect estuarine water quality are the ongoing subsistence and recreational activities everywhere within the NPR-A. The subsistence and recreational activities have involved the occasional use of small boats in estuaries. As a result, small amounts of fuel have probably been spilled, but the adverse effect on estuarine water quality appears to have been negligible.

b. Effects of Oil and Gas Activities

The No Action Alternative would prohibit oil and gas leasing in the Northwest NPR-A Planning Area--and therefore geological exploration (drilling)--but would not necessarily prohibit geophysical (seismic) exploration. There are two options under this alternative, one of which would allow seismic exploration. Seismic in the estuarine areas would be conducted on ice during winter surveys that are assumed to occur every other winter season. The activities would probably not affect NPR-A estuarine water quality because discharges (e.g., garbage, human waste) would be prohibited and the risk of impacts from fuel spills would be small because the amount of fuel involved would be relatively small.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative. None of the Alternative C stipulations or ROP's would affect impacts to estuarine water quality.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Impacts to estuarine water quality under the No Action Alternative are expected to be negligible, whether or not seismic exploration activities are allowed in the Planning Area.

6. Air Quality

a. Effects of Non-Oil and Gas Activities

This general, area-wide discussion analyzes the potential impacts on air quality of the No Action Alternative for the Northwest NPR-A Planning Area. Impacts to air quality would result from discharges (air emissions). Disturbances and noise do not cause air-quality impacts. Supporting materials and discussions are presented in Section III.A.3.b (description of existing air quality on the North Slope of Alaska). Under the No Action Alternative option prohibiting seismic exploration, nothing would change from the existing situation described in Section III.A.3. Under the No Action Alternative permitting seismic exploration to continue, mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control emissions and discharges.

b. Effects of Oil and Gas Activities

Air pollutants discussed include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC). Ozone (O_3) is not emitted directly by any source; it is formed in a series of complex photochemical reactions in the atmosphere involving VOC and NO_x.

Nitrogen oxides (NO_x) consist of both nitric oxide (NO) and nitrogen dioxide (NO_2). The NOx is formed from the oxygen and nitrogen in the air during combustion processes, and the rate of the formation increases with combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2. The NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with photochemical smog.

Carbon monoxide (CO) is formed by incomplete combustion. It is a problem mainly in areas having a high concentration of vehicular traffic. High concentrations of carbon monoxide present a serious threat to human health because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide (SO_2) is formed in the combustion of fuels containing sulfur. In the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in acid rain precipitation.

Emissions of particulate matter associated with combustion consist of particles in the size range less than 10 micrometers (μ) in diameter (PM_{10}). Emissions of particulate matter associated with combustion, especially particles in the size range of 1 to 3 μ, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity. There are three principal phases: exploration, development, and production. For a more detailed discussion of emission sources associated with each phase, refer to *Air Quality Impact of Proposed OCS Lease Sale No. 95* (Jacobs Engineering Group, Inc., 1989). Information from that report is still relevant even for operations that would occur within the Northwest NPR-A Planning Area. Certain emission sources discussed therein obviously do not apply for operations occurring on land, but the report does include a fairly comprehensive analysis of activities and emission sources that do occur during oil and gas exploration, development, and production, regardless of the specific locations in which they may occur. Significant emission sources are summarized below.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-04). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed, except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for nitrogen dioxide, sulfur dioxide, and particulate matter less than 10 µ to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas. Class I allows the least degradation and also restricts degradation of visibility. The entire NPR-A is Class II, which allows a moderate incremental decrease in the air quality of the area. Baseline PSD pollutant concentrations and the portion of the PSD increments already consumed are established for each location by the EPA and the State of Alaska before issuance of air-quality permits. Air-quality standards do not directly address all other potential effects, such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

The Alaska Department of Environmental Conservation (ADEC) has jurisdiction for regulating and permitting air-quality emissions within the Northwest NPR-A Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including the need to obtain construction and operating permits. Construction air-quality permits include prevention of significant deterioration requirements.

For seismic exploration under the No Action option permitting such work to continue, vehicles used in gathering seismic and other geological and geophysical data would produce emissions. Pollutants generated would primarily consist of NO_x (these would consist of NO and NO_2; ambient air standards are set only for NO_2), CO, and SO_2.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative. None of the stipulations or ROP's would affect potential impacts to air quality.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Impacts to air quality under the No Action Alternative would be localized and negligible.

7. Vegetation

Ground-impacting management actions within the Northwest NPR-A Planning Area that may affect vegetation under the No Action Alternative include those from non-oil and gas activities and those related to seismic exploration of oil and gas resources.

a. Effects of Non-Oil and Gas Activities

These actions include point-to-point air traffic, aerial surveys, paleontological and archaeological excavations, camps for research and recreation, overland moves, and off-highway vehicle (OHV) (e.g., four-wheelers, snowmachines, and airboats) use. Most of these activities, except for overland moves, snowmachines, and some aerial surveys, occur from June to September.

Most off-runway landings during aerial surveys would be by fixed-wing aircraft using skis or floats; fewer would be by wheeled, fixed-wing aircraft. Only wheeled, fixed-wing aircraft have the potential to affect vegetation. Most wheeled-aircraft landings would occur on sand or gravel bars, or possibly on dry, gravelly ridges. These landings have the potential to cause minor, short-term damage to the scattered vegetation present on the bars or ridges. The specific locations, season, number of landings, weight of aircraft, etc. associated with these activities would affect the extent of the minor impacts expected.

Archaeological digs are most likely to occur on drier soils, where a sod layer has formed. In some archaeological digs, the sod may be removed and replaced, causing a temporary disturbance rather than vegetation destruction. However, the surface vegetation may be destroyed in some archaeological digs and in most or all paleontological digs. The combined extent of such activities is not expected to exceed 1 acre per year.

Camps can result in vegetation trampling from foot traffic and tent placement, and in small spills of stove or generator fuel. This can result in temporary (one to a few growing seasons) disturbance to vegetation. Most recreational camps are expected to occur on river bars, where vegetative cover is minimal. Large camps for research or resource inventory are likely to occur on existing gravel pads, which also have minimal vegetative cover. The total land surface affected by camps is not expected to exceed 10 acres per year and would be scattered over several sites, with most containing little or no vegetation.

Most overland moves through the Planning Area involve traffic between Deadhorse and Barrow, Barrow and Atqasuk, or Barrow and Wainwright. Moves would occur in winter only, when the ground is frozen and covered with snow. The impact to vegetation varies with vehicle type, vegetation type, and snow conditions. Low-ground-pressure wheeled vehicles have less impact than steel-tracked vehicles or sleds on skids. Less impact usually would be expected in the wetter tundra where the effect, if any, may be the compression of snow and dead matter leaving "green trails" visible for one to a few growing seasons (Sec. IV.B.20, Visual Resources). However, if a tracked vehicle makes a tight turn or drops its blade too deeply through the snow, surface vegetation may be disrupted. If this occurs in wet tundra, thermokarsting can cause impacts greater than those commonly experienced in drier tundra. Travel over low shrubs could cause plants to be broken, and travel over tussocks sometimes results in their tops being crushed or scraped off. Thus, overland moves may vary from having no observable effects in some situations to damaging vegetation and melting permafrost to the extent that it may take years or even decades (Emers and Jorgenson, 1997; Jorgenson and Martin, 1997) to heal. Trails within the Planning Area on the three routes mentioned above total about 225 mi in length. If a trail is 12 ft wide, the impact potentially could affect about 330 acres. See the discussion below on seismic activities for the effects of spills.

The OHV use would be primarily--or entirely--in support of subsistence activities. Snowmachines used in the winter when the ground is frozen and covered by snow would have no or negligible impact on vegetation. Use of four-wheel-drive vehicles, if the vehicle is heavy enough, can kill vegetation and result in thermokarst. However, most or all such use is likely to be in the immediate vicinity of villages on private lands and not on lands managed by the BLM. The impacts of airboats on vegetation would depend on how they are used. If they are kept in the river channels, airboats would have no impact on vegetation. If airboats are driven across very shallow marshes, they might disturb the sediments in which water sedge grows and result in damage to these plants.

b. Effects of Oil and Gas Activities

There are two options under the No Action Alternative, one that would allow seismic exploration in the Planning Area and one that would not. If seismic exploration were not allowed, then there would be no associated impacts to vegetation. The following discusses the potential impacts if seismic exploration were to be allowed.

(1) Effects of Disturbances

Seismic exploration causes impacts to vegetation similar to those described for overland moves. If seismic exploration is allowed, it is assumed there would be one crew active in the Planning Area in alternate winters, collecting either 2-D or 3-D seismic data. The exterior dimensions of a typical 2-D survey area vary from about 960 to 1,920 mi^2 (614,400 to 1,228,800 acres) and the maximum area impacted by seismic lines is $\leq$ 19,400 acres (400 to 800 mi x 200 ft wide). This figure is presented as a maximum, not only because 800 mi is the higher end of the assumed range, but also because not all of the area within the 200-ft-wide path would actually be overrun by a vehicle. Trails also are made by camp-move vehicles, which traverse about the same distance as line-miles surveyed (Emers and Jorgenson, 1997). In addition, trails are made through the Planning Area while traveling to and from the survey area. A camp-move trail is about 12 ft wide, and it is assumed the camp train would involve two or three strings of trailers. These strings could use the same trail, but this may cause more severe, longer lasting disturbance than the use of separate trails. For this analysis, it is assumed that, on average, 2.5 individual camp-train strings would use different trails to decrease overall disturbance and, thus, camp-move trails effectively would impact a path 30 ft wide. With $\leq$ 800 mi of trail within the survey area and an additional 25 mi entering and leaving the Planning Area, this would impact a total of $\leq$ 3,100 acres. Thus, total area impacted by 2-D seismic surveys would at most be 22,500 acres every other year, less when areas surveyed are smaller than maximum size, or zero if 3-D surveys are conducted instead. Impacts on lands east of the Planning Area while traveling between there and Kuparuk are discussed in the cumulative analysis.

A study of tundra disturbance by winter seismic surveys on the eastern portion of Alaska's North Slope (Jorgenson et al., 1996) indicated that 1 to 2 years after a survey, the disturbance level to the affected tundra under seismic lines was little to none on 11 percent of study plots, low on 64 percent, medium on 23 percent, and high on 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on 97 percent of the study plots, and no areas of medium or high disturbance remained. The tundra under camp-move trails did not recover as rapidly. One to two years after the survey, the disturbance level to the affected tundra under camp-move trails was little to none on 22 percent of study plots, low on 52 percent, medium on 24 percent, and high on 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on 85 percent, with low on 10 percent, medium on 4 percent, and high on 1 percent.

The above study looked at the effects of seismic exploration that took place about 20 years ago and used some vehicle types that were developed 30 to 40 years ago. Presumably, newer equipment types have less impact on tundra vegetation. However, the above study represents nearly all of our knowledge about long-term recovery from seismic exploration (National Research Council, 2003). For that reason, the results from the above study are used as assumptions for further analyses of impact to vegetation in this document. Nonetheless, results of a study of seismic exploration impacts near the delta in 2001 (Jorgenson et al., 2003) are presented here for comparison. This comparison, however, requires several caveats. Besides comparing modern to older equipment, these two studies occurred in different winters when the snow cover probably differed. They occurred on two different areas of the North Slope with different terrain types; and the data (visual estimates) were collected by different observers. In the 2001 study, conducted in the summer following the seismic work, the disturbance level to affected tundra under seismic lines was little to none on 30 percent of plots, low on 66 percent and medium on four percent. No plots on seismic lines were estimated to show high disturbance. The disturbance level to the affected tundra under camp-move trails was little to none on 18 percent of plots, low on 54 percent and medium on 29 percent. No plots in the random sample displayed a high level of disturbance, but at least one occurrence of high disturbance was observed elsewhere in the study area. If the difference in results between the two studies was due entirely to advances in equipment design, then this suggests that modern seismic lines would see reduced levels of disturbance (primarily more area in the little to none class and less in the medium class) and camp-move trails would see very similar levels of disturbance.

Applying the data from the older study to the above scenario for 2-D seismic surveys in the Planning Area suggests that ≤ 5,660 acres would experience medium to high disturbance every other year (if 2-D rather than 3-D surveys are done) and, after 9 years of recovery for any single year's activity, that level of disturbance would remain evident on ≤ 160 acres.

It is assumed that a 3-D seismic operation would cover a total area of 300 to 600 mi^2 (192,000 to 384,000 acres), or 31 percent of the total area covered by a 2-D survey. However, the number of line-miles covered within that area would be much greater, varying from 3,750 to 7,500. Thus, the tundra area impacted by seismic lines would be ≤ 182,000 acres (7,500 mi by 200 ft wide) for one survey. As for 2-D surveys, this figure is a maximum because it uses the higher end of the range of line-miles and not all of the area within the pair of 100-ft wide lines would be overrun by a vehicle. For 3-D surveys, the distance covered by camp-move vehicles would not be similar to line-miles of survey as is the case for 2-D surveys. It is assumed that camp-move trails would approximate 31 percent (≤ 250 mi) of those for 2-D surveys, because the total area involved in a 3-D survey is 31 percent of that covered by 2-D. There still would be an average of an additional 25 mi traveled each way when entering and leaving the Planning Area. Thus, camp-move trails would impact ≤ 1,110 acres of tundra for one survey. Using the figures from Jorgenson et al., 1996, suggests there would be ≤ 45,800 acres of medium to high disturbance following a survey and ≤ 60 acres remaining after 9 years.

Under the seismic option of the No Action Alternative, it is assumed that either one 2-D or 3-D seismic operation would occur in the Planning Area during every other winter season. Depending on the survey type and the number of line-miles actually accomplished per survey, the range of areas impacted over each two-year period would be 11,300 to 183,100 acres. The total area of tundra within the Planning Area impacted by seismic surveys as a result of the first lease sale may be less than the product of these numbers times the number of surveys since the sale, because individual surveys may overlap one another among years. However, the decrease in acreage impacted might be countered by the higher level of disturbance possible in those areas of overlap.

If it is assumed that impacts to vegetation from overland moves and seismic surveys would occur to different land-cover classes in proportion to their occurrence in the Planning Area (Table III-06)--with the exception of the three water classes--then these impacts, whether or not quantified as to area involved, would occur among the land-cover classes as presented in (Table IV-23). However, this assumption would be invalid under the following scenario.

As discussed in Section III, Description of the Affected Environment, more than 95 percent of the Planning Area may be classified as "wetland" by some definitions. There are, however, some general differences between the northern and southern portions of the Planning Area. The northern portion lies in the coastal plain and has a higher frequency of "marsh wetlands" (aquatic, flooded tundra, and wet tundra land-cover classes, see (Table IV-23), whereas the southern portion lies in the foothills and has a higher frequency of "tussock wetlands" (tussock tundra and dwarf shrub land-cover classes, see (Table IV-23). If it is assumed that seismic exploration activity is more likely to be concentrated in the northern portion of the Planning Area, then the "marsh wetland" cover types would be affected in greater proportion than suggested in (Table IV-23) and the "tussock wetland" cover types would be affected less. The comparative value of these two generalized wetland types depends on the context in which they are being evaluated. For instance, the "marsh wetlands" are generally of greater importance to waterbirds, whereas the "tussock wetlands" are generally of greater importance to some shorebirds and songbirds, or to caribou.

(2) Effects of Spills

Under the No Action Alternative, there would be no spills of crude oil because there would be no oil/gas lease sales and subsequent drilling. Spills of refined oil (diesel fuel, hydraulic fluid, lubricants) could occur during overland moves and seismic surveys. Most of these spills are likely to be small, averaging 3 to 5 gallons or less, would affect small areas of ground ($< 50\ ft^2$), and the contaminated snow would be cleaned up immediately upon discovery. A spill from a large storage tank is much less likely, but could affect up to 500 ft^2. Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery, with wetter areas recovering more quickly (Jorgenson, 1997; McKendrick, 2000).

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Control and cleanup of spills (see ROP A-6 for Alternative C) would protect both vegetation and soils. Measures equivalent to Stipulation C-1b for Alternative C would restrict operations to those conditions when soils are capable of withstanding overland travel without effect. Measures equivalent to ROP's C-1c and C-1e for Alternative C would provide the AO with control over the kinds of vehicles operated as well as provide guidance for the protection of the insulative vegetation.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Impacts to vegetation from management actions under the No Action Alternative would involve either disturbance or destruction. If the option allowing seismic exploration were implemented, seismic work would account for most (>95%) of those impacts. The duration of all impacts would be short term, ranging up to 5 months. Complete recovery of the vegetation in impacted areas could vary from 1 year to decades. The overall impact to the vegetation communities of the 8.8 million acres of BLM-managed surface lands in the Planning Area would be negligible without seismic exploration. From 0.1 to 2.0 percent of the Planning Area would be impacted every other year by seismic surveying. This represents only a minor impact to vegetation communities overall. However, if the seismic exploration were to cause a moderate to high level of disturbance near a population of one of the rare plant species, the effect on that particular taxon could be moderate to severe.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

(1) Effects of Non-Oil and Gas Activities

Actions associated with the No Action Alternative that could cause disturbance to fish include camps for research and recreation, and overland moves. Most of these activities, except for overland moves, occur during June to

September.

Ground activities related to research include data collection activities and camp setup. Camps vary in size from small mobile parties that remain at a site for a few days or move daily, to larger camps that may be set up in one location for portions of the summer field season. Regardless of size, potential impacts to fish at these sites are related to fuel spills that would enter the water. Mobile camps are likely to have only small quantities of stove fuel needed for cooking or gas necessary for boat motors. Impacts from spills at these sites pose little risk to fish. Stationary camps often have fuel caches used for helicopters. Fuel is either stored in bladders or drums with quantities of up to 5,000 gallons on site. Given this scenario, a fuel spill at a storage site could occur and potentially impact fish. Possible impacts are presented below in "Effects of Spills."

Recreation activities are similar to mobile research camps in that they are likely to be short term in nature with daily or frequent movements between sites. Impacts from this activity include potential fuel spills and sport fish harvest. Fuels in these camps are likely to be limited to stove fuel and possibly gas used in boat motors. The risk of water contamination by a spill is negligible given the types of containment used and the small amounts of fuel involved. Fishing activity is widely dispersed for float trip parties. Eight parties (Table IV-28) with four persons per party are expected to float or use boats in the Planning Area in any given year. Based on past BLM permitting experience, it is expected that almost all fish caught would be released. Similarly, fishing activities at research camps involve mostly catch and release. Therefore, impacts to fish from hook-and-line fishing are not expected.

Overland moves are permitted during the winter after the ground is frozen and there is sufficient snow cover. Common routes of travel include Prudhoe Bay or Oliktok to Barrow, Barrow to Wainwright, or Barrow to Atqasuk. Typical routes are over the sea ice between Prudhoe Bay and Barrow, and over upland terrain from Barrow to Wainwright and Atqasuk. An estimated 20 to 60 trips per year are anticipated under the No Action Alternative. The most likely source of concern to fish and their habitat during this activity is a fuel spill. Most spills are expected to be small (< 5 gallons) and would occur during fuel transfer. A larger spill from a fuel tank is less likely, though possible. Impacts related to spills are discussed in this section under "Effects of Spills."

(2) Effects of Oil and Gas Activities

The two options under the No Action Alternative are allowing and not allowing seismic activity. If seismic activity is not allowed, then impacts to fish from seismic activities are precluded. The following paragraphs discuss potential impacts under the option allowing seismic surveying.

(a) Effects of Disturbances

Seismic surveys in the Northwest NPR-A Planning Area are expected to use Vibroseis as the technique for seismic data collection. Acoustical energy pulses emitted by this equipment can locate subsurface geological structures that might contain oil or gas. The energy pulses are generated by special vibrator equipment mounted on all-terrain, low-ground-pressure vehicles. The equipment used can collect either 2-D or 3-D data depending upon evaluation needs. Under the No Action Alternative, it is assumed that one 2-D or one 3-D seismic operation would occur in alternate winters. A typical 2-D operation would be expected to cover 400 to 800 line-miles per season, while a 3-D operation covering a 30- x 15-mi survey area would contain approximately 5,625 line-miles of data.

Survey lines in both 2-D and 3-D seismic operations form a grid and pass over both land and water (ice-covered lakes) in the course of data collection. Some of the lakes can be expected to harbor fish. When a vibrator operates on floating ice, a considerable portion of the wave field travels horizontally within the ice and water layers.

Possible impacts to local populations of fish from the pressure waves are a concern to consumptive users and biologists. In an effort to quantify pressure wave action, Nyland (2002) conducted a field test on an unnamed fish bearing lake in the Colville River Delta in northern Alaska. Average ice thickness was 1.8 m and average water depth was 1.6 m. Vibrators were used to emit pressure waves at distances from 7.3 to 1,000 m from a base point in the lake. Hydrophones located in the water collected the sound pressure levels. Variation in sound levels with the distance from the source and peak particle velocities were measured. Though no fish were examined as part of this study, maximum sound pressures recorded were below the Alaska Department of Fish and Game guidelines for instantaneous pressure changes allowed in the swim bladders of fish.

The effects of vibration on most overwintering fish are expected to be short term and sublethal. Likely effects would include avoidance behavior. Based on the study outlined above, the relatively small number of seismic surveys expected, the short time duration of the pressure impulses in any given spot (several seconds), and the low density of arctic fish in most of the Planning Area in the winter, seismic surveys are not expected to have a perceptible effect on populations of arctic fish.

(b) Effects of Spills

The bodies of freshwater in the Planning Area are substantially smaller in size than the marine environment, where the effects of former oil spills have been observed. Fuel spills associated with the No Action Alternative are likely to be small and would consist of refined oils. Likely sources of spills under this alternative are from fuel bladders or tanks at research and seismic sites, and from transfer of fuel from storage systems to equipment.

Most fuel spills would not come in contact with fish habitat. Refueling and storage are stipulated to occur at least 500 ft from fish-bearing waterbodies. The only exception is refueling of light duty equipment. The BLM fueling operations, such as at research camps, add further protections by requiring spill cleanup material at all caches and secondary containment for storage in excess of 50 gallons or if a fuel spill can reasonably be expected to reach water. Some spills in the winter would be related to seismic studies or overland moves. These would likely occur during refueling and would be contained with onsite absorbents. Given the small size of the anticipated fuel spills associated with the No Action Alternative, measurable effects on arctic fish populations in the Planning Area are not expected.

(3) Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to Stipulations A-1, A-2, A-3, and C-2 and ROP C-1 for Alternative C would be most likely to be beneficial to arctic fish. The effects of accidental fuel spills and loss of overwintering fish habitat would be minimized by implementation of these stipulations.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative. The current operating procedures and stipulations developed through the permitting process and attached to land use authorizations for research, overland moves, seismic operations, and recreational operations are adequate to protect fish resources under the No Action Alternative.

(4) Conclusion

Under the No Action Alternative, disturbance related to research, recreation, overland moves, seismic surveys, and fuel spills is not expected to have a measurable effect on arctic fish populations in the Northwest NPR-A Planning Area over the life of the plan.

b. Marine Fish

Under the No Action Alternative, the Northwest NPR-A Planning Area would not be offered for oil and gas leasing. Because several species of marine fishes (Figure III-25) occur year-round or seasonally in the marine waters within and adjacent to the Planning Area, some individual fishes may be exposed to effects from other authorized activities.

(1) Effects of Non-Oil and Gas Activities

Coastal activities that may affect marine fishes under the No Action Alternative include vessel traffic and fuel spills. The occurrence of these events is not likely to have a measurable effect on marine fish populations. If a large, diesel-fuel spill were to occur in coastal marine waters, some individual marine fishes may be harmed or killed. A large spill is not likely to have a measurable effect on any marine fish population.

(2) Effects of Oil and Gas Activities

Marine fish could be adversely affected by seismic surveys if the surveys were to occur above overwintering areas. Likely effects would include avoidance behavior and short-term added stress, but also could result in the death of some individuals of the more sensitive lifestages (e.g., juveniles). The effect on most overwintering marine fish is expected to consist of only short-term, sublethal effects. No measurable effect on marine fish populations would be expected. The likelihood of seismic surveys occurring above overwintering areas is considered very low.

(3) Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

The effects of any fuel or oil spills on marine fish would be mitigated by measures equivalent to stipulations A-1 through A-3 and ROP's A-3 through A-8 under Alternative C.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

(4) Conclusion

Under the No Action Alternative, the effects of activities other than oil and gas exploration and development on marine fish would be local and short term, with no measurable effects on populations.

c. Essential Fish Habitat

The only essential fish habitat (EFH) designated in the Planning Area covers the five species of Pacific salmon: chinook (or king) (*Oncorhynchus tshawytscha*), coho (or silver) (*O. kisutch*), pink (or humpback) (*O. gorbuscha*), sockeye (or red) (*O. nerka)*, and chum (or dog) (*O. keta*) (North Pacific Fisheries Management Council, 1997). Designated salmon EFH in the freshwaters of Alaska encompass virtually all of the coastal streams to about 70 ° N. latitude. The southern point of the coastal portion of the Northwest NPR-A Planning Area (Icy Cape) is located at about 70 ° 15' N. Salmon EFH in marine waters of Alaska is formally designated as the area within the 320-km exclusive economic zone boundary of the United States, down to a depth of 500 m (North Pacific Fisheries Management Council, 1999). There is little evidence of viable, self-sustaining salmon populations in the Beaufort and the northern (north of 70 ° N.) Chukchi Sea. Present salmon populations have a very difficult time establishing and persisting, most likely because of the marginal habitats (Craig, 1989a; Fechhelm and Griffiths, 2001). Based on the above discussion (also see EFH in Section III of this document), and given the protection provided by the mitigation measures formuated for this IAP/EIS, the proposed action is not expected to adversely impact salmon or their habitat. It has been assigned the EFH determination "may affect, not likely to adversely affect."

Because the potential impacts to the few salmon that are present in the Northwest NPR-A Planning Area are much the same as those for all other fish species, impacts on salmon, as part of EFH, are evaluated in the general fisheries analyses for this alternative.

9. Birds

This section discusses potentially adverse effects of management actions on non-endangered birds within the Northwest NPR-A Planning Area under the No Action Alternative. The primary effects on birds exposed to such activities would be 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by refined-oil products, wastewater, and solid/liquid wastes of varying toxicity. Nearly all of the approximately 70 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northwest NPR-A portion of the Arctic Coastal Plain (ACP). Principal bird groups considered here include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Non-Oil and Gas Activities

(1) Effects of Ground-Based Disturbance

Noise from human activities, as well as visual presence of humans and/or equipment, may disturb birds during any part of the annual cycle spent in Northwest NPR-A. Birds may be disturbed especially during sensitive periods as when attending a nest, brood-rearing, or in a flightless molt condition. Potentially disturbing activities include winter ground transport, ground-based resource surveys, activities associated with camps, waste removal and remediation, and recreational activities (Table IV-28). Attraction of predators to sites of activity may increase predation on birds.

(a) Ground Transport

Most ground transport associated with private, industry, or agency activities (Table IV-28) would occur during winter months (December-April), when nearly all birds are absent from the region. If the 20 to 60 trips annually between Prudhoe Bay or Oliktok Point and Barrow take place over offshore ice, there would be no effect on birds. Although there is little direct evidence from winter studies, the effect of occasional (e.g., 1 trip/week) overland traffic along the coast is likely to only temporarily displace any ptarmigan, gyrfalcons, and snowy owls present in the area for <1 day and up to an estimated 700 ft (213 m) from the route (Grubb et al., 1992; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978). If traffic is more routine (e.g., 3 trips/week), these species may vacate an area of up to 0.6 mi (1 km) from the route. These effects are expected to last the winter-transport season, with potential for recovery to original distribution and abundance following cessation of the activity in late spring.

(b) Summer Camps

Large summer camps (15 persons) potentially could be located at sites noted in the Northeast NPR-A IAP/EIS (1998) that are outside the Northwest NPR-A Planning Area, or at new locations such as the upper Meade River area. Such encampments may result in a local-disturbance area as much as 700 ft (213 m) to 0.6 mi (1 km) (Grubb et al., 1992; Johnson et al., 2003; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978) from each camp (35 to 776 acres; 0.14 to 3.14 km^2) for the 6-week duration of operation (Table IV-28). Humans on foot and noise-generating activities are expected to cause responses ranging from moving to the safety of a nearby lake to departure from the area for several hours (Burgess and Ritchie, 1989). Nest attempts and success are expected to decline in any such area, but the effect probably would vary considerably depending on the availability of appropriate habitat for each species comprising the local bird community (undisturbed habitat in the immediate vicinity of these occupied or formerly occupied sites may be of variable extent); the intensity of disturbance factors, the sensitivity of each species to disturbance; and the potential for habituation to particular factors (e.g., Haugh, 1982; Johnson and Noel, 1996). Smaller encampments, with fewer people and less equipment operation, are expected to cause correspondingly lower levels of disturbance, but still are likely to temporarily displace local birds from the immediate vicinity for variable periods. A few species (e.g., glaucous gull, common raven) may be attracted to encampments.

1) Local Effects

Since future large camp locations within the Northwest NPR-A are uncertain, their potential impact on local areas occupied by species of concern must be estimated. However, one potential location on the upper Meade River, for example, could result in disturbance of medium- to high-density areas for species such as Pacific loon, red-throated loon, tundra swan, long-tailed duck, Sabine's gull, and some shorebird species (Map 36, Map 38, Map 39, Map 42, and Map 46) recorded on the annual breeding pair surveys (Mallek, Platte, and Stehn, 2002). Regional population trends of red-throated loon and Sabine's gull are of concern because of recent declines. Local populations of those species adversely affected are likely to experience minor declines in breeding success in summers when camps are occupied; and the lost productivity may be difficult to separate from natural variation in population numbers and variation inherent in survey methods currently in use. Likewise, brood-rearing or molting birds probably would be displaced from the vicinity of these camps, but the small area and numbers involved are expected to result in negligible loss of foraging habitat for these local groups of individuals and negligible declines in survival and recruitment. In addition, at least one gyrfalcon nest was active on the upper Meade River in 1999 (Ritchie and Wildman, 2000). It is expected that camps would be located to avoid resources of concern. The overall effect of camps on regional (ACP) bird populations is likely to be negligible except that the effect could potentially escalate from negligible to minor for species such as the red-throated loon and king eider whose populations have shown substantial declines in recent decades (Gotthardt, 2001; Larned et al., 2001). Vegetation trampling and/or excavation that occur near camps are likely to represent negligible habitat loss.

Small resource-survey camps along rivers are relocated frequently, (e.g., every 3 to 5 days during a 3-week interval). Activities at these camps may disturb nesting passerines for short periods, but the effect of such short-term presence on population productivity is likely to be negligible. However, raptors at nest sites along the portion of the Colville River that abuts the southeastern Planning Area that are exposed to 3- to 5-day disturbances might exhibit a more substantial adverse response, although Ritchie (1987) found that short-term disturbance of peregrine falcon nest sites did not cause significant alteration of activity patterns and no significant changes in production of fledglings. The potential exists for brief periods of disturbance of peregrine falcon, gyrfalcon, and rough-legged hawk nest sites from such activities in the southern portion of the Planning Area (Ritchie and Wildman, 2000), although it is not likely that periods of short duration would cause nest site abandonment. If scientific survey or research camps were occupied for periods longer than 3 to 5 days and/or surveys extended over larger areas, greater numbers of nesting attempts by raptors, waterfowl, shorebirds, or passerines could be disrupted, but the expected minor local loss of productivity likely would cause only a negligible regional population effect. Small recreational parties traveling along rivers or backpacking through wetland areas for relatively short periods are expected to have no more impact than small survey camps.

2) Predator Effects

The attraction of bird predators (glaucous gull, common raven, arctic fox, brown bear) to uncontained refuse is well known. Even if waste is carefully controlled, previously habituated individuals may be attracted to camps. It is not certain in most instances what effect predation by these species has on overall reproductive success and local population trends, although some studies have demonstrated a strong correlation between the presence of predators and lower reproductive success. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose: Burgess and Rose, 1994; Johnson and Noel, 1996; common eider: Lanctot, et al., 2001; Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox predation pressure (e.g., brant and shorebirds: Underhill et al., 1993). Camps supporting proposed summer activities in the Planning Area could attract predators, but most camps would be short-term with small numbers of people present. Large summer camps would be in place for sufficient periods to attract a temporary local concentration of predators that may affect breeding success of local bird communities. Activities at such camps could affect loons, waterfowl, and any of several shorebird and passerine species present. Overall productivity and recruitment lost from the local area may be difficult to separate from natural variation in population numbers.

(c) Waste Removal

During the breeding season, disturbance from hazardous waste and solid material removal, and remediation or cleanup of fuel spills reaching offsite areas (involving operation of heavy equipment for up to 3 to 4 weeks) may displace small numbers of nesting, brood-rearing or molting birds from the immediate area temporarily, although effects are not expected to extend beyond 700 ft to 0.6 mi. Either activity could cause local disruption of some breeding attempts or foraging activities, but the losses may be difficult to separate from natural variation in population numbers. These camps would be covered by solid waste stipulations.

(d) River Transport

From June to September, boat travel to resource-survey camps and for recreation or hunting on the Colville River--and potentially other rivers--could expose substantial numbers of arctic peregrine falcons, as well as gyrfalcons and rough-legged hawks, to human presence (Ritchie, 1987). Float-trip traffic on the Colville is expected to number up to 8 parties per season (about 1 float trip every 1.5 weeks; see Table IV-28), typically with 4 persons in each party. River traffic on this section is expected to be lower than that which occurs below Umiat, a frequency that has not prevented the regional peregrine population along that portion of the river from increasing. There is no indication that this level of activity is adversely affecting the other two species, but monitoring that would address this question has not been done routinely. The tall-shrub riparian habitat along rivers is important habitat for nesting passerine birds. Studies to determine the effect of varying traffic levels in this situation have not been done, but any severe effects are likely to be localized primarily where river parties concentrate their onshore activities.

(2) Effects of Aircraft Disturbance

Both fixed-wing aircraft and helicopters are used for summer-season (June-September) aerial surveys, support of ground-based surveys and camps, and support of recreational activities.

(a) Summer Camp Support

Establishment and maintenance of large summer camps (see above) require aircraft support several times per week as well as flights for transport to worksites and for aerial wildlife and other surveys. Routine overflight of bird high-use areas by aircraft supplying or operating out of these camps could cause effects ranging from abandonment of nesting efforts (or lower survival of young in extreme cases) to avoidance of certain areas of favorable habitat for future nesting attempts or brood-rearing. Regardless of whether flights originate from Deadhorse or Barrow, or elsewhere, and where the destination site is located in the Planning Area, it is likely that some areas of high density for one or more species would be overflown. Under the No Action Alternative, aircraft are stipulated to fly above 1,500 ft when within ½ mi of raptor nesting cliffs, and 2,000 ft above caribou insect-relief areas, which would avoid disturbing birds in those areas as well. Also, routes could be chosen to avoid areas important for those species whose populations have declined. Except in the vicinity of large camps, disturbance effects from aircraft logistical flights are likely to be negligible, although routine flights may cause minor effects on nest success and survival in the local populations of declining species.

(b) Wildlife Surveys

Aerial wildlife surveys based at large camps are expected to involve daily flights for 2 weeks, primarily in June and July in several wildlife areas, although caribou tagging may continue through July. Aerial surveys for eiders in mid-June and the aerial breeding pair survey in late June-early July cover similar areas of the ACP each year. However, in a given year, only about 2 to 4 percent of the survey areas are overflown (Larned et al., 2001; Mallek, Platte and Stehn, 2002), so disturbance on an areawide basis is likely to be negligible. In some years, smaller areas are overflown more intensively. For example, beginning in 1999, a 100 mi^2 area northwest of Atqasuk was surveyed sufficiently intensively during the week-long eider survey period to provide 50 to 100 percent coverage (Larned et al., 2001). In addition, a portion of the standard ACP eider survey area was flown by helicopter instead of the typical fixed-wing aircraft. All of these wildlife survey flights, particularly those involving helicopters, have a considerable potential for disturbance because they require low-altitude flight (100 to 150 ft) over areas occupied by birds that may be in sensitive phases of the annual cycle (nesting, broodrearing, molting). If such surveys were carried out once per season, they still would likely have a negligible effect on both local and regional populations.

Eider and breeding-pair survey areas overlie about 16 peregrine falcon sites observed in 1999 (some with only a single bird present), and 2 known rough-legged hawk sites in the southern portion of the Planning Area (Ritchie and Wildman, 2000); however, any given area would be overflown only every fourth year. Raptor surveys potentially could disturb a given nest every year, but a single disturbance event during the breeding season is not expected to cause nest abandonment.

Occasional BLM resource aerial surveys would occur June to August. Use of aircraft to establish or move small recreational or agency camps and carry out aerial surveys could occur in addition to routine supply operations for larger camps, although the former are likely to be scattered, so particular areas probably would be overflown only a few times. These operations are not expected to add significantly to the standard wildlife surveys or supply operations for larger summer camps. Overall, most areas are likely to be overflown no more than a few times and thus the impact on local or regional bird populations is likely to be negligible. Impacts may be minor in the immediate vicinity of large camps, where aircraft disturbance could be relatively routine for up to six weeks, but likely still negligible on regional populations.

The overall impact of aircraft would depend both on the character of the operations such as type of aircraft, flight frequency, altitudes, routes used (lateral distance from sensitive areas), season of operation, and the sensitivity of the population segment exposed to potentially disturbing operations. For example, studies in the vicinity of Teshekpuk Lake (Derksen et al., 1992) found that molting brant were significantly more disturbed by helicopters flying below 3,511 ft (1,070 m) within 2.5 mi (4.0 km) than they were by helicopters above this altitude, as indicated by the duration of escape behavior. Disturbed birds were found to move away from an area at five times the rate of undisturbed birds, suggesting that disturbance could elevate daily energy expense by adding the cost of disturbance avoidance behavior. Also, disturbance may add considerably to the cost of recovering exhausted energy reserves following spring migration or accumulating the energy required for feather growth during molt and fat deposits for use during fall migration, by displacing brant from preferred habitat that presumably represents the most favorable energy intake situation (Derksen, et al., 1992). Molting brant could be subject to greater predation if they are forced to move between lakes (Derksen, Weller, and Eldridge, 1979). Weight loss of brant in the Teshekpuk Lake area was modeled under various disturbance intensities (varying frequency and altitude) from aircraft (Derksen, et al., 1992; Miller, 1994). There is some question whether brant can take in enough food to undergo molt without drawing on stored fat reserves, or protein, and thus may not be able to compensate for the added energy costs of disturbance (Taylor, 2002, pers. comm.). Based on the results of the Teshekpuk Lake brant study, the level of aircraft activity likely to occur in the Northwest NPR-A probably would cause only slight weight loss in this and other species in a few local areas, and result only in minor effects in the populations of those areas. The ultimate result of such an effect in terms of reproductive success or survival of young or adults has not been determined for any species; any lost productivity or recruitment may be difficult to separate from natural variation in population numbers.

Although bird species vary in sensitivity to disturbance, any breeding or post-breeding birds exposed to routine aircraft disturbance could be displaced from local habitats and/or subject to increased energy demands. For example, helicopter disturbance of one gyrfalcon pair did not cause nest abandonment or reduced productivity, but the pair did not occupy that site the following year (Platt, 1977).

(3) Effects of Spills

Birds experiencing moderate to heavy contact with refined-oil products (primarily fuels and lubricants) are not expected to survive. However, if such spills (estimated average volume less than 1 bbl) were to occur on pads (or ice roads in winter) where they could be contained and removed, significant exposure of birds would not be expected to occur. If fuel were to reach a lake where waterfowl or other waterbirds were present, especially during the brood-rearing period, losses of up to a few tens of individuals would be possible. A fuel release entering a stream or river may result in similar losses. Recovery to the original population status may be difficult to determine because of the natural variation in population numbers.

b. Effects of Oil and Gas Activities

Although this alternative precludes oil and gas exploration and development, if the option allowing seismic surveys were to be implemented, seismic surveying would occur during winter months (December-April), when nearly all birds are absent from the region. One 2-D seismic operation (expected to occur in alternate winters, typically involving 10 vehicles with a crew of 40 to 60, moving camp every 3 to 7 days and traversing gridlines 5 to 10 mi apart) could displace small numbers of ptarmigan, gyrfalcons, and snowy owls temporarily from within 700 ft (213 m) to 0.6 mi (1 km) of the local activity area around each 5- to 10-mi segment of 400 to 800 mi (644 to 1,287 km) of survey gridlines in a winter season. A typical 3-D seismic operation, involving a crew of 50 to 80 people collecting 2 to 4 mi^2 of data per day can cover 300 to 600 mi^2 (777 to 1,554 km^2) per season. Because areas of potential disturbance and the birds are both dispersed over a large area, there is not expected to be a significant population effect. Seismic trains, operating in winter, are required by stipulation to remove solid waste from BLM lands, hence this activity is not expected to enhance the survival of arctic foxes significantly. Primarily fixed-wing aircraft would be used for support of seismic surveys.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

If the option allowing winter seismic exploration activity were to be implemented, impacts on birds could be mitigated through restrictions placed on operators to mitigate effects of four types of impacts: 1) disturbance from noise or activity; 2) adverse alteration of habitats; 3) contamination of waterbodies occupied by birds; and 4) mortality of fish that are prey for fish-eating birds. Measures equivalent to stipulations A-3, B-1, B-2, C-2, D-2, and F-1 and ROP F-1 under Alternative C would avoid most disturbance of several bird species from late winter seismic activity, some breeding season disturbance of birds, and avoid some adverse alteration of habitats. They could help prevent spilled fuel or other toxic materials from reaching waterbodies where waterbirds or fish prey of fish-eating birds could become contaminated, or contamination of surrounding nesting and brood-rearing habitats. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a particular species' regional population.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Most disturbance effects on birds under the No Action Alternative--associated with winter ground transport and seismic exploration, summer aircraft support of small survey or research camps or recreational parties, aerial bird surveys, boat traffic at the current level on the Colville and other rivers, waste removal and fuel-spill cleanup activities, and habitat loss in the vicinity of camps--are likely to be negligible (temporary), both at the local and ACP regional population level. Disturbance in the vicinity of large summer camps (including air support for them and aerial surveys based from them) and smaller camps (if relatively numerous and occupied for the maximum time period noted) is likely to cause minor effects (persistent during the period of activity) on local bird communities. Such effects also are likely to be negligible for ACP regional populations of abundant, stable or increasing species, but may be elevated to the minor level for species that are uncommon, decreasing, or recently declined. Although in the vicinity of large camps this may represent a substantial local effect for declining species such as the red-throated loon or king eider, in the context of likely near-term activities it is not expected to represent a significant impact. Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations would minimize disturbance from most factors associated with oil and gas seismic exploration and help prevent degradation and contamination of essential bird habitats.

10. Mammals

a. Terrestrial Mammals

(1) Effects of Non-Oil and Gas Activities

Activities that may affect terrestrial mammals include aerial surveys (including those for wildlife) and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps (hunting and river floating), and overland moves. Overland moves occur during the winter on frozen tundra, ice roads, or stable, shorefast ice. The other activities occur from summer to early fall (June-September). Short-term displacement and/or disturbance (few minutes to a few hours) of terrestrial wildlife may result from helicopter and fixed-wing traffic, and ground traffic associated with these activities. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of 162 ft (60 m) and to exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150 to 1,000 ft (45 to 300 m) (Calef, DeBock, and Lortie, 1976). These documented reactions were to aircraft that circled and repeatedly flew over caribou groups. While aircraft associated with aerial wildlife surveys may circle or fly over a group of caribou more than once, aircraft associated with support of survey/inventory camps would pass over caribou only once on any given flight to or from a camp. Recreational and research camps may result in short-term displacement (24 hours to 6 weeks) or harassment of terrestrial mammals and minor disturbance to the vegetation and soil due to trampling (< 3/4 acre). Potential habitat disturbance from large camps would be reduced by using existing sites whenever possible. Camps may attract bears and foxes, and result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but would contribute to cumulative adverse effects. Direct mortality and degradation of habitat of small rodents (such as lemmings and voles) may occur locally at excavations, camps, and on trails used for overland moves. However, these losses would be insignificant to regional populations on the Arctic Coastal Plain. Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts to terrestrial mammals. For example, overland moves require the use of low-ground-pressure vehicles and are permitted to travel only over snow-covered, frozen ground to minimize impacts to vegetation and soil. Special recreation permits stipulate the proper handling of wastes and fuels.

Very small fuel spills (< 1 bbl) could occur in association with resource inventory surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly in the environment with only a local effect on vegetation. Such events are not expected to have any significant effects on terrestrial mammals.

(2) Effects of Oil and Gas Activities

(a) No Seismic Option

Under this option, no seismic operations would be conducted within the Planning Area and consequently, there would be no impacts to terrestrial mammals.

(b) Seismic Option

One 2-D or 3-D seismic operation (40 to 80 people) would occur in alternate years. Habitat impacts would be minor as seismic activities occur during the winter on frozen tundra or ice. Potential causes of disturbance to terrestrial mammals from seismic activities include surface vehicular traffic on frozen tundra or ice, and fixed-wing aircraft traffic. In most cases, these activities are expected to cause short-term (few minutes to < 1 hour) displacements and/or disturbance of terrestrial mammals. When 3-D seismic exploration survey lines are located only 500 to 2,000 ft apart, localized displacement of terrestrial mammals could last for several days. Effects on caribou and moose would be similar in type to those discussed under non-oil and -gas activities, but greater in extent, frequency, and duration.

Studies of the effects of oil and gas exploration on muskoxen in Alaska and Canada have focused on disturbances associated with winter seismic operations. Some muskoxen reacted to seismic activities at distances up to 2.48 mi (4 km) from the operations; however, reactions were highly variable among individuals (Reynolds and LaPlant, 1985). Responses varied from no response to becoming alert, forming defense formations, or running away (Winters and Shideler, 1990). The movements of muskoxen away from the seismic operations did not exceed 3.1 mi (5 km) and had no apparent effect on muskoxen distribution (Reynolds and LaPlant, 1986). Unlike caribou, muskoxen are not able to easily travel and dig through snow. In the winter, they search out sites with shallow snow, and greatly reduce movements and activity to conserve energy (USDOI, FWS, 1999a). Muskoxen survive the winter by using stored body fat and reducing movement to compensate for low forage intake (Dau, 2001). Because of this strategy, muskoxen may be more susceptible to disturbances during the winter. Repeated disturbances of the same animals during winter could result in increased energetic costs that may affect mortality rates. Depending upon the location of the seismic exploration, impacts on muskoxen would be non-existent to minimal. Most of the Planning Area is currently unoccupied by muskoxen, although potential habitat encompasses much of the Planning Area, and populations outside of the Planning Area are gradually expanding their range. At most, seismic operations would be expected to encounter no more than an occasional lone bull. No breeding groups would be affected, except possibly from seismic crews accessing the Planning Area from overland routes from Kuparuk River area.

Exploration activities and human presence pose potentially serious disturbances to denning bears. In one study, seismic activities within 1.15 mi (1.8 km) of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds, Reynolds, and Follmann, 1986). The investigators suggest that seismic testing activities within about 600 ft of a den may cause abandonment of the den. Under this alternative, Stipulation J-2 prohibits exploration activities within ½ mile of occupied grizzly bear dens. If den locations are known in the areas that seismic work occurs, impacts to hibernating bears would be reduced. If den locations were unknown, the stipulation would have little effect. Impacts to bears are expected to be minimal since the level of proposed seismic work is low. In addition, the area of highest potential for oil is the lowest density bear habitat.

Seismic camps may result in localized disturbance and/or displacement of terrestrial mammals for up to a few days. Bears and foxes may also be attracted to camps. However, no adverse impacts are anticipated. Since seismic camps generally move at least once a week and proper handling of wastes is emphasized by standardized stipulations (Appendix 13), the potential for bears or foxes to be attracted to human food sources is low. In addition, most seismic activity would occur when bears are hibernating.

Potential effects on wolverines could include disturbance from air and surface-vehicle traffic, and increased human presence. Wolverines are considered a shy and secretive species, and they may be sensitive to disturbance. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake are known to have caused the displacement of a wolverine from its den (Harry Brower, Jr., as cited in USDOI, BLM, 1997a).

Small rodents (such as lemmings and voles) may be locally affected through direct mortality and minor loss of habitat from overland traffic associated with seismic operations. Their predators (such as short-tailed weasels) may be indirectly affected in local areas due to a reduction in prey. These losses are expected to be insignificant at the population level.

(c) Summary

Among the terrestrial mammal populations that could be affected by management actions under the No Action Alternative are caribou of the Teshekpuk Lake herd (TLH) and the Western Arctic herd (WAH). Caribou may be temporarily exposed to helicopter traffic and other human activities associated with resource inventories and seismic operations, but such exposure is not expected to have any effects at the population level. Moose, muskoxen, grizzly bears, wolves, wolverines, foxes, and small mammals may be locally affected by activities in the Planning Area.

(3) Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Mitigation measures regarding solid- and liquid-waste disposal, fuel handling, and spills (equivalent to stipulations A-1 and A-2, and ROP's A-1 through ROP A-7 under Alternative C) would reduce the potential effects of spills and human refuse on grizzly bears, arctic foxes, and other terrestrial mammals. Measures equivalent to stipulations F-1 and F-2 on aircraft overflights would minimize disturbance of caribou by requiring minimum altitudes of 1,000 to 2,000 ft above ground level (AGL) over caribou winter ranges and the summer insect-relief area, respectively, during critical times of the year.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative

(4) Conclusion

The effects of the No Action Alternative on terrestrial mammals are expected to be local and short term, with no significant adverse effects on mammal populations.

b. Marine Mammals

Under the No Action Alternative, the Northwest NPR-A Planning Area would offerred for oil and gas leasing. Seven species of non-endangered marine mammals--ringed, spotted, and bearded seals; Pacific walruses; polar bears; and beluga and gray whales--commonly occur year-round or seasonally in coastal habitats adjacent to the Planning Area. Some individual members of these species may be exposed to effects from authorized activities under the No Action Alternative.

(1) Effects of Non-Oil and Gas Activities

Ground-impacting management actions along the coast within the Planning Area that may affect non-endangered marine mammals under the No Action Alternative include aerial surveys (including 14 days of surveys of wildlife); ground activities (such as resource inventories); paleontological excavations (about 1 acre disturbed); research (3 weeks for small camps and 6 weeks for large camps) and recreational camps (hunting and river floating); and seismic exploration, and overland moves. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. The other activities take place in summer and early fall (June-September). The primary potential causes of disturbance of marine mammals are helicopter and fixed-wing aircraft traffic and humans on foot. These activities, if they occur along the coast of the Planning Area, may cause short-term (less than 1 hour) displacements or harassment of hauled-out seals and polar bears.

Recreational camps in some cases may attract bears, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population, but would contribute to cumulative adverse effects.

Very small fuel spills (less than 1 bbl) are expected to occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly with only local effect on vegetation. Under current regulations, fuel spills are required to be cleaned up immediately, if possible. Such events are not expected to have any significant effects on marine mammals in the Planning Area.

(2) Effects of Oil and Gas Activities

(a) No Seismic Option

No effects on marine mammals are expected to occur under this option.

(b) Seismic Option

Seismic activities are expected to have short-term and local disturbance effects on a few individual polar bears, ringed seals, or other marine mammals. The effects are expected to be similar to the effects described under Alternative A (Section IV.C.10.b.2).

(3) Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Handling of food and garbage under mitigation measures equivalent to stipulations A-1 and A-2 (waste prevention, handling, and disposal) in Alternative C would prevent the attraction of polar bears to campsites--encounters that could result in the taking of polar bears in human/bear interactions. As with stipulation C-1 (overland moves) under Alternative C, operators planning winter activities between October 30 and April 15 must consult with FWS to prevent disturbance of denning polar bears and activities would be prohibited within 1 mi of known polar bear dens. This consultation is expected to prevent most disturbances of denning polar bears under the No Action Alternative. Measures equivalent to ROP F-1 (aircraft traffic) under Alternative C would reduce the number of aircraft disturbances of marine mammals and other wildlife.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from non-oil and gas activities would apply to authorized activities under the No Action Alternative.

Under the Marine Mammal Protection Act (MMPA), harassment or "taking" of marine mammals is prohibited unless the lessees have a Letter of Authorization (LOA) that would allow them to unintentionally harass marine mammals during their operations. To limit and avoid excessive harassment or taking of non-endangered marine mammals, the MMPA requires lessees to have an LOA to conduct activities that may harass or take marine mammals. This requirement is expected to limit any disturbance of marine mammals associated with seismic activities in the Northwest NPR-A Planning Area.

(4) Conclusion

Under the No Action Alternative, the effects of activities on marine mammals (seals, polar bears, and whales) would be local and short term with no significant adverse effects to the populations.

11. Endangered and Threatened Species

This section discusses potentially adverse effects of management actions on endangered and threatened species within the Northwest NPR-A Planning Area under the No Action Alternative. Primary effects on bowhead whales (endangered) would result from disturbance during their semiannual migration past the Planning Area. Primary effects on eiders (threatened) exposed to such activities would be: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, staging, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by refined-oil products, wastewater, and solid/liquid wastes of varying toxicity.

a. Effects of Non-Oil and Gas Activities

(1) Effects on the Bowhead Whale

Bowhead whales may be present in the Beaufort Sea offshore of the northern Planning Area primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea. They may be present in the Chukchi Sea off the western Planning Area in April to early June during their northward spring migration. Under the No Action Alternative, it is likely bowheads would be disturbed by activities associated with the management plan only under exceptional circumstances--such as when whales migrate near the coast coincident with the presence of barge traffic, or possibly when air traffic approaches a shoreline camp. For example, in 2000, when the median distance of migrating whales offshore was just 11.0 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance from underwater or airborne noise would have existed. Effects from such exposure are likely to be negligible.

(2) Effects on Spectacled and Steller's Eiders

Spectacled eiders are widely distributed on lakes throughout much of the Planning Area in summer (Larned et al., 2001; Ritchie and King, 2002), and essentially absent from the area between October and May. The highest densities occur in several areas from Dease Inlet west to the Chukchi coast and west of the community of Atqasuk to Peard Bay and Kuk River/Wainwright Inlet (Map 62). Steller's eiders are sparsely distributed in the Planning Area, particularly in the northwest portion between Dease Inlet/Admiralty Bay and the Chukchi coast, and nest attempts apparently are relatively infrequent. They are absent from the area from late October to May. Effects of management actions on spectacled and Steller's eiders, summarized below, are likely to be similar to those discussed for other waterfowl species in Section IV.B.9.

Most ground transport activities occur in winter and thus would not disturb eiders or affect their habitats. Eiders are likely to be displaced from within 700 to about 3,000 ft of large summer encampments (Grubb et al., 1992; Johnson et al., 2003; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978), causing a local decline in nest attempts and success. Local eider populations may experience minor declines in breeding success from disturbance in summers when camps are occupied, although this may not be as relevant to Steller's eiders with their scattered distribution. Small, frequently moved camps are likely to cause negligible local decrease of nest success and productivity. Overall habitat loss in Northwest NPR-A is expected to be negligible. Predators attracted to camps may decrease breeding success of local eiders. Waste removal and fuel spill cleanup may disturb local nesting or brood-rearing birds for varying periods, resulting in nest failure for those directly involved. Small groups of travelers on the Colville and other rivers at the level anticipated are expected to cause minimal disturbance of eiders.

Effects of routine aircraft activity associated with large camps may range from causing avoidance of certain areas by eiders to abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights may pass over areas where eiders occur at higher density. Aerial survey flights for monitoring bird or caribou populations have considerable potential for disturbance of eiders because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the Arctic Coastal Plain (ACP) per season, so areawide disturbance effects are likely to be minimal. In isolated areas, aircraft effects are likely to be negligible; potentially minor effects may occur in the vicinity of large camps. Spills of refined-oil products are likely to be contained and cleaned up before contacting eiders. Quantitative effects resulting from most factors are likely to be difficult to separate from natural variation in population numbers.

b. Effects of Oil and Gas Activities

Seismic surveys may occur during winter months (December-April), when nearly all bowhead whales and spectacled and Steller's eiders are absent from the region. As a result, it is likely that the effect of seismic exploration activity on these species would be negligible.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Although no oil and gas development would occur under the No Action Alternative, winter seismic exploration activity may occur. Measures equivalent to stipulations A-3, C-2, and D-2 under Alternative C could mitigate potential impacts on eiders by reducing the effects of three types of disturbances to eiders: disturbance from noise or activity, adverse alteration of habitats, and contamination of waterbodies occupied by eiders. Such measures would avoid some disturbance of eiders during the breeding season and avoid some adverse alteration of habitats. Such measures would help prevent spilled fuel or other toxic materials from reaching waterbodies where eiders could become contaminated, or contamination of surrounding nesting and brood-rearing habitats.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative

d. Conclusion

Under the No Action Alternative, bowhead whales are not likely to be affected by activities associated with the management plan. Most disturbance effects on spectacled and Steller's eiders under the No Action Alternative--associated with summer aircraft support of small survey or research camps and recreational parties, aerial bird surveys, boat traffic at the current level on the Colville and other rivers, waste removal and fuel-spill cleanup activities, and habitat loss in the vicinity of camps--are likely to be negligible both at the local and ACP regional population level. Disturbance in the vicinity of large summer camps, including air support for them, could cause minor effects on local nesting eiders. Such effects also could be elevated to the minor level for the ACP spectacled eider population that shows a recent non-significant decline, and likely the Steller's eider as well. This would represent a significant effect for these regional populations. Quantitative effects may be difficult to separate from natural variation in population numbers. Standardized mitigation measures would minimize disturbance from most factors associated with seismic exploration and help prevent degradation and contamination of essential bird habitats.

12. Economy

a. Effects of Non-Oil and Gas Activities

Employment generated by 8 one-week float-trip parties per year would still occur (Delaney, 2002, pers. comm.). This is equal to one person working for 8 months.

b. Effects of Oil and Gas Activities

Under the seismic option of the No Action Alternative, one seismic survey every other winter is projected to occur. A seismic survey party of approximately 50 persons would work for 4½ winter months.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative. No stipulations or ROP's are relevant to potential economic effects of the No Action Alternative.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Employment under the No Action Alternative would be about equal to one person working for 8 months in recreation-field employment and approximately 50 persons working for 4½ winter months in support of seismic surveying. Under the No Action Alternative, the potential economic effects of oil and gas-related activities--including employment, personal incomes, and revenues to the State and NSB--would not occur.

13. Cultural Resources

a. Effects of Non-Oil and Gas Activities

Archaeological research/excavation is conducted by BLM and by permit within the Northwest NPR-A annually. While excavation is a destructive activity, it is necessary for the recovery of scientific data, such as for geological and paleontological research. Excavation and collection normally occur during the summer. Geological and paleontological researchers are trained to recognize cultural resources and to respond to such encounters accordingly. Because of surface and near-surface contexts, cultural resources are often encountered by chance. Some Pleistocene-age animal remains are occasionally recovered in archaeological deposits. In such situations, the bones would represent subsistence use of the animal(s) by humans, and the faunal material would be considered part of the archaeological record as well as belonging to the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment generally impact relatively small areas. Therefore, such camps and the activities that are associated with them--such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation--are not expected, in and of themselves, to have any significant effect on cultural resources.

b. Effects of Oil and Gas Activities

Under the No Action Alternative option that allows seismic activity, there are only two types of activity that have the potential for causing measurable impacts on cultural resources--excavation and collection and seismic data gathering operations. Because seismic data gathering activity is authorized only during the winter using low-ground-pressure vehicles such as rolligons, there is little chance that significant impacts to below-ground cultural resources could occur. Under certain circumstances, impacts to surface cultural resources could occur from the passage of seismic vehicles. In most cases, surface cultural resources (usually structures of some type), can be visually detected and subsequently avoided, even when snow covered. Surface cultural resources that are not structures are not easily detectable but, given their nature, are usually sufficiently protected from impacts by snow cover and frozen vegetation. The exception to this is human skeletal remains that lie on the surface.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to Stipulation C-1b and ROP C-1e for Alternative C would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact cultural resources that are near the surface.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Under the No Action Alternative, impacts to cultural resources would be minimal, whether or not seismic activity is allowed.

14. Subsistence-Harvest Patterns

This discussion is concerned with subsistence resources and subsistence-harvest patterns of Native communities in and adjacent to the Northwest NPR-A that could be impacted by management actions within the Planning Area. These communities are Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. Under the No Action Alternative, no oil and gas leasing would occur, and the current BLM management regime would continue. Additionally, no management designations such as wilderness, Wild and Scenic Rivers, or off-highway vehicle (OHV) designations would be made. Consequently, there would be no effects on subsistence-harvest patterns from management designations.

The primary subsistence resources and aspects of subsistence-harvest patterns covered in this analysis are:

1. heavy reliance on caribou and fish in the annual average subsistence harvest for all five villages;
2. heavy reliance on bowhead whales in Wainwright, Barrow, and Nuiqsut (and beluga whales in Point Lay);

3. the overlap of subsistence-harvest areas for many species harvested by these communities;
4. the importance of subsistence hunting and fishing as cultural values that are central to the Inupiat way of life and culture; and
5. the importance of guaranteeing healthy populations of these resources for local subsistence needs.

For a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, see the discussion for Alternative A (Sec. IV.C.14).

a. Effects of Non-Oil and Gas Activities

Ground-impacting management actions within the Planning Area that may affect subsistence-harvest patterns under the No Action Alternative include 1) aerial surveys (including those inventorying terrestrial mammals and birds) and 2) ground activities (such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps, and overland moves). All of these activities occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned exploration drill sites.

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbance activities and fuel spills on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed above. Effects from ground-impacting activities and small fuel spills on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to short term and local, and to have no regional population effects.

b. Effects of Oil and Gas Activities

(1) No Seismic Option

Under this option, no seismic operations would be conducted within the Planning Area and, consequently, there would be no impacts to terrestrial mammals, freshwater fish, marine fish, birds, bowhead and beluga whales, and other marine mammals. Thus, there would be no effects to subsistence-harvest patterns.

(2) Seismic Option

Under this option, seismic operations would be conducted within the Planning Area. Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of seismic activities on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in Sections IV.B.8 through IV.B.11 above. Because the effects from seismic surveys on subsistence resources are expected to range from negligible to short term and local, and to have no regional population effects, the effects to subsistence-harvest patterns would also be negligible to short term and local.

The fall and winter harvest seasons are times when subsistence resources are available well past coastal areas and rivers accessible in the summer. Winter allows access to an expanded harvest area for ungulates and furbearers and can lead to greater potential industry and hunter contact and consequent disruption of harvest activities. Winter also is a time when wildlife are more vulnerable to natural environmental stresses limited forage, severe cold, high winds, and compacted snow cover. The effects on certain subsistence resources (and their harvest) from stresses produced by seismic activities may actually be more pronounced during winter.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to stipulation H-1 and ROP I-1 under Alternative C would reduce potential conflicts with subsistence-harvest activities in the Planning Area.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Impacts under the No Action Alternative on subsistence resources would range from negligible to short term and local, with no regional population effects expected on any of the resources. Impacts under the No Action Alternative on subsistence-harvest patterns and practices would therefore also range from negligible to short term and local. Little net change is anticipated from disturbance effects to subsistence resources and the communities within or adjacent to the Planning Area.

Although subsistence resources of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut could be affected periodically from ground-impacting activities, small fuel spills, and seismic activities, overall the effects on subsistence-harvest activities would be negligible. Effects to the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-impacting activities, small fuel spills, and winter seismic activities are expected to be negligible.

15. Sociocultural Systems

This discussion is concerned with those communities in and adjacent to the Northwest NPR-A that could be impacted by ground-management actions within the Planning Area: Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. Under the No Action Alternative, no oil and gas leasing would occur, and the current BLM management regime would continue. Additionally, no management designations such as wilderness, wild and scenic rivers, or off-highway vehicle (OHV) designations would be made and, consequently, there would be no effects on sociocultural systems from management designations.

The primary aspects of the sociocultural systems that could be impacted are 1) social organization, 2) cultural values, and 3) social health as described in Section III.C.4. For a more in-depth discussion of the parameters for sociocultural-effects analysis, see the discussion for Alternative A (Section IV.C.15) .

a. Effects of Non-Oil and Gas Activities

Management actions within the Planning Area that may affect sociocultural systems under the No Action Alternative include aerial surveys (including those inventorying terrestrial mammals and birds) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps, and overland moves. Most of these activities would occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot.

(1) Effects of Disturbance

As the above factors are normal activities under the existing BLM management regime, little net change is expected from disturbance effects to subsistence resources and harvest patterns (see Sec. IV.C.15, Subsistence-Harvest Patterns). Therefore, little net change is expected to traditional community activities or to traditional practices for harvesting, sharing, and processing of these resources.

(2) Effects of Spills

Spills from fuel storage at construction sites and camps could occur. The size of such spills is likely to be small (a few barrels) and the area of contamination would be small. Cleanup activities are not likely to cause great disturbance to the surrounding environment, to normal subsistence-harvest activities, or to traditional practices for harvesting, sharing, and processing of these resources.

b. Effects of Oil and Gas Activities

(1) No Seismic Option

No seismic operations would be conducted within the Planning Area under this option. Consequently, there would be no impacts to subsistence resources, harvest activities, or traditional practices for harvesting, sharing, and processing of these resources.

(2) Seismic Option

Effects from seismic surveys on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to short term and local, and to have no regional population effects. Little net change is expected in disturbance effects to subsistence resources and to community subsistence-harvest practices within or adjacent to the Planning Area.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Stipulation H-1 would specify that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities.

Measures equivalent to stipulation H-1 and ROP's H-1 and I-1 under Alternative C would reduce potential conflicts with subsistence activites.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative

d. Conclusion

Impacts under the No Action Alternative on subsistence resources range from negligible effects to short term and local, with no regional population effects expected. Although subsistence resources of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut could be affected periodically from ground-impacting activities, small fuel spills, and seismic activities, the overall effects on subsistence-harvest activities would be negligible. With negligible effects expected on subsistence resources, subsistence-harvest practices, and on population and employment, impacts to the sociocultural systems of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut are expected to be negligible as well.

16. Environmental Justice

a. Effects

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by activities in the Northwest NPR-A Planning Area and the No Action Alternative. Because of the reliance of the Inupiat on subsistence foods, effects on subsistence resources and subsistence-harvest practices would affect Inupiat Natives. The effects of the No Action Alternative on subsistence species, North Slope subsistence communities, and sociocultural systems are summarized below.

Potential effects from noise, disturbance, and fuel spills on subsistence resources, subsistence-harvest practices, and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. For a detailed discussion of Environmental Justice, see the cumulative analyses for subsistence-harvest patterns and sociocultural systems in Sections IV.F.8.n and IV.F.8.o.

(1) Effects on Subsistence Species

Impacts under the No Action Alternative on subsistence resources range from negligible effects to short term and local, with no regional population effects expected. Although subsistence resources of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut could be affected periodically from ground-impacting activities, small fuel spills, and seismic activities, overall effects on subsistence resources would be negligible. The lack of seismic surveying activity could potentially reduce disturbance to overwintering caribou.

(2) Effects on Subsistence Communities

Effects to the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-impacting activities, small fuel spills, and winter seismic surveying activities are expected to be negligible.

(3) Effects on Sociocultural Systems

Under the No Action Alternative, with negligible effects expected on subsistence resources and practices and in population and employment, changes in the sociocultural systems of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut are expected to be negligible as well.

b. Conclusion

With negligible effects expected on subsistence resources and practices, in population and employment, and on the sociocultural systems of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut, environmental justice effects from the No Action Alternative are expected to be negligible as well. Disproportionately high adverse effects on Alaska Inupiat Natives are not expected from the No Action Alternative.

17. Coastal Zone Management

The Northwest NPR-A Planning Area lies entirely within the boundaries of the North Slope Borough (NSB); the vast majority of the land within the Planning Area is under Federal jurisdiction. The remaining lands are limited primarily to Native entities. The Coastal Zone Management Act (CZMA), as amended, excludes from the coastal zone "... lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers, or agents" (16 U.S.C. Sec. 1453). Although these lands are excluded from the coastal zone, all uses and activities having reasonably foreseeable effects on any coastal use or resource must be consistent with the standards of the Alaska Coastal Management Program (ACMP) and the enforceable policies of the North Slope Borough's Coastal Management Program (CMP).

The statewide standards, codified in 6 AAC 80, include standards addressing coastal habitats, coastal resources, and uses and activities. The primary goal of the NSB's Program is to protect the subsistence lifestyle of the

Borough's largely Inupiat population, while also encouraging and managing economic development. Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the Inupiat, given cultural and historic patterns of existence within NPR-A lands. Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Requirements address: reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil-spill-control and -cleanup plans; causeways and residential development associated with resource development; air and water quality; and solid-waste disposal.

a. Effects of Non-Oil and Gas Activities

Four North Slope communities (Barrow, Wainwright, Nuiqsut, and Atqasuk) are located within the NPR-A with Nuiqsut located outside the Northwest NPR-A Planning Area. Two other North Slope communities are located near the NPR-A (Point Lay and Anaktuvuk Pass), and their residents make extensive use of NPR-A land and resources. Ground-impacting management actions are associated with:

1. aircraft use to transport personnel, supplies, and equipment for fieldwork and to fly aerial surveys;
2. excavation and collection of archaeological, paleontological, geological, and soil samples;
3. ground activities associated with aircraft use and camps for field survey and recreational activities;
4. hazardous- and solid-material removal and remediation;
5. overland moves of equipment and supplies and seismic activities; and
6. recreational activities.

The statewide standards and North Slope Borough policies may apply to those actions that may have reasonably foreseeable effects on coastal uses and resources, including subsistence and recreational uses.

Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority to the Inupiat, given cultural and historic patterns of existence within NPR-A lands. Activities that may adversely affect coastal uses and resources related to subsistence activities (including hunting and fishing) and resources (such as arctic fish, migrating birds, caribou, moose, and other fur-bearing animals), cultural and archeological resources, water quality, soils and vegetation, and recreation uses are analyzed in Section IV.B through IV.F. Effects associated with ground transport and seismic surveys in winter, effects of camp activities and aerial surveys, and small spill cleanup are expected to be temporary and minimal to negligible. Therefore, no direct or significant impact, as defined in Alaska Statute 46.40.210, is anticipated.

Under the No Action Alternative, there are two options with regard to seismic surveying activity: one option would permit continued winter seismic surveys throughout the Planning Area and the other option would prohibit such surveys. Summer aerial surveys and geologic field investigations may occur.

At the present time, seismic surveys, if conducted as a stand-alone activity and not in conjunction with an exploration or development plan, do not require a separate consistency review under the ACMP and are covered under the State's General Concurrence "B list" of categorically approved activities.

b. Effects of Oil and Gas Activities

The No Action Alternative reflects current BLM management of the Northwest NPR-A, under which no new oil and gas leasing would occur. Since no oil and gas leases would be offered, there would be no lease-related petroleum exploration, development, or production.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

Under the No Action Alternative, current BLM management practices applicable to activities other than oil and gas (i.e.,water-resource protection and extraction, handling of solid and liquid wastes and disposals) and land use authorizations issued in the Planning Area provide adequate protection to surface and subsistence resources.

d. Conclusion

No direct and significant impacts on any coastal use or resource are anticipated for any of the activities associated with the No Action Alternative. Enforcement of existing BLM regulations and required operating procedures and the use of existing BLM management practices would provide for consistency. Conflicts with the statewide standards of the ACMP and the enforceable policies of the North Slope Borough's Coastal Management Program are not anticipated.

18. Recreation Resources and Wilderness

a. Effects of Non-Oil and Gas Activities

The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators such as hunting and float-trip guides, most of whom focus their activity along the Colville River and southern foothills. The BLM estimates that up to three of the permittees--accounting for at most six trips--may float from the headwaters area to Umiat. These trips would be for hunting and would take place in August or the first week of September. They would consist of about four persons who probably would not camp within the Planning Area (since the Colville River is outside the Planning Area). Up to two permittees, accounting for up to four parties of four persons each, may conduct trips in the Arctic Plain and Foothills of the Planning Area. This use would be during the summer to enjoy the scenic, wildlife, and paleontological resources of the area. Each party would camp up to three times each in the Planning Area. A very limited number of SRP's may be associated with other types of use. At least one permittee may operate on floats taking hunters or sightseers to lakes within the Planning Area. These flights may result in camping similar to that of fly camps or backpack camps.

Floating parties along the Colville would carry enough fuel for a small stove and their boat engines. They would camp for no more than one night in any one place, and their camping practices and likely impacts would be consistent with those of fly camps or backpack camps described above.

Under the No Action Alternative, most impacts to recreation resources would result from activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, one camp doing survey or collection efforts is anticipated at any one time. In winter months, several overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., rolligons, tractors), noise from generators and aircraft, human presence, and associated activity all would have some minimal short-term impact on solitude, naturalness, or primitive/unconfined recreation. These adverse, short-term impacts would be confined primarily to the activity site viewshed (i.e., approximately ½ mi in any direction from the site) and are expected to affect no more than approximately 500 acres at a time (one camp @ 500 acres/camp). A longer lasting impact from overland moves would be from "green trails," which are discussed under Visual Resources (Section IV.B.20).

b. Effects of Oil and Gas Activities

Under the seismic option of the No Action Alternative, seismic-survey work would continue. Seismic surveying would occur in winter using "cat trains" of low-ground-pressure vehicles supported by light aircraft. Seismic crews would be housed in mobile camps consisting of trailer sleds pulled by Crawler tractors. Most impacts on recreational resources from these moving camps and associated activities would be a result of noise from generators, aircraft, and human presence. Impacts would be minimal, temporary, and confined to the immediate area (i.e., within approximately ½ mi in any direction). A longer lasting impact from overland moves would be from "green trails," which are discussed under Visual Resources (Section IV.B.20).

Under the No Action Alternative, wilderness values of naturalness and outstanding opportunities for primitive recreation or solitude would not receive special protection under the Wilderness Act. However, under this Alternative, no development is anticipated within the Planning Area. Therefore, little to no long-term impacts to the wilderness values are expected. Solitude and naturalness would be impacted when "cat trains" and seismic surveys travel through an area, but the effects would be temporary.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to stipulations A-3 and C-2 and ROP's A-1, A-2, A-5, A-8, and F-1 under Alternative C would protect recreation resources. In addition, mitigation measures developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, and seismic operations would protect recreation values.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

Impacts to recreation resources from activities other than oil and gas would be minimal and short term, affecting about 500 acres. Impacts from ongoing oil and gas activities (seismic surveys) also would be short term, affecting about 500 acres. Green trails from overland moves and seismic surveys also would be visible during summer months.

19. Wild and Scenic Rivers

Under the No Action Alternative, no rivers would be recommended for inclusion in the National Wild and Scenic Rivers System. Within the Planning Area, 22 streams have been identified as meeting the minimum standard for eligibility. This section analyzes the effects of No Action Alternative on the 22 streams. River values in the Planning Area include the unpolluted and free-flowing nature of the streams listed in Table III-38, as well as subsistence resources and use, fisheries, wildlife, and cultural resources. With the exception of the Colville River, all the rivers listed in Table III-38 were found eligible as scenic river areas (see discussions in Section II.B.11, Section II.F.3, and Appendix 11). In the case of the Colville River--the only potential wild river--the lack of road access would also be considered a river value because of the requirement that wild river areas are vestiges of primitive America, generally accessible only by trail.

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities on subsistence resources and use, recreation fisheries, wildlife, archeology, and cultural resources are described elsewhere in this section. Threats to these outstandingly remarkable values are minimal under this alternative. Similarly, non-oil and gas activities under the No Action Alternative are not expected to have any appreciable effect on the existing water quality or free-flowing nature of the streams.

b. Effects of Oil and Gas Activities

(1) Seismic Option

Seismic exploration and cross-country moves may impact river values under the No Action Alternative. The impacts to subsistence resources and use, fisheries, wildlife, and cultural resources are described elsewhere in this section. Spills associated with seismic exploration have the potential to cause minor impacts to water quality in individual eligible streams. Cross-country moves may cause river ice to freeze in unnatural patterns, and could perhaps cause some ponding of water behind artificially created ice dams during breakup, a negative effect on the free-flowing nature of the affected stream. This potential effect on river values has not been reported previously on the coastal plain.

The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon are unlikely to be impacted by seismic activities because of low oil and gas potential.

(2) No Seismic Option

Impacts to river values under the No Action Alternative are not expected to occur if seismic exploration is not allowed.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

Measures equivalent to stipulations A-1, A-3, C-1, and C-2 and ROP's A-1, A-2, A-3, and A-4 under Alternative C would contribute to the conclusion that seismic exploration would have little effect on river values. Without these measures, greater impacts from spills and damage to stream banks at river crossings would be expected to occur and impacts to water quality would be expected to increase.

Measures equivalent to ROP C-1 under Alternative C would reduce the likelihood of impacts to the free flow of streams by reducing the likelihood of additional freezeup and unnatural breakup of rivers. Such measures would also provide protection from rutting and changes in drainage patterns for riparian areas.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

d. Conclusion

The No Action Alternative without seismic exploration effectively protects river values, although it does not include any recommendations for designating any rivers as components of the National Wild and Scenic Rivers System. Seismic exploration has a small potential to negatively affect water quality, free flow, and to cause damage and erosion on riverbank areas. The stipulations and ROP's would help limit potential impacts. Considering the level of expected activities and the protection provided by the proposed mitigation measures, any impacts that might occur to wild and scenic river values under the No Action Alternative are expected to be minimal. Considering the lack of known impacts to water quantity and quality, and that there are no projected impacts to outstandingly remarkable values under the No Action Alternative, impacts on wild and scenic river values under the No Action Alternative are expected to be minimal.

20. Visual Resources

Under the No Action Alternative, no visual resource classes would be assigned within the Planning Area. Management of visual resources would take place in individual environmental analysis of each proposed activity.

a. Effects of Non-Oil and Gas Activities

Most impacts to visual resources would result from summer on-the-ground management activities such as aircraft landings and fuel caches; wildlife surveys; cultural and paleontological surveys with possible excavation activities; field camps (one field camp of 1 acre or less each); hazardous- and solid-material removal and remediation activities with possible gravel pads and roads; and in the winter, overland moves using OHV's. Between 20 to 60 overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impact on visual resources or scenic quality. These adverse, short-term impacts would be confined primarily to the activity site viewshed (i.e., approximately ½ mi in any direction from the site) and are expected to affect no more than approximately 500 acres in any one season.

A longer lasting impact would be "green trails" resulting from winter overland moves. Green trails are created by vehicles compacting snow and dead vegetative material that, in turn, results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of the overland move but where they do occur, they can be very detectable from the air for 2 to 5 years, and in some cases longer. They are usually difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with overland moves. Because overland moves are a relative constant from year to year and generally follow the same route(s), approximately 100 mi of intermittent green trails would be visible from the air during any one summer season.

b. Effects of Oil and Gas Activities

(1) Seismic Option

Under this option, seismic-survey work would continue. This work would occur in winter using cat trains with low-ground-pressure vehicles supported by light aircraft. Seismic crews are housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps and associated activities would result in a short-term adverse impact on visual resources or scenic quality of the area. These impacts would be confined primarily to the activity-site viewshed, or approximately 1/2 mi in any direction. Assuming one seismic 2-D or 3-D operation per season, seismic operations are expected to affect 500 acres annually.

A longer lasting impact would be "green trails" resulting from winter overland moves. Green trails are created by vehicles compacting snow and dead vegetative material. In turn, this results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of the overland move but where they do occur, they can be very detectable from the air for 2 to 5 years, and in some cases longer. They are usually difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with overland moves. Approximately 100 mi of intermittent green trails from seismic activities would be visible from the air during any summer season.

(2) No Seismic Option

Under this option, no seismic-survey work would occur. With a no activity on the ground, no visual impacts would occur.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's relevant to waste prevention, handling and disposal, and spills, and to overland moves and seismic work listed for Alternative C generally reflect the standard stipulations BLM commonly attaches to permits for seismic survey activities in the Northwest NPR-A Planning Area. The agency would generally continue to impose these restrictions if management chooses to adopt the No Action Alternative.

The standardized stipulations (Appendix 13) that BLM commonly applies to mitigate impacts from authorized activities would apply under the No Action Alternative.

Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, and seismic operations would protect visual resources.

d. Conclusion

Impacts to visual resources from activities other than oil and gas would be minimal and short term, affecting about 500 acres. Impacts from seismic surveys also would be short term, affecting approximately 500 acres. Approximately two hundred miles of green trails from overland moves and seismic surveys also would be visible during summer months for 2 to 5 years.

21. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared comprehensive impact analyses on those resources within the Northwest NPR-A Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section IV.E.7).

Effects of First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative C would involve either disturbance or destruction, and would affect a negligible fraction of the Planning Area. The impacts of oil exploration would be of the same types as for Alternative A, but would cover fewer acres because of the reduced level of activity by the oil/gas industry. Exploration activities would include: vegetation disturbance on 11,000 to 183,000 acres every other year from seismic surveys; construction of ice roads on < 210 acres per year and ice pads on < 35 acres; and permanent, minor vegetation destruction and alteration from the construction of exploration well cellars. It is assumed that no development would occur under Alternative C, so none of the impacts of development as described under Alternative A would occur. Although none are projected, spills could occur during seismic surveys and exploratory drilling; any spills would affect much less than the 5 acres for Alternative A.

Effects of Multiple Sales: The impacts of oil exploration following multiple lease sales under Alternative C would include about double the vegetation disturbance from seismic work as under a single-sale scenario for Alternative C, and about one-sixth the level of multiple sales under Alternative A. The extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time between the first sale and subsequent sales. Exploration activities also would result in < 0.01 acres of permanent vegetation destruction around well cellars and alteration, per year, of < 250 acres around and under ice pads and roads. These levels are slightly more, on a per year basis, than those of a single sale under Alternative C and roughly 10 percent of the levels of multiple sales under

Alternative A. Development activities, and subsequent impacts to vegetation, are assumed not to occur under Alternative C. The likelihood of refined oil spills from seismic activities following multiple sales under Alternative C would remain at the same level as for the first sale.

Soils (Section IV.E.1)

Effects of First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative C would be unlikely to cause loss of soils and any impacts would be expected to be negligible. Impacts from exploration that requires winter operations again would be unlikely to cause loss of soils. Any impacts would be expected to be minor to negligible, the single measurable impact being that of well cellars. Development is assumed to not occur with this alternative. The area of soils impacted by any spills would be similar to the area of vegetation affected. Spills would be cleaned up immediately, causing minimal contamination to soils.

Effects of Multiple Sales: Generally, under Alternative C impacts would be similar in nature to those under Alternative A without the development phase. Impacts to soils from exploration activities would be small to negligible, while development impacts would remain small to moderate. The duration of these impacts would range from several years if the vegetation were disturbed up to several decades if the soils were destroyed. The overall impact to soils of the Northwest NPR-A Planning Area would be negligible (with seismic) to moderate (with development).

Water Resources (Section IV.E.3)

Effects of First Sale: The impacts of activities other than oil and gas exploration and development under Alternative C would be expected to be significantly less than those under Alternative A. The potential short-term impacts from exploration and development would be water withdrawals from up to 40 lakes, and--during construction--increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 350 acres. Long-term impacts from development of gravel roads, pads and pits (such as melting of permafrost and disrupting drainage patterns) could impact up to 200 acres. Roads would pose the single most significant impact because of the diversions, impoundments, and increased sediments runoff associated with them, so limiting the length of the roads would cause the greatest reduction in impacts to the water resources. While any surface-disturbing activity could affect water resources, Alternative C would protect more areas of special aquatic resources, including those areas adjacent to streams and lakes identified as critical aquatic habitat. The potential adverse effects of Alternative C on water resources should be very much less than Alternative A.

Effects of Multiple Sales: Adverse impacts from multiple lease sales could be up to 3 times greater than a single sale, while indirect impacts might take years to develop. While shared infrastructure could reduce the adverse effects to water resources of multiple sales, both long- and short-term impacts (as noted above), as well as recovery times, could increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity.

Freshwater Quality (Section IV.E.4)

Effects of First Sale: The short-term, localized impacts from seismic and exploratory activity would be reduced approximately one third and one quarter, respectively, compared to Alternative A. Long-term impacts from seismic would be less than Alternative B and equivalent with the No Action Alternative.

Effects of Multiple Sales: Long-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale.

Estuarine Water Quality (Section IV.E.5)

Effects of First Sale: There would be a greatly reduced risk of spills, but still a slight chance of them in NPR-A bays for two reasons — fuel might be transported across the bays for onshore exploration and there might be further State and Federal leasing of adjacent offshore waters.

Effects of Multiple Sales: Multiple sales would have very low level of effects on estuarine water quality, similar to the effects from the first sale.

C. Alternative A

1. Soils

a. Effects of Non-Oil and Gas Activities

The types of activities and associated impacts that may affect soils under Alternative A are the same as those analyzed under the No Action Alternative (Sec. IV.B.1) and include aircraft use (landing and take-off), OHV use, and other ground activities. Excavation and collection activities would disturb approximately 6 acres annually, compared with no more than 1 acre under the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Snow trails, ice roads, snow roads, ice pads, runways, and other similar transportation and storage structures have little effect on soils.

Seismic operations affect soils primarily through the action of on-the-ground travel. Fundamental to the protection of frozen soil is prevention of disturbance to the insulating vegetative layer. Any activity using heavy vehicles has the ability to depress the vegetative layer and reduce insulation. All vehicle use has the risk of removing the vegetative mat. During the summer months, when seasonal thaw occurs, soils may be more susceptible to disturbance, as the active layer may contain large amounts of melt water and the saturated soils may not be capable of resisting the forces of vehicle traffic. In areas such as the foothills--where soils are thin or soils are well drained, or vegetation is otherwise underlain by materials containing less water--vehicle travel has occurred in summer months with little disturbance. Generally, winter months--when soils are frozen (especially the seasonal thaw layer)--compose the only time period when when soils are capable of supporting the weight of heavy vehicles.

Holes that are dug in the earth for construction of well cellars affect soils for 16 ft^2 of ground (0.006 acres). Soil loss and thermokarsting would likely occur. For the projected 8 to 40 exploration and delineation wells from the first lease sale, this could result in the destruction of up to 1 acre of soil.

Development normally entails a long-term commitment of resources. Sacrificing soils usually is part of development. Soils are destroyed through burial or truncation. Embankments such as work pads, camp pads, roads, and pump stations made from sand, gravel, or rock fragments completely cover the natural soils. Working material sites, conventional pipeline construction, digging, scraping, and excavating destroy the pedogenic horizons. Off-pad traffic (including foot traffic) and other surface-disturbing activities damage the vegetative cover and surface organic mat. The exposed mineral portion of the soils may erode. These activities also alter the thermal balance, and the risk of thermokarsting increases. Thermokarsts, gullies, and sediment impact other resources and land uses. Examples are difficult surface travel and access across gullies and thermokarsts. The amount of soil erosion increases with the amount of surface disturbance. The most effective mitigation is to keep the areas of surface disturbance (i.e., alteration of the vegetative cover or damage to the surface organic mat) as small as possible using design approaches to minimize the effect to the surrounding area. The amount of soil loss, based on the estimated areal extent of vegetation destruction, should be similar to that discussed under Vegetation Sec.IV.C.7.

Aspects of development that could impact soils (just as they might impact vegetation) include construction of gravel pads, roads and airstrips; potential construction of a pump station within the Planning Area; excavation of material sites; and construction of pipelines.

(a) Gravel Pads, Roads, and Airstrips

It is assumed that the gravel footprint for the average, mid-sized oil field development in the Planning Area would cover a total of 100 acres of a combination of pads, roads, and airstrips. Under Alternative A, up to 5 fields would be developed following the first lease sale (Table IV-04). This would result in an impact on up to 500 acres of soils.

(b) Material Sites

Excavations of material sites for gravel fill would destroy soils over the area of the excavation and probably affect soils near stockpiled overburden. Following the assumptions made for vegetation, it is assumed that there would be one material site within the NPR-A for each oil/gas development, each with a surface disturbance of 20 to 50 acres (average 35 acres). Under Alternative A, this would result in the destruction of up to 175 acres of soils.

(c) Pipelines

Areas of disturbance to soils would be similar to the areas of disturbance described under Vegetation (Sec. IV.C.7). The area disturbed by the drilling of holes for vertical support members (VSM's) for pipelines and the deposition of the resulting spoil would amount to 0.03 acres per pipeline mile, or up to 6.8 acres within the Planning Area under Alternative A. Impacts from the remainder of the transport line as it extends east of the Planning Area are evaluated under the cumulative case.

Additional pipelines that could be placed on the original VSM assembly would not increase the amount of soil disturbance. Buried pipelines--a common construction method for gas pipelines--would cause a dramatic shift for disturbed soils. As described under vegetation, the result would be an impact area of up to 45 acres along the assumed 25-mi route within the Planning Area. Soils thus disturbed in the northern third of the Planning Area are more likely to experience thermal degradation as a result. In this case, the soils might not be lost completely, but soil horizons as well as the thermal regime would be completely confused. Melting of ice in the soils would result and the filled area, normally mounded immediately after fill, would level over time as melt water migrates. Ponding could occur.

(2) Effects of Spills

Oil spills may impact soils as the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled and minimize surface disturbance. The area affected is limited to that area immediately adjacent to and covered by the spill

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROP's under the No Action Alternative, in addition to those in the following discussion, would be effective in minimizing impacts on soils. ROP E-3 would control the permanent crossings of rivers (development only). This ROP would reduce the level of soil erosion along riverbanks. ROP E-7 controls the reclamation of mine sites and requires a project plan. Project planning provides the opportunity for design elements that may reduce erosion. Emphasis in all activities would be on maintaining the thermal properties of the existing vegetation and surface organic mat or substituting other thermal insulation.

d. Conclusion--First Sale

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to vegetation from activities other than oil exploration and development under Alternative A would be minor to negligible (see Section IV.C.7) and unlikely to cause loss of soils. Any impacts to soils would be expected to be negligible.

Winter exploration operations resulting from the first sale would be unlikely to cause loss of soils. Well drilling would result in up to 1 acre of soils lost or disturbed from well cellars. Any impacts to soils would be expected to be minor to negligible.

Development resulting from the first sale would cause loss or disturbance to soils through the construction of gravel pads, roads, and airstrips for each oil/gas development; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the loss or disturbance of up to 700 acres of soils. The duration of these impacts would be permanent. Oil spills that impact soils would affect an area similar to the area of vegetation affected--up to 5 acres within the Planning Area. Spills would be cleaned up immediately, causing minimal disturbance to soils. The impacts from development activities to soils under Alternative A would be minor to low.

e. Multiple Sales

It is assumed that multiple sales under Alternative A would result in additional exploration activities. The annual level of seismic operations is assumed to stay the same. The total number of exploratory and delineation wells would increase to 24 to 96 wells drilled from ice pads resulting in up to 1 acre of soils lost or disturbed from well collars.

The multiple sales scenario assumes that an additional 0 to 5 fields would be developed for a total of 0 to 10 fields (Table IV-06). Lost or disturbed soil follows direct impacts to vegetation. Similar to the area of vegetation loss, soil loss or disturbance would also be up to 1,530 acres. Soil loss or disturbance from material sites would increase to up to 350 acres. A projected 295 mi of VSM-supported pipelines would result in up to 9 acres of lost or disturbed soils. A buried pipeline might result in 90 acres of lost or disturbed soils. The incidences of spills would double, raising the total acres affected to up to 10.

f. Conclusion--Multiple Sales

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Under Alternative A, a range of area activities based on the price of oil and the probabilities of exploration and development is assumed. Although little impact to soils is expected from exploration activities, the impacts to soils from development activity under Alternative A would involve either disturbance or loss of relatively small- to moderate-sized areas. The duration of these impacts may range from several years if the vegetation is disturbed to several decades if the soils are destroyed. The overall impact to soils of the Northwest NPR-A

Planning Area would be negligible (with seismic) to moderate (with development).

2. Paleontological Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative A, the types of non-oil and -gas activities would be the same as they are in the No Action Alternative; however, the level of seismic surveying activity and duration could increase by as much as a factor of 3. Despite this increase in activity, the impact on paleontological resources, which are buried relatively deep, would still be minimal.

b. Effects of Oil and Gas Activities

Under Alternative A, the level of seismic activity is expected to increase beyond that of the No Action Alternative because oil and gas exploration would be allowed in all areas of the Northwest NPR-A Planning Area. While the types of impacts to paleontological resources would remain the same, the increased level of seismic activity increases the possibility that impacts could occur. Even with the increased activity level, in most instances (as described in the No Action Alternative), any impacts that do occur are expected to be minimal and not significant.

Because paleontological resources are not ubiquitous in the Planning Area as are habitat and wildlife, it is quite possible that oil and gas exploration or development activities would have no impact on paleontological resources, simply because the oil and gas activities occur where paleontological resources are not present.

(1) Effects of Disturbances

Because most activity would occur during the winter months, the potential for impact to buried paleontological resources remains relatively low. The likelihood of impacting surface paleontological materials is also low because of their isolated and rare occurrence

The drilling of as many as 16 exploration wells and 24 delineation wells could occur under Alternative A. However, because of the limited availability of drill rigs, no more than a few wells are expected to be drilled at one time. If the maximum case of 40 exploration and delineation wells were to occur, the drilling activity would certainly be carried out over the span of several winter seasons and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no gravel or rock needed, no significant disturbance of the ground would occur and buried paleontological resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of the actual drilling would be the creation of the drill hole itself. It is possible that drilling the borehole could impact important accessible paleontological material, but the likelihood of that occurrence is minuscule.

The effects of disturbance from development--i.e., the construction of as many as 8 production pads (connected by roads), one airstrip, one pump station, two staging bases and approximately 230 mi of mainline and gathering pipeline (most of which would be in Northeast NPR-A or on State lands east of NPR-A)--could occur under Alternative A. Surface disturbance resulting from this work would impact approximately 250 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to paleontological resources would result from the excavation of material for construction of the permanent facilities. If the source of materials for the pads, roads, and airstrip is terrestrial, then extraction of material could impact paleontological resources. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of VSM's. Depending on the depth at which the VSM's are set, it is possible--though highly unlikely--that paleontological resources would be impacted. If buried pipelines were to be used, disturbance and impacts to paleontological resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline.

(2) Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than in a summertime terrestrial spill. In any case, paleontological resources usually are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they could occur during the snow-free months. Although cleanup from these spills might be more invasive because of the non-frozen surface environment, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological remains could be impacted in the same manner as surface cultural material. However, since the occurrence of significant surface paleontological remains is rare, the probability of any impact is remote.

c. Effectiveness of Stipulations and Required Operating Procedures

There are no stipulations or ROP's that directly address the protection of paleontological resources. However, stipulation C-1b and ROP C-1e would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface. In addition, stipulations A-1, A-2, and A-3 and ROP's A-6 and E-1 would help to prevent large fuel or crude oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. The National Historic Preservation Act (NHPA) requires that an archaeological/paleontological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities such as the construction of buried pipelines are considered undertakings. If paleontological resources are identified during the survey, Federal law requires that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

d. Conclusion--First Sale

Under Alternative A, impacts to paleontological resources would be minimal. The greatest potential impact would be from mineral extraction and buried gas pipeline. Mineral material sites could impact any paleontological resources that exist in an estimated 175 acres, and buried pipelines could impact any paleontological resource located along the pipeline route. However, measures are in place to ensure effective mitigation of any potential impact that might result from mineral extraction or pipeline construction.

e. Multiple Sales

Under Alternative A, potential impacts could increase by a factor of two, depending on a suite of variables, including infrastructure. The scattered nature of paleontological deposits and the fact that the locations of most remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

f. Conclusion--Multiple Sales

Under Alternative A, potential impacts to paleontological resources could increase by a factor of two over that of the first sale, depending upon a suite of variables, including infrastructure.

3. Water Resources

a. Effects of Non-Oil and Gas Activities

Non-oil and gas management actions within the Planning Area that may affect water resources under Alternative A would be similar to those in the No Action Alternative, except that the number and frequency of camps and moves would increase somewhat. The amount of increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative A provides the fewest restrictions on oil and gas leasing, all of the areas adjacent to streams and lakes identified as critical aquatic habitat would be open to surface activities. Therefore, many of the additional camps and moves likely would be near these critical aquatic habitat areas.

Because the surface-disturbing activities (defined by events of such magnitude, extent, and duration as to create the effects discussed in this section) are not expected, no significant long-term effect on water resources is expected. However, there may be some sites that require remediation (from earlier exploration or military activities); these sites are identified in the discussion on hazardous materials (Section III.A.1.f).

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Under Alternative A, seismic activities probably would increase relative to that expected under the No Action Alternative (Sec. IV.A.1.b), but these activities still would occur seasonally at transitory locations when snow is sufficient to cover the tundra and lakes and rivers are frozen. As noted under the No Action Alternative, significant thermokarst erosion of damaged winter seismic trails made under current practices has not been observed, but such erosion is possible if less than ideal snow conditions occur, particularly because snow cover is so strongly influenced by wind scour and drift that may expose areas of tundra to surface disturbance (Walker et al., 1987). Observations by BLM and others (National Research Council, 2003) indicate that short-term impacts--such as diversions of shallow water tracks and limited ponding--are estimated at about 1 percent of the proposed seismic lines (Sec. IV.A.1.b); newer, low-ground-pressure equipment could reduce this significantly, to about 10 acres. Long-term impacts due to thermokarst erosion, such as diversions of shallow water tracks and limited ponding, are estimated at about a tenth of an acre. Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987).

Because the projected exploratory drilling occurs in the winter, the principal effects on water resources would be the construction of ice roads and pads. Construction of ice roads allows winter overland transport of the equipment and material used in exploration and delineation well drilling. Ice pads are constructed to support drill rigs and staging activities. While this is preferable to summer surface activities, the ice roads and pads require large quantities of water to be available--an estimated 1.0 to 1.5 million gallons per mile of road, and 2 million gallons per pad. Water supply for drilling as well as for camp use also would be significant--up to 1.6 million gallons per site (Sec. IV.A.1.b). The estimated total winter water pumpage for the levels of activities (Sec. IV.A.1.b) under Alternative A could be up to 424 million gallons, or the equivalent of 1,300 acre/ft. While there are a multitude of lakes on the coastal plain of the Planning Area, many of these lakes are shallow and most either freeze solid or have very limited free water during the winter when exploration takes place (Sloan, 1987). Based on remote sensing (Mellor, 1987) and other surveys, a typical large tundra lake (about a mile or more in length and 8 to 10 ft deep) used as a winter water source could have from less than 10 acre/ft to more than 100 acre/ft of water available for pumping. This estimate assumes the Alaska Department of Natural Resources (ADNR) drawdown limitation of 15 percent of the under-ice water volume, although under Alternative A, this is not a requirement. While water withdrawal from riverine pools is generally not permitted by the Alaska Department of Fish and Game (ADF&G), it is not prohibited under Alternative A. Given that the seasonal fluctuation of water depth in rivers is much greater than that of lakes, and that the variability of over-wintering fish population is also greater in rivers than it is in lakes, it would seem to be significantly harder to determine safe amounts of water removal from isolated deep pools within the largely frozen (up to 95%) rivers. Depending on the areas leased and number of exploratory wells drilled, annual water usage for exploration under Alternative A could require pumping water from as few as 13 to as many as 130 or more lakes during a winter's exploration season. If more than 15 percent of the under-ice water volume is removed, as is allowed under Alternative A, then fewer lakes would be required, but less of the critical over-wintering habitat would remain in the pumped lakes.

Removal or compaction of snow cover can increase the depth of freezing (often a foot or more) greatly reducing the water quantity within a lake or river pool. Since the ice thickness may approach 7 ft on undisturbed lakes, significant amounts of additional water would be lost as the ice thickness increases from snow compaction or clearing. Altering travel to avoid crossing or clearing deep lakes and augmenting snow cover by using snow fences would reduce ice buildup on lakes and rivers, and melted snow could be used in camps and for drilling. Use of aggregate ice chips created from crushed lake ice could reduce water usage on ice roads but would greatly increase the depth of freezing in the lakes used in this process. Shallow lakes and ponds that normally would freeze to the bottom are the best source for this ice aggregate. Taking aggregate from the frozen areas of deep lakes would increase the ice thickness of the unfrozen area and could eliminate marginal aquatic habitat.

After each season of use, ice roads are abandoned and allowed to melt when spring snowmelt begins. Ice ramps or bridges that cross streams or lakes should be removed or breached before spring breakup. While some ponding might occur during a rapid onset of snowmelt, melt-water channels--similar to the melt-water channels that cut through naturally occurring river aufeis (overflow icing)--would develop in the ice-road surface and rapidly drain the impounded water (Sloan et al., 1975). If the location of ice roads is offset from year to year, the effects of these short-term impoundments should be negligible. Ice roads and pads created to last several years have a greater impact on the underlying tundra mat, compacting and killing larger areas of vegetation (Walker, 1996). Because this could cause more thermokarst and subsequent drainage alteration, multiple-year ice roads should be avoided. Multiple-year ice pads show fewer impacts, since their limited size results in less disruption of flow and subsequent ponding, so effects are usually limited to some vegetative impacts around the margins. These effects are discussed further in the vegetation section.

Overland ice road construction becomes impractical over 50 mi. Due to the relatively short length of the winter season for construction and drilling, overland moves using low-ground-pressure vehicles and trailers (Rolligons) can be used to haul drilling rigs to ice pads without an ice road. In some cases, where distances are too great for drilling to be completed in one season, the ice pad is insulated and the drill rig stored over the summer. In these cases, the amount of water required is greatly reduced. However, hauling heavy loads on snow roads may adversely impact the tundra and stream and lake crossings.

The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells. Cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations. Use of mud pits may be allowed by the AO. If mud and cuttings are stored on the surface, sediments and other contaminants could be flushed into the watershed. Requiring that wastes be stored in lined and bermed areas and disposed of before spring breakup, however, would reduce the potential for this.

The projected oil and gas development activities would involve constructing ice roads to haul equipment and gravel for the construction of production pads, connecting roads, and landing strips. The potential impacts of oil and gas development on the water resources in the Planning Area may include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

(a) Thermokarst

Thermokarst refers to ground subsidence that occurs when the removal of surface cover exposes ice-rich permafrost to a higher temperature regime and subsequent melting. Stream banks and lakeshores are particularly vulnerable to thermokarst, because the wave action of the water would accelerate the removal of the degrading protective cover. Fine-grained sediments are the most likely to contain ice-rich permafrost, resulting not only in extensive thermokarst but also in increased sediment erosion and changes to stream channel and bed morphology. With the exception of the Colville River, most of the streams and lakes in the Planning Area have banks or shorelines that consist largely of fine-grained sediments.

(b) Drainage Disruption

Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation as well as potential thermokarst. Proper siting and adequate design capacity of culverts, bridges, pipelines, and other structures would minimize drainage problems.

(c) Erosion and Sedimentation

In addition to thermokarst and drainage alteration, erosion and sedimentation can be caused by construction or other activities that disturb the streambed or stream banks, or that remove protective shoreline vegetation. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposit, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Winter or low-water construction and transport activities and adequate armoring of fill would minimize erosion and sedimentation problems.

(d) Water Removal

Consumptive water use in the summer is seldom a problem on the coastal plain, as water generally is abundant. Exceptions would be in smaller coastal streams or most foothills streams during late summer, when shallow pools might be pumped dry. In the winter, however, all but the largest lakes and riverine pools are subject to dewatering if consumptive use is high. Depending on the areas leased and number of development wells drilled, annual water usage for development activities under Alternative A would vary considerably. Because of the continued need for ice roads, annual water use during development could be similar to that for exploration, requiring water from at least 13 and up to 130 or more lakes, assuming the ADNR drawdown limit of 15 percent of the under-ice water depth. If more than 15 percent is removed--as allowed under Alternative A--then fewer lakes would be required, but less of the critical over-wintering habitat would remain in the pumped lakes or rivers. Removal or compaction of snow cover also can increase the depth of freezing, greatly reducing the water quantity within a lake or pool. Augmenting snow cover by using snow fences not only would reduce ice buildup on lakes and rivers, but melting snow also could be used as a supplemental water source for camps and drilling.

(e) Gravel Removal

While some of the gravel used for the construction of permanent facilities may be obtained from permitted sites outside the Planning Area, some material sites would be required within the Planning Area. Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. Locating gravel pits far enough away from streams and lakes to avoid breakup or storm flooding would greatly minimize these effects to water resources. While gravel sources are scarce in the Planning Area, sand and silt are more abundant. Composite or "all season" pad designs--using a mixture of gravel, sand, and silt layered with styrofoam and geotextiles--can reduce gravel requirements significantly Sec. IV.A.1.b .

Gravel construction of pads, roads, and an airstrip would cover about a 100-acre footprint per field, or a total of 500 acres following the first lease sale under Alternative A. In the coastal plain of the North Slope where low surface gradients limit flow and permafrost is ubiquitous, gravel pad and road construction can create significant water impoundments and thermokarst erosion equivalent to twice the area directly covered by the gravel, or up to 1,000 acres. It is possible that a dock and staging areas will also be built under Alternative A. This could substantially increase the gravel requirement--depending on the size and number and type of structures required --to 100 acres per site. Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 acres per site, or from 100 to 250 acres total under Alternative A. Unlike the ice roads and pads, gravel structures and pits would create long-term impacts over the life of the field(s).

(f) Pipelines

If oil pipelines result from the development under Alternative A, they could range from 215 to 275 mi in length and affect from 430 to 550 acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during construction. If gas pipelines are also constructed, impacts could double--up to 1,100 acres.

(2) Effects of Spills

Because Alternative A has the largest area made available for leasing and the least restrictive leasing conditions, spills from exploration activities would have the greatest potential for significant impacts of the leasing alternatives considered. The effects of spills on water quality are analyzed in Section IV.C.4 . Under the projected development activities, spills and spill cleanup would involve both crude oil and refined petroleum products, probably from fuel-storage areas or handling operations. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2 . Storage of fuel in lined and bermed areas and the onsite availability of absorbents and removal equipment would help ensure that the size of any area affected by a spill and cleanup efforts is kept to a minimum. Crude-oil spill cleanup associated with production operations and pipelines is possible and could adversely affect streams and lakes. While the petroleum residue from a spill could be flushed from streams within a few years, the impacts to lakes and ponds could persist for decades. Spill cleanup in a watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining, oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects; spill-prevention and response measures are described in Section IV.A.4 .

Spills of chemicals and saline waters would be rapidly diluted in a large lake or river. In small lakes, tundra ponds, and shallow water tracks, the impacts would be greater, with waters remaining toxic to sensitive species for several years. These spills could be pumped out of the water body, if confined, or neutralized and then diluted with uncontaminated freshwater.

c. Effectiveness of Stipulations and Required Operating Procedures

Several stipulations and ROP's would protect water resources under Alternative A. Stipulations A-1 through A-3 would regulate hazardous materials, fuel storage, and fuel handling, which could impact lakes and rivers. ROP's A-1 through A-8 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and cleanup plans. ROP C-1 would regulate overland moves, seismic work, and other heavy equipment travel during the winter when conditions limit impacts to water resources. ROP D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but makes no mention of deep lakes or setbacks. ROP's E-1, E-2, and E-6 would limit facility design and construction impacts near lakes and rivers. Stipulation G-1 would require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Stipulation J-1 would limit development activities that would impact lakes and rivers. While stipulation B-1 would limit water withdrawals to that which "does not endanger resident fish populations," ADNR stipulations limit water withdrawals to 15 per cent of the under-ice water volume. Water withdrawal from riverine pools is not permitted by ADF&G. There would be no restriction on clearing or compaction of snow from fish-bearing lakes or riverine pools, as required by ADF&G. There would be no setbacks or consultation requirements for sensitive areas adjacent to certain rivers and deep lakes. ROP E-7 would require an approved gravel mine site reclamation plan, but there would be no restrictions on the location of gravel pits in rivers and lakes, their respective floodplains or shorelines, or in areas adjacent to critical aquatic habitat. Stipulation E-8 would allow causeways and docks in river mouths and deltas that could create flow diversions and impoundments, especially during spring breakup when ice-jam flooding is common.

d. Conclusion--First Sale

The impacts of activities other than oil and gas exploration and development under Alternative A are expected to be similar to those under the No Action Alternative, i.e., little, if any, impacts would occur. The potential long-term impacts of oil and gas development activities on the water resources in the Planning Area include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. Since roads pose the single most significant impact (from diversion, impoundment, and increased sediment runoff), limiting the length of the roads would bring about the greatest reduction in impacts to the water resources.

The potential short-term impacts from exploration and delineation would be water removal from up to 130 lakes and riverine pools, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 3,000 acres. In some deep lakes, water drawdowns could exceed that required by State regulations and would then impact the biotic environment of those lakes. Long-term impacts from development of gravel roads, pads and pits could impact up to 1,850 acres. Pipelines--both aboveground oil pipelines (not including in-field lines) and gas pipelines--could add up to an additional 1,100 acres of impacted lakes. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative A, because it includes the critical lake and river habitat in the leasing area, would cause the greatest disturbance of all the leasing options.

e. Multiple Sales

While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally (for example, ten times as many wells may not result in ten times as much impact, although impacts would increase). Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. While difficult to quantify, multiple sales could result in short-term impacts, from exploration and delineation, from water removal from up to 260 lakes and riverine pools, and during construction, from increased water impoundments, diversions, thermokarst erosion and sedimentation of over 6,000 ac. Long-term impacts from development of gravel roads, pads and pits could impact over 3,000 acres of water resources from water impoundments, diversions, and thermokarst erosion. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative A, because it includes the critical lake and river habitat in the leasing area, would cause the greatest disturbance of all the leasing options.

Shared use of infrastructure such as airfields, roads, camps, and pipelines, would significantly reduce the size of the impacted areas and adverse effects to the water resources. Since roads pose the single most significant impact--because of the diversions, impoundments, and increased sediments runoff--limiting the length of the roads would bring about the greatest reduction in impacts to the water resources. Where infrastructure is not shared, both long- and short-term impacts, as noted above, and recovery times would increase.

f. Conclusion--Multiple Sales

Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. While shared infrastructure could reduce the adverse effects to water resources of multiple sales, both long and short-term impacts (as noted above) as well as recovery times would increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity.

4. Freshwater Quality

Leases would be offered in all of the Northwest NPR-A, and exploratory operations could occur during the ice-covered or open water season. The stipulations and ROP's would apply to exploration, construction, and discharges; additional restrictions might be applied during the review of any exploration or development plans.

a. Effects of Non-Oil and Gas Activities

As discussed under the No Action Alternative, ground-impacting actions other than seismic operations would not affect water quality.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Exploration activities within the Planning Area that may affect water quality under Alternative A are 2-D and 3-D seismic activity beyond that described under the No Action Alternative, ice-road construction, pad construction, and drilling-fluid storage and disposal. Under this alternative, short-term effects to water quality would impact about 10 acres. Long-term impacts due to thermokarst erosion are estimated at about a tenth of an acre. Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987). Spillage of crude oil or produced waters is attributable predominantly to development activities, so a discussion of spillage is more appropriately deferred to the following analysis of development impacts.

Use of water for ice-road construction could affect water quality in four ways. Because ice roads would be rerouted every year to minimize tundra disturbance, effects on water quality from any of these actions would be short term, lasting generally one season in any area. First, the winter extraction of water or ice from NPR-A waters could change the chemistry of those waters. Ice roads require 1.0 to 1.5 million gallons per mile of road, over tens of miles. Ice-road construction on the North Slope generally starts no sooner than December to ensure that the tundra is solidly frozen to avoid disturbance and because ice building requires consistent, very cold temperatures. By December, shallow ponds and lakes, those less than about 3 ft deep, are frozen solid. Water would have to come from deeper lakes. Lakes (6 ft deep) usually are frozen solid by the end of winter and, therefore, do not contain fish. Thus, ice-road builders could extract the maximum possible from such lakes, with perhaps extraction of most of the approximately 3 ft of water that would be left unfrozen by December in a 6-ft deep lake. Water could be extracted from deeper lakes, but these lakes are likely to contain fish, which would be put at risk from water removal. The amount of water that could be removed from fish-bearing lakes is limited by stipulation.

As surface waters freeze, salts are extruded from the forming ice into the underlying water, increasing salinity. In coastal tundra waters, the alkalinity is associated with the salt content, and increases and decreases in alkalinity parallel those of salinity. Pumping water from a freezing lake would remove the more saline and more alkaline water from under the lake ice. During snowmelt, less saline, less alkaline runoff water would replace the removed waters. In lakes less than 6 ft deep, which freeze to the bottom, the salts normally would be frozen out of the entire water column and extruded into the sediment thaw bulb underlying the lake. These salts are then slowly and partially leached back into the water column the following summer. For such lakes, the early summer condition would be low salinity, low alkalinity water, regardless of whether water was removed for ice-road construction. Based on observed lake pH, these lakes are weakly--but still apparently adequately--buffered against acid snowmelt Sec. III.A.2.b .

In lakes greater than 6 ft deep, the salts and alkalinity extruded from ice formation normally would remain in the never-frozen bottom water. These lakes start the summer with more saline, relatively strongly buffered waters underneath the melting ice. Winter removal of more saline water underneath the ice would result in less saline, less buffered lake waters in early summer following winter water extraction. Thus, following winter extraction of water, their early summer chemistry would be more similar to that of lakes less than 6 ft deep.

A second way that ice-road construction could affect water quality would be road construction over lakes deep enough not to freeze to the bottom. Many of these lakes are just a foot to a few feet deeper than the minimum 6-ft depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5-ppm dissolved oxygen standard needed to protect resident fish (Alaska Department of Environmental Conservation, 1997).

A third way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively saline, more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice before its melting during snowmelt, increasing initial salt content of the meltwater. This effect may be measurable during initial snowmelt, but the effect on water quality should be minimal and local, most likely expressed as a slight buffering of pH during initial snowmelt.

A fourth way that ice-road construction could affect water quality would be through modification of the local hydrology along the ice road. The minimum ice road thickness would be 6 in. Snowdrifts against the low-relief roadbed would extend a few feet beyond the roadbed with average water content of a fraction of an inch. However, the 6-in roadbed would dam waters upslope of the roadway, affect local drainage, and restrict water supply downslope of the roadway. Because snowmelt runoff is in excess of coastal tundra dead-storage capacity (Miller, Prentki, and Barsdate, 1980), the restricted water supply on the downslope side of the ice road should have a very local but otherwise negligible effect.

In Prudhoe Bay, flat, thaw-lake plains have been shown to be the land classification most vulnerable to hydrologic effects of road and pad construction (Walker et al., 1987, 1989; Robertson, 1989). In such terrain and despite drainage culverts, the area affected by impoundments (ponding) and thermokarst along gravel roads and pads was equal to twice the area covered by the pads and roads. Ice roads can persist through a considerable portion of the snowmelt period, for as long as a month. However, their ability to impound upslope waters is negligible and any impoundments only last a few days. Because the 6-inch thickness of ice roads is 4 to 10 percent of the 5- to 13-ft thickness of a gravel road, the impoundments upslope of an ice road should be proportionately less in area than for a gravel road, or < 10 percent of the area covered by the ice road. Ecology of these less-persistent impoundments along ice roads should be a cross between those of wet tundra and ponded tundra, with no effect on water quality.

The thermokarst erosion along roads and pads at Prudhoe Bay was considered by Walker et al. (1987) to be a delayed, synergistic impact that occurred primarily on thaw-lake plains. It did not occur on river floodplains at Prudhoe Bay because of minimal ground ice. Thermokarst erosion was attributed to vegetative disturbance and to thermal effects of road dust, flooding, and flaring operations. Thermokarst effects are likely to be negligible for one-time use winter ice roads because of the lack of vegetative disturbance, the lack of road dust, and minimal upslope impoundment.

Use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice road construction. Effects during exploration on water quality from any of these mechanisms would be short term, lasting generally one season.

Annual ice-pad and ice-road construction could cover about 310 acres during each year of exploration, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice road construction would require winter extraction of water that would affect up to 110 acres of nearby intermediate-depth (6-ft) lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. In the unsuccessful exploration scenario, ice-pad and ice-road construction would occur only in one winter. Temporary upslope impoundment of snowmelt waters could cover another 30 acres for a few days, but without effect on water quality.

The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells, with no impacts to surface water quality. Mud pits and discharge of exploration drilling muds and cuttings would be prohibited. This analysis assumes direct reinjection of drilling fluids. Under this scenario, there likely would be no impact from drilling fluids used in exploration.

Nevertheless, cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations and, in some cases, use of reserve pits may be allowed by the AO. Such establishment of temporary reserve pits could degrade nearby water quality. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least as far as 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft (but not at greater distances) were found in bioassays to be toxic to a sensitive zooplankton species. Spread of contaminants from these reserve pits was due to overflow of the pits during snowmelt, the practice of draining the snowmelt overflow from pits onto the tundra, and to seepage.

Requiring the pits to be lined and bermed would not necessarily protect tundra from this contamination. Berms increase snow drifting, increasing the overflow problem. Historically, because clay is the standard liner for waste pits, the clay in drilling muds has been assumed on its own to be adequate as a pit liner. However, the chemical formulation of drilling muds is designed to keep the drilling mud dispersed, which can eliminate its ability to act as a seal. The potential for impact from pit-stored drilling fluids would be reduced if fluids were properly disposed of before spring breakup.

Development activities within the Planning Area that may affect water quality under Alternative A for the high-resource scenario are ice-road and -pad construction and spills. There would be no impact from drilling fluids used in development. Mud pits and discharge of drilling fluids and produced waters would only be allowed in emergencies. Muds and cuttings would be either disposed of downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters would be reinjected. Some washed cuttings could be used in gravel-road or pad construction. Pipelines carrying crude oil or waterflood would be above ground, and their construction and physical presence would have a negligible affect on water quality.

Because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, with the water being obtained from about 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring at least a surface water source of 12 additional acres. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from about a 5-acre source. Some of this water likely would come from lakes less than 6 ft deep, because shallower lakes freeze solid by late winter. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

Construction of gravel pads and within-field roads with airstrip would cover about a 100-acre footprint for a single field and require a million cubic yards of gravel. The preferred sources for gravel are existing borrow pits on the east side of the Colville River. In recent decades, suction dredges have been used in the NSB to mine sand and gravel from the Colville River Delta at Nuiqsut; the Meade and Kokolik rivers; lakes at Atqasuk and Barrow; and lagoons at Barrow, Wainwright, and Kaktovik (Walker, 1994). Dredged holes took a few too many years to refill. Dredging increased upriver bottom erosion by increasing the steepness of river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Water quality, as evidenced by the healthy fish populations, does not appear to be adversely affected by this dredging activity (Walker, 1994). Because gravel is a scarce commodity, alternative construction technology could be refined to lessen gravel use and associated impacts, but such alternatives are not assumed.

The primary effect on water quality from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion (Walker et al., 1987). Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations, as discussed under the No Action Alternative. The thermokarst erosion is partly because of the thermal effects of dust blown off the gravel onto the tundra. Thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel or over up to 200 acres for the development assumptions made in this alternative. Ecology of impounded waters appears to be similar to that of similarly sized ponds, but impoundments are more ephemeral (Kertell, 1996).

Although downslope drying of tundra because of upslope impoundment is possible, spring snowmelt generally is expected to be in excess of watershed dead storage in coastal tundra and would limit the effect of downslope drying on water quality. Snowdrifts develop on the sides of elevated roads, which also limits downslope drying. In addition, most flowing water makes it across the road through culverts; the road-impounded waters are a small portion of the total flow. Standard North Slope practice in gravel road construction includes culverts to limit disturbance of drainage patterns (Robertson, 1989). In defined drainages, multiple culverts are constructed to accommodate breakup flow as well as summer flow. In flatter tundra, single culverts are spaced at intervals to limit ponding of sheet flow during breakup. Bridges are the preferred alternative to culverts where stream flow and water depth are sufficient to create ice damming and flow diversions during spring breakup.

(2) Effects of Spills

Spills are another impacting agent on water quality. A number of small crude spills (0 to 130) averaging 3 bbl and smaller fuel spills (0 to 323) averaging 0.7 bbl are projected to occur onshore (See Table IV-17). Roughly 75 percent of crude spills and likely all fuel spills would occur on pads or roadbeds off the tundra surface. Spill response would remove almost 100 percent of a spill from frozen tundra prior to snowmelt for two-thirds of the year. During one-third of the year--late May through late September--spills could reach and impact tundra waters before oil-spill response is initiated or completed. Thus, at most, about 8 percent of crude spills could be reasonably anticipated to reach tundra waters. This calculation results in an estimate of up to ten spills, averaging 3 bbl, reaching tundra waters.

Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer. In one NPR-A experiment (Sec. IV.A.1.b(2) of the *Northeast NPR-A Final IAP/EIS,* BLM, 1996), 5 bbl of Prudhoe Bay crude were spilled into a 0.07-acre tundra pond. Dissolved-oxygen concentrations a week after the spill were reduced by about 4 mg/l below levels in a control pond, in some measurements to less than the 5 mg/l state standard for protection of wildlife. In 2 inches of water underneath the spill, oxygen concentrations were measured at 0.7 to 0.9 mg/l versus 5 mg/l in the control pond. At the 3-inch water depth, oxygen concentrations under the slick increased to 3.9 to 6.9 mg/l versus 8.2 to 10.7 mg/l in the control pond. At the 4-inch water depth (average pond depth, Miller, Prentki, and Barsdate, 1980), outside the slick, oxygen concentration was within the expected normal range, 10.8 mg/l versus 11.4 mg/l in the control pond. The oxygen deficit under the slick (and also in shallower waters of the control pond) was attributable to decreased oxygen influx from the air and the relatively high rate of (natural) sediment respiration in coastal tundra ponds, not to oil-enhanced respiration in the pond.

In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters because sediment (and water column) respiration rates are negligible. In addition, sediment respiration has even less relative effect in the thicker water column of lakes deep enough not to freeze solid in winter. Such lakes, even those that hold fish, tend to be supersaturated with dissolved oxygen in winter, to levels above the state water-quality standard of 110 percent saturation (Sec. III.A.2.b of the *Northeast NRP-A Final IAP/EIS*; USDOI, BLM and MMS, 1998). An exception might be if a spill occurred underneath thick ice cover in very restricted waters holding a concentrated population of overwintering fish that already has depleted oxygen levels. Occasional low oxygen concentrations and kills of overwintering fish have been observed in North Slope waters in the past.

However, the primary effect of a small spill on tundra water quality would be from direct toxicity rather than from oxygen depletion or other secondary effects. Long-term toxicity (7 years) can result from a small spill, as shown in the NPR-A experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

In a real spill, response likely would recover the bulk of spilled oil, but sufficient oil could remain to promote long-term, local toxicity. Over the life of a field, spills could affect the water quality of about six ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

In *Northeast NPR-A IAP/EIS* (USDOI, BLM and MMS, 1998), the effects of a 325-bbl spill reaching the Colville River and Teshekpuk Lake in summer were analyzed and the effects are hereby incorporated by reference. In the Colville River, the high rate of water flow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment. Similar effects would be expected in the unlikely event that an oil spill were to reach any of the rivers included in this assessment.

As noted in *Northeast NPR-A IAP/EIS* (USDOI, BLM and MMS, 1998), a similar oil spill reaching Teshekpuk Lake also would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of the slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected for any of the lakes in the Planning Area, if an oil spill were to occur.

Applicable ambient-water-quality standards for marine waters of the State of Alaska are (1) total aqueous hydrocarbons in the water column may not exceed 15 µg/l (0.015 ppm); (2) total aromatic hydrocarbons in the water column may not exceed 10 µg/l (0.010 ppm) and (3) surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. The State of Alaska criterion of a maximum of 0.015 ppm of total aqueous hydrocarbons in marine waters--about 15-fold background concentrations--provides the readiest comparison and is used in this discussion of water quality. This analysis considers 0.015 ppm to be a chronic criterion and 1.5 ppm, a 100-fold higher level, to be an acute criterion.

Major crude oil spills generally result in peak dissolved-hydrocarbon concentrations that are locally and marginally at toxic levels. Effects of spills < 1,000 bbl can be considered negligible. A spill ($\geq$ 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area of a few hundreds of square miles. Concentrations above the 1.5-ppm acute criterion could occur over a few tens of square miles during the first several days of such a spill.

A saltwater spill, although unlikely, can be hypothesized. Such a spill would greatly exceed State water-quality standards (Alaska, Department of Environmental Conservation, 1997), which prohibit:

- total dissolved solids or salinity from exceeding 1,500 mg/l (1.5 %0 salinity), including natural conditions;

- increases in salinity exceeding one third of the concentration of the natural condition of the waterbody.

In a year with high rainfall, some of the salt would be diluted and flushed from the tundra in summer. Some of the salt water would settle into the deepest reaches of the contaminated waters. The freeze/thaw cycle in the Arctic and the depth of any lake reached by the spill would play a controlling role in the fate of the remaining contaminating salts from a spill.

In winter, surface waters < 6 ft deep freeze solid (Hobbie, 1984). In a saltwater spill into such waters, the remaining salt from the spill water would be extruded from downward-freezing ice in fall and be forced into the underlying sediment (Prentki et al., 1980). Most of the salt would remain trapped in the sediment after the next spring's meltout, giving these waters an initial low salinity. During the summer, salinity slowly would increase as ice in the bottom sediment melts and the sediments compress (Miller, Prentki, and Barsdate, 1980).

In waters > 6 ft, freezing of ice would force salt from a spill into the deeper water below the ice, increasing salinity of that water proportionately. During snowmelt, the lakes form moats--a ring of water at the shoreline. For deeper lakes, the winter ice cover persists through spring snowmelt and would protect the more saline water below the winter-formed pycnocline (the plane separating two layers of different density). Snowmelt waters flow just below the ice (O'Brien et al., 1995) or along the moated margins of the lakes, but above the pycnocline. These snowmelt waters pass through and exit over flooded tundra in sheet flow or through shallow outlets without contributing to or diluting concentrations of dissolved solids in the lake. Only after peak snowmelt and waterflow does the protective ice cover of deeper lakes melt and allow the wind to mix the water column, destroying the pycnocline. The net result of this flow regime in deeper lakes would act to preserve the contaminating salts from removal or dilution from snowmelt waters. Salinity above State standards could persist for several years.

A waterflood pipeline could flow at 2.4 to 8.3 million gallons per day of Beaufort Sea water, equivalent to production rate from a single field (see Sec. IV.A.1.b and Table IV.A.1.b-3 of the Northeast NPR-A Final IAP/EIS; USDOI, BLM and MMS, 1998). If a spill were to result from catastrophic failure of the pipeline, it quickly would be noticed by instrumentation and flow stopped, with perhaps spillage equivalent to an hour's flow. Alternatively, spillage up to 10 percent of throughput from a smaller leak might not be detected from input/output balances for about a day. This less-than-catastrophic spill would spill greater volume, from 240,000 to 830,000 gal. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches (Miller, Prentki, and Barsdate, 1980), which would retain 13,000 to 63,000 gal/acre. Thus, the spill would spread over 4 to 64 acres.

Storm surges along the NPR-A coast have flooded nearshore coastal tundra in the past, resulting in salt contamination of much greater magnitude than hypothesized here. The lake used as a supply of freshwater at the Naval Arctic Research Laboratory in Barrow was flooded in a fall storm surge in the early 1960's. The laboratory pumped some saline bottomwater out of the lake over the next few years, but a more saline taste and off-flavors affected the potability for several years. However, the water was still used for water supply.

(3) Summary

Primary affecting factors under Alternative A are water extraction, water impoundment, thermokarst around structures and roads, and spillage of oil and salt water.

During exploration, annual ice-pad and -road construction (310-acre footprint each year), drilling, and domestic needs for water could require winter extraction of unfrozen water from about up to 110 acres of nearby lakes. Most of this water use is for ice roads. If exploration continues >1 year, the areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

If development occurs (the high-resource scenario), because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, requiring water from 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring water from 12 additional acres of lake. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from about 5 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion up to 200 acres for development. Unlike the situation for ice structures, the same 200 acres would be affected each year over the life of the field.

Over the life of a field, spills could degrade water quality of about six ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of nearby rivers, such as the Colville or Ikpikpuk Rivers. The spreading of a similar-sized (325 bbl) spill over about 60 acres of nearby lakes for a few weeks could be considered an effect on water quality.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROP's that limit the volume of water that can be taken or that prevent crude oil or fuel spills from entering the water (lakes, ponds, streams, or rivers) would lower the potential effect on water quality.

Stipulation A-1 would be effective in establishing the quick response to any potential crude oil and fuel oil spill. Stipulation A-2 and A-3 and ROP's A-3, A-4, E-1, E-6, and E-7 would help prevent oil spills from reaching freshwater streams and lakes and would help prevent freshwater degradation.

d. Conclusion--First Sale

Long-term (decade-or-more) effects would occur over a few hundred acres. Oil spills could result in waters of about 6 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded from an oil spill over the course of a few weeks along a short stretch of nearby rivers and lakes.

e. Multiple Sales

Effects of seismic trails would be similar to those for one sale, over about an acre. During peak exploration, annual ice-pad and ice-road construction could cover about 370 acres, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice-road construction would require winter extraction of water from up to 130 acres of nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 to 4 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice road construction would be similar to that for exploration, requiring water from 130 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or 200 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields. Over the life of development resulting from multiple sales, spills could degrade water quality of about eight ponds or small lakes, resulting in persistent toxicity and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of nearby rivers and lakes. Multiple sales would not result in additional waterflood pipelines and the effect of a waterflood spill would be the same as for one sale.

f. Conclusion--Multiple Sales

Long-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about 8 ponds or small lakes remaining toxic to sensitive species for about 7 years.

5. Estuarine Water Quality

Under Alternative A, leases would be offered throughout the Northwest NPR-A Planning Area, including the coastal waters in Kasegaluk Lagoon northeast of Icy Cape, the Kuk River, Elson Lagoon, Dease Inlet, and Admiralty Bay. Exploratory operations could occur during the ice-covered or open water seasons. A standard set of stipulations and ROP's would apply to exploration, construction, and discharges; and additional restrictions might be applied during the review of any exploration or development plans.

a. Effects of Non-Oil and Gas Activities

As described for the No Action Alternative, non-oil and gas activities would include ongoing subsistence and recreational activities, onshore oil and gas exploration in the Northeast NPR-A and, as discussed in the cumulative effects section, shipping, and offshore oil and gas leasing on the adjacent State and Federal portions of the Beaufort Sea. Previous NPR-A leasing was for an area without coastal villages; in contrast, the Northwest NPR-A Planning Area includes two such villages--Barrow near Elson Lagoon and Wainwright near the Kuk River. Subsistence activities and wastewater handling near these coastal villages could affect the estuarine water quality. To date, the adverse effect of these activities on estuarine water quality appears to have been negligible.

b. Effects of Oil and Gas Activities

Estuarine water quality might be affected by several aspects of oil and gas activities: permitted discharges, permitted construction and disturbance, transportation, and accidental oil spills. The following two paragraphs explain why this assessment is focused on the probable barging of heavy equipment through estuaries like Admiralty Bay, the probable construction of a gravel dock for staging onshore equipment, the possible drilling of a few exploration wells from temporary ice islands, and the possible construction of a few gravel pads for drilling many production and service wells from onshore to offshore.

Part of the reason for the focus on the Admiralty Bay region is the information on Map 9, showing the tracts leased in the Northeast NPR-A. They form a NW/SE-oriented band of high geological potential. If this trend extends into the Northwest NPR-A, it would be located near Admiralty Bay and somewhat south and east of other NPR-A bays and lagoons. Even if there were no leasing in Admiralty Bay, it could be used as a staging area for the barging of heavy equipment to support nearby onshore operations (Sec. IV.A.b(4)(b)).

The amount of offshore transportation and drilling can be estimated with the information in Table IV-05. The estimated number of exploration wells for Alternative A, which includes the onshore and offshore portions of the Planning Area, would be 6 to 16, depending on the price of oil ($18/bbl to $30/bbl; 2002$). Similarly, the estimated number for Alternative C, which excludes the offshore area and adds several restrictions to onshore drilling, would be 3 to 8 exploration wells. The difference between the two alternatives (a few exploration wells) would be a combination of the offshore wells and the onshore wells that wouldn't be drilled because of additional restrictions. A similar process can be used to estimate that some production pads wouldn't be constructed and many production/service wells wouldn't be drilled if all of the offshore areas were eliminated and restrictions were added to onshore activities. To summarize, the assessment is focused on the area around Admiralty Bay, the possible drilling of a few exploration wells from temporary ice islands, the probable construction of some permanent gravel pads for transportation and production, and the possible drilling from onshore to offshore of many production and service wells.

(1) Effects of Disturbances

Drilling discharges would be prohibited or regulated by the EPA. There would be only regulated discharges of domestic wastes, reserve-pit fluids and/or produced waters in waters shallower than 10 m (ROP A-4), and sludge waste would be injected into wells (ROP A-3). The 10-m depth contour is outside of all the NPR-A lagoons and bays, so there would be no unregulated discharges within the lagoons and bays. As a result, there would probably be no unacceptable effects on estuarine water quality due to drilling discharges.

Leasing would probably lead to some onshore operations and the barging of heavy equipment through estuaries such as Admiralty Bay; the barging would lead possibly to construction of a short dock, such as East Dock. Construction of a short dock would probably increase local water turbidity temporarily. Long docks and causeways along the central Beaufort coast, such as West Dock and the Endicott causeway, have had a documented, ongoing effect on surrounding water quality; in contrast, East Dock has not had a documented effect, so a short dock in an NPR-A estuary would probably not affect water quality beyond the initial construction period.

Leasing would possibly lead also to construction of a few offshore artificial production pads that would temporarily increase water turbidity. Many artificial islands have been constructed with gravel and/or gravel bags in shallow bays near Deadhorse, including Sag 3, Niakuk 3 and 4, Resolution, Duck 3, Goose, Endicott, and NW Milne. Construction and abandonment of some of these islands has had a temporary affect on water turbidity but long-term effects have not been documented. The effects would depend partly on the site-specific situation, and the site-specific effects of any exploration and/or development plans would be reviewed further in detail by BLM (Sec. II.E).

(a) Ice Roads and Ice Islands

Leasing would possibly lead to the drilling in an estuary such as Admiralty Bay of a few exploration wells with temporary ice islands and ice roads. Many ice roads and several ice islands have been constructed in the Beaufort Sea. For example, ice roads are constructed each year to the Northstar Development Project and along the coast to the east and west from Prudhoe Bay. They are usually constructed by pumping seawater from below the ice cover up onto the ice surface. Ice islands are usually constructed by spraying seawater onto the ice surface until the thickened ice mound rests on the sea floor. An ice island was constructed at the Mars Prospect near Cape Halkett at the northeast corner of NPR-A (USDOI, MMS, 1985). Another was constructed at the Karluk Prospect in inner Stefansson Sound (USDOI, MMS, 1988). The environmental assessments for these proposals identified two types of effects. One was the possible effect of thickened ice roads and ice islands on seafloor kelp communities in

Stefansson Sound. The proposed ice road to Karluk was rerouted slightly to avoid shading the dense parts of the kelp community. Kelp grows in only one NPR-A coastal bay--Peard Bay (Truett, 1984); if an exploration or development plan for an ice island or ice road is submitted for the bay, the site-specific effects could be assessed at that time (Sec. II.E). The other environmental effect was the possible use of snowmaking additives, such as the additives that are used in snowmaking equipment at ski hills. When the weather turned relatively warm during the construction of the Karluk ice island, the proposal was modified to include the possible use of such an additive. The effect of the additive on seawater water quality and/or organisms was not well known, and the proposal was withdrawn when the weather turned cold so no additional information was collected. Aside from these two types of possible effects, the past ice roads and ice islands have melted soon after the natural ice cover with no reports of environmental effects.

(b) Gravel Islands and Buried Pipelines

Leasing would probably lead to the barging of heavy equipment through an estuary such as Admiralty Bay, the possible construction of a few gravel production pads and buried pipelines, and the possible drilling of many production and service wells. The effects on water quality due to the construction of gravel islands and buried pipelines were assessed recently in the Northstar and Liberty EIS's (U.S. Army Corps of Engineers, 1999; USDOI, MMS, Alaska OCS Region, 2002b). The latter concluded that "the greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column" and that "turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops." There were no reports from Northstar construction that the water-quality effects exceeded the minor expected effects. The water-quality effects of construction in the Northwest NPR-A would probably be similar, partly because the Liberty area, Northstar area, and NPR-A coastal bays and lagoons are similarly turbid, as shown by a satellite image (Map 9). The image includes a black band along the coast where the water is too turbid for accurate readings of phytoplankton chlorophyll. The black band is relatively broad along the Beaufort Sea coast, including the NPR-A waters in Elson Lagoon, Dease Inlet and Admiralty Bay, indicating that the water is relatively turbid. The black band is relatively narrow along the Chukchi Sea coast, including the waters in Peard Bay and Kasegaluk Lagoon, indicating that the water is less turbid. The difference indicates that construction turbidity in Elson Lagoon, Dease Inlet, or Admiralty Bay would have less effect on natural water quality than construction turbidity in Peard Bay or Kasegaluk Lagoon. Another possible effect of gravel-island and buried pipeline construction in Peard Bay would be a slight, temporary reduction in the productivity of the kelp that grows there. A former proposal for the Liberty island and pipeline placed them near the relatively large Stefansson Sound Boulder Patch; the Liberty EIS concluded that "sediment plumes from pipeline and island construction probably would reduce Boulder Patch kelp production by 2-4 percent per year" over three consecutive kelp-growth years (USDOI, MMS, Alaska OCS Region, 2002b:p. 26). In the unlikely event that an exploration or development plan is submitted for a gravel island and/or buried pipeline in Peard Bay, the level of effect on that small kelp patch might be similar in magnitude, but the site-specific effects could be assessed and mitigated at that time (Sec. II.E). In summary, the water-quality effects of gravel-island construction and buried pipeline construction in the Northwest NPR-A would probably be temporary and minor, especially along the Beaufort Sea coast, and site-specific exceptions could be mitigated through subsequent NEPA assessments.

(c) Docks

Leasing would possibly lead to the construction in an estuary such as Admiralty Bay of a short dock for the barging of heavy equipment to nearby onshore exploratory operations. Such a dock would probably have to be a few thousand feet long, extending into about 10 ft (3 m) of water. Furthermore, leasing would possibly lead to a discovery in an NPR-A bay, which would probably be developed from shore with extended reach drilling, or from a gravel island with a buried pipeline to shore. If neither of these plans would work, then development with an elevated pipeline might be proposed with a temporary dock or short causeway that would be removed upon abandonment. An example of such a structure is East Dock in Prudhoe Bay; it is about 1,300 ft (400 m) long, extending into 4 ft (1.2 m) of water. Since its construction over 30 years ago, there have been no reports of adverse water-quality effects (e.g., circulation changes or temperature and salinity discontinuities). Most likely, a dock or short causeway in an NPR-A bay would not have measurable adverse effects on water quality. In contrast to docks or short causeways in bays, the West Dock and Endicott Causeway extend more than 2 mi (3 km) into offshore water. These long offshore causeways had relatively short breeches and affected the local water quality, creating cross-causeway differences in hydrologic conditions (e.g., water temperature and salinity) (USDOI, MMS, 1990). Enlarged breeches in West Dock have alleviated most of the cross-causeway differences but enlarged breeches in the Endicott causeway have not alleviated the differences (Fechhelm et al., 2001). The water-quality discontinuities have affected the nearshore distribution of anadromous fish, as discussed in USDOI, MMS (1990) and in this EIS Section IV.C.8.b on marine fish. In summary, a short dock or causeway in an NPR-A estuary would probably not affect hydrologic conditions, but long, permanent causeways with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions. However, ROP E-6 explains that permanent facilities in estuaries would be approved only if the applicant can demonstrate that adverse impacts to hydrologic conditions are minimal; ROP K-3 explains that no permanent development facilities would be permitted in water within three-quarters mile of shore in Dease Inlet, Admiralty Bay, and Elson Lagoon; and ROP E-8 requires that coastal facilities must be designed to prevent significant changes to nearshore water-quality characteristics (e.g. salinity and temperature). If a development plan for an unacceptable dock or causeway is submitted, the site-specific effects could be assessed and mitigated probably with breeches at that time.

(2) Effects of Spills

The present quality of the NPR-A coastal waters is pristine--like most of the arctic coast (Arctic Monitoring and Assessment Program, 1997)--in spite of natural oil seeps such as the one at Cape Simpson in the Northeast NPR-A (Sec. III.A.2.b(5) and Becker and Manen [1988]). Spills are very unlikely to occur, but there are several aspects that would add slightly to the risk of spills in estuaries. For example, they might occur as a result of the probable barging of equipment through NPR-A estuaries such as Admiralty Bay, as a result of the possible drilling of a few offshore exploration wells, the possible drilling of many production and service wells, or the possible use of buried pipelines. The likelihood of a future spill that would affect NPR-A estuarine waters would be greatest for small spills (Sec. IV.A.2.b), such as spills during the barging of fuel and supplies through estuaries. Stipulation A-1 would require the development and implementation of spill contingency plans before the transportation of fuel. The stipulation might not reduce the likelihood of accidental fuel spills but would probably improve the response to them. Also, the likelihood of an onshore fuel spill seeping into wetlands and then estuarine water would be reduced by several stipulations. Stipulation A-3 would prohibit lessees from refueling equipment near waterbodies. Stipulation A-2 would require dikes around any fuel storage areas. Stipulation D-1 would prohibit exploratory drilling that might cause more-than-minimal impacts to hydrologic conditions.

In contrast to the likelihood of small spills, the likelihood of a large spill that would affect the estuarine water is extremely low. The risk of such a spill would be due partly to oil leasing on the outer continental shelf. As noted in the EIS for three proposed Beaufort Sea oil and gas lease sales (USDOI, MMS, Alaska OCS Region, 2002c), "a large spill is unlikely to occur based on a mean spill number ranging from 0.08 to 0.11 for Alternative I for MMS Proposed OCS Lease Sales 186, 195, and 202." However, that EIS analyzed a 1,500 bbl spill from a production facility and a 4,600 bbl spill from an offshore pipeline.

This IAP/EIS analysis assumes a spill of 500 or 900 bbl and a very large blowout of 120,000 bbl (Table IV-19 and Tables App 9-10 to App 9-12). If one of these spills were to occur offshore during winter, the oil would probably be deposited on or under the ice cover. If a spill were under the ice, the relatively warm oil would probably rise to the ice cover, melt into the bottom of it, and become immobilized. The water circulation under the ice cover in bays is very sluggish, as described in Section III.A.2.c, so dissolved hydrocarbons would not be distributed far. In any case, on-ice spill responses by Alaska Clean Seas (Alaska Clean Seas, 1999 a, b, and c) are generally effective, so almost all of a small spill could probably be recovered. In contrast to small spills, the effects of and responses to a 500- or 900-bbl spill is discussed below, and the effects of a very large spill are discussed in Section IV.J.

If the spill were to occur during the open-water season, it might form a slick or become dissolved in the water column. If it were to form a slick, the slick from a 500- or 900-bbl spill would probably sweep an estimated 40 to 55 mi² (100 to 140 km² ; Tables App 9-10 and App 9-11). If the spill occurred during the melt-out or broken-ice seasons, the slick might cover 50 to 70 mi² (35 to 180 km²) and deposit oil on 22 mi of coastline (Table App 9-11). The largest estimated area (70 mi²) would be slightly smaller than the area of a typical estuary like Admiralty Bay, and the 22 mi of coastline would equal about half of the total Admiralty Bay coastline. Such an oil slick could measurably degrade NPR-A estuarine water quality and shorelines. As described in Section III.A.2.c above, spilled oil would persist on some types of shoreline for many years, and possibly for more than a decade (www.oilspill.state.ak.us/facts/lingeringoil.html).

If a summer oil spill became dissolved in the water column, the effect can be estimated with calculations in the Liberty EIS (USDOI, MMS, Alaska OCS Region, 2002b). That EIS calculated the effect of similar-sized spills in Foggy Island Bay that is about the same depth as Dease Inlet. It concluded that hydrocarbons dispersed in the water column from a large (greater than or equal to 500 bbl) crude-oil spill could exceed the 1.5-parts per million (ppm) acute (toxic) criterion during the first day in the immediate vicinity of the spill (USDOI, MMS, Alaska OCS Region, 2002b:Sec. III-16.l). Further, the hydrocarbon concentration could exceed the 0.015-ppm chronic criterion for up to 30 days in an area that ranges up to 70 mi² (180 km²). Again, the 70 mi² is slightly smaller than a typical estuary like Admiralty Bay. Spill effects of this magnitude would probably not extend far offshore (e.g., into Elson Lagoon or coastal oceanic waters) because of the deep water depth.

Several types of contingency responses would help to reduce the effect of a large offshore oil spill on estuarine water quality. As noted above, the Alaska Clean Seas (ACS) responses for on-ice spills are relatively effective. Alaska Clean Seas maintains an inventory of response equipment--for spills in open water and on ice and broken ice--including booms, skimmers, igniters, pumps, ditch witches, storage tanks, etc. (Alaska Clean Seas, 1999a, b, and c). Some proposed tactics probably would (while removing oil from the water) have indirect adverse effects on water quality. For example, in situ burning of oil would leave a residue and dispersants would intentionally increase the concentration of oil in the water column. Also, wetlands--and subsequently offshore water quality--might be affected by the decanting of free water from storage tanks, as explained by ACS Tactics D-5, R-15, and R-25. The effect would be mitigated partly by the requirement for explicit approval from the State On-Scene Coordinator for the decanting of such water, as explained by Tactic D-5.

In summary, a very large oil spill would be extremely unlikely; if it occurred during the winter and spread on or in the ice cover, most of it could be recovered. Small spills are more likely to occur, in part because of the probable barging of fuel to coastal staging facilities in estuaries like Admiralty Bay. If a small spill occurred during the open-water or broken-ice seasons in an NPR-A estuary like Admiralty Bay, it could measurably degrade estuarine water quality and contaminate shorelines, in spite of proposed spill responses. The largest estimated area (70 mi²) of a slick would be slightly smaller than the area of a typical estuary like Admiralty Bay, and the 22 mi of contaminated coastline would be about two-thirds of the total Admiralty Bay coastline. Such an oil slick could measurably degrade NPR-A estuarine water quality and shorelines. Hydrocarbons dispersed in the water column from a spill would probably exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of the spill.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulation A-1 would require the development and implementation of spill contingency plans before the transportation of fuel. The stipulation might not reduce the likelihood of accidental fuel spills but would probably improve the responses to them. Also, the likelihood of an onshore fuel spill, that might drain quickly into estuarine waters, would be reduced by two stipulations. Stipulation A-2 would require dikes around any fuel storage areas, and Stipulation A-3 would prohibit lessees from refueling equipment near waterbodies. Furthermore, a third stipulation, D-1, would have an indirect benefit on estuarine waters, reducing the likelihood of spills that might drain into streams and then into estuarine waters. Stipulation D-1 would prohibit exploratory drilling that might cause more-than-minimal impacts to fish and hydrologic conditions.

Stipulation A-1, which would require the implementation of spill contingency plans before the transport of fuel, would be especially effective for leases in and near coastal water. Fuel might be barged during summer to operations on or near navigable waters. Drilling would probably occur only during the solid-ice season when responses to blowouts would be relatively effective. Some operations would occur only during the ice-covered season using ice roads and ice islands, but multi-year operations near navigable waters would possibly use gravel islands, transporting supplies either during winter or during the open-water season with barges. Almost 10,000 bbl of fuel would be needed for drilling throughout an ice-covered season (November to May), so the use of small fuel barges would be cost effective. The USCG or MMS would have responsibility for technical reviews of offshore spill plans; current Federal regulations (30 CFR 254.2(a) and 254.6) do not require approval of the spill plan until the facility is being used (i.e., drilling). However, with Stipulation A-1, BLM could require operators to have an approved plan before BLM approval of the exploration or development plans. Even with approved spill plans, spills could occur but the responses would probably be more effective. Effective response would be beneficial because diesel fuel is relatively toxic and--even though spills in general are very unlikely--fuel spills are a relatively common type of spill. In summary, Stipulation A-1 would help to reduce the effect of fuel spills on NPR-A estuarine water quality

With ROP A-4, there would be only regulated discharges of domestic wastes, reserve-pit fluids and/or produced waters in waters shallower than 10 m, and sludge waste would be injected into wells (ROP A-3). The 10-m isobath is outside of all the NPR-A lagoons and bays, so there would be no unregulated discharges within the lagoons and bays. As a result, there would probably be no unacceptable effects on estuarine water quality due to discharges.

With ROP E-6, permanent facilities in estuaries would be approved only if the applicant can demonstrate that adverse impacts to hydrologic conditions are minimal, and ROP E-8 would require that coastal facilities must be designed to prevent significant changes to nearshore water-quality characteristics (e.g., salinity and temperature). These ROP's would help to avoid the construction of long causeways with inadequate breeches that would probably have measurable, long-term impacts on hydrologic conditions.

d. Conclusion--First Sale

Drilling discharges would be regulated by the EPA; because the 10-m depth contour is outside of all the NPR-A estuaries, there would be no unregulated discharges within the estuaries. Leasing would probably lead to the barging of heavy equipment through estuaries like Admiralty Bay. Construction of a short dock would probably only affect hydrologic conditions temporarily, but long causeways with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions. The likelihood of a spill that would affect NPR-A estuaries would be greatest for small spills, such as fuel spills during the barging of supplies through estuaries. If a small spill occurred during the open water, it might form a slick or become dissolved in the water column. A slick from a 500- or 900-bbl spill would contaminate approximately two-thirds of the coastline in an estuary like Admiralty Bay. Hydrocarbons dispersed in the water column from a small spill would probably exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of the spill. Several types of contingency responses would help to reduce the effect of such a spill on estuarine water quality.

e. Multiple Sales

Although it is not expected that a large amount of new information will become available after the first sale that would alter or refine the assessments, technology continues to improve. By such means, future spill response could become more effective. Also, the technology for extended-reach drilling is improving, making it easier to drill into nearshore prospects from safer, onshore locations. Therefore, the effects of subsequent and/or multiple sales would probably be slightly lower than the first sale.

f. Conclusion--Multiple Sales

The effects of subsequent sales and/or multiple sales on estuarine water quality would probably be slightly lower than for the first sale because of technological developments in extended-reach drilling.

6. Air Quality

This discussion analyzes the potential impacts on air quality that could be caused by the activities and developments induced by each of the sale proposals for the Northwest NPR-A Planning Area. Mitigation of adverse air quality impacts would result from operators' use of the best available technology to control discharges. Disturbances and noise from non-oil and -gas activities do not cause air quality impacts.

a. Effects of Non-Oil and Gas Activities

Impacts to air quality would result primarily from emissions from oil and gas operations. Emissions from non-oil and gas activities are extremely limited; they include insignificant emissions because of the activities related to the very small population and their habitation and transportation activities.

b. Effects of Oil and Gas Activities

Air pollutants discussed include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC). Ozone (O_3) is not emitted directly by any source but is formed in a series of complex photochemical reactions in the atmosphere involving VOC and NOx.

Nitrogen oxides consist of both nitric oxide (NO) and nitrogen dioxide (NO_2). The NO_x is formed from the oxygen and nitrogen in the air during combustion processes, and the rate of the formation increases with combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2. The NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with photochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas having a high concentration of vehicular traffic. High concentrations of carbon monoxide present a serious threat to human health because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur. In the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in acid rain precipitation.

Emissions of particulate matter associated with combustion consist of particles in the size range < 10 microns (µ) in diameter (PM_{10}). Emissions of particulate matter associated with combustion, especially particles in the size range of 1 to 3 µ, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity. There are three principal phases: exploration, development, and production. For a more detailed discussion of emission sources associated with each phase, refer to Air Quality Impact of Proposed OCS Lease Sale No. 95 (Jacobs Engineering Group, Inc., 1989). Information from that report is still relevant even for operations that would occur within the Northwest NPR-A Planning Area. Certain emission sources discussed therein obviously do not apply for operations occurring on land, but the report does include a fairly comprehensive analysis of activities and emission sources that do occur during oil and gas exploration, development, and production, regardless of the specific locations in which they may occur. Significant emission sources are summarized below.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-04). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed, except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for NO_2, SO_2, and PM_{10} to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three PSD classes. Class I allows the least degradation and also restricts degradation of visibility. The entire NPR-A is Class II, which allows a moderate incremental decrease in the air quality of the area. Baseline PSD pollutant concentrations and the portion of the PSD increments already consumed are established for each location by the EPA and the State of Alaska before issuance of air quality permits. Air-quality standards do not directly address other potential effects, such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

Under the State Implementation Plan, the Alaska Department of Environmental Conservation (ADEC) has jurisdiction for regulating and permitting air-quality emissions within the Northwest NPR-A Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including the need to obtain construction and operating permits. Construction air quality permits include prevention of significant deterioration requirements.

(1) Effects of Disturbances

During the exploration phase, emissions would be produced by 1) vehicles used in gathering seismic and other geological and geophysical data; 2) diesel power-generating equipment needed for drilling exploratory and delineation wells; 3) vehicles in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Pollutants generated would primarily consist of NOx (these would consist of NO and NO_2; ambient air standards are set only for NO_2, CO, and SO_2. It is assumed that exploration activity would begin in the year following a sale. Emissions from exploration for the first sale would be from seismic surveys and from drilling 6 to 16 exploration wells and 2 to 24 delineation wells from 1 to 4 rigs.

During the development phase, including temporary construction operations and drilling, the main sources of emission would be the following:

- gas turbines used to provide power for drilling;

- engines for electrical power, including rig generator (during construction phase only; standby only during commissioning);
- heavy construction equipment used to install facility and pipelines (including gravel-hauling dump trucks);
- construction and commissioning support equipment, including cranes, pumps, generators, compressors, pile drivers, welders, heaters, and flare;
- support vehicles; and
- drill-rig-support equipment, including boilers and heaters.

For these operations, the best available control technology would be applied under the EPA air quality regulations. The main emissions would be NOx, with lesser amounts of SO_2, CO, and PM_{10}. Once in the atmosphere, nitric oxide gradually converts to nitrogen dioxide.

For the production phase, the main source of emissions would be from turbines for power generation and gas compression, and from power generation for oil pumping and water injection. The emissions would consist mainly of NO_x, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses of volatile organic compounds (VOC's) from oil/water separators, from pump and compressor seals and valve packing. Using seal systems designed to reduce emissions would minimize these sources. Produced water and slop-oil tanks would be equipped with a vapor-recovery system, which would recover emissions of VOC's from these tanks and return them to the process. Operators would probably have a flare available 24 hours a day, 365 days a year. If there were venting (unexpected), it would emit VOC's. However, flaring would burn up any emissions of VOC's, and they should not create a pollution problem. Flaring would produce some NO_x, SO_2, PM_{10}, and CO. Venting or flaring would probably produce only a very small amount of SO_2, because sulfur in the produced gas should be very low (though never completely absent).

Abandonment of facilities developed after the proposed sales would cause much higher vehicular traffic, and also more heavy equipment operations than during the production phase of operations, but effects probably would be quite similar to the construction portion of the development phase of operations. Because abandonment operations would last perhaps a maximum of 10 to 15 percent of total operations time and would include no activities that should affect air quality more significantly than previously discussed, these operations would cause insignificant effects on air quality.

Other sources of pollutants related to oil and gas operations are accidents such as blowouts and oil spills. Typical emissions from such accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts or oil spills produce other pollutants.

Emissions from development for the first sale under Alternative A would be from the development of a maximum of 4 to 7 fields and the installation of up to 275 mi of pipeline, and the drilling of a maximum of 270 production and service wells. Peak-year production emissions would result from operations producing about 59 million barrels of oil and from transportation of that oil.

Additional information and discussion from the EIS for Sale 144 provide some details relevant to the current analysis. Table IV.B.12-1 of the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement* lists estimated uncontrolled-pollutant emissions for the peak-exploration, peak-development, and peak-production years from that sale proposal. That EIS also has additional relevant discussion, especially in the last paragraph of Section IV.B.12. Modeling discussed there shows that NO_2 had the highest concentration of the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and Federal ambient air quality standards. Information from that Beaufort Sea Sale 144 FEIS is relevant for the Northwest NPR-A IAP/EIS because that Sale 144 included the area immediately offshore from the Northwest [and Northeast] NPR-A and analyzed effects from a scenario including assumed greater oil development than assumed for the Northwest NPR-A. Emissions analyzed for the Beaufort Sea also included some emission sources not applicable to operations on land in the NPR-A. Emissions from expected NPR-A operations would include no significant emission sources not analyzed for the Beaufort Sea. Therefore, effects analyzed and pollutants modeled are greater than what would be expected for the Northwest NPR-A.

Air-quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a "typical" field which might be developed in NPR-A), the highest predicted concentrations for NO_2, SO_2, and PM_{10} occurred just outside the facility boundary and were close to the PSD Class II maximum allowable increments. The highest onshore concentrations would be considerably less due to the dispersion over distance. The combined facility concentrations plus background were well within the ambient air quality standards (between 2 and 30 percent of the standards).

Because Alternative A should have air emissions that are similar to those predicted for Northstar or Liberty, it can be inferred that the expected pollutant contributions would also be well within PSD increments and Federal ambient air-quality standards.

(2) Effects of Spills

(a) Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOC's from offshore facility or pipeline oil spills likely would evaporate almost completely within a few hours after the spill occurred. The article cited discusses the rate of evaporation and ambient concentrations of 15 different VOC compounds. The EPA classifies several of these compounds--such as benzene, ethylbenzene, toluene, and n-xylenes--as hazardous air pollutants. The study results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spill starts and are reduced by two orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are significant in the immediate vicinity of an oil spill, but concentrations are greatly reduced after the first day. In the event of an oil spill on land in the NPR-A, the air-quality effects would be less severe than offshore (because some of the oil could be absorbed by vegetation or into the ground), but some effects might last longer before the VOC compounds were completely dissipated.

Diesel fuel oil could be spilled either while being transported or from accidents involving vehicles or equipment. A diesel spill would evaporate faster than a crude oil spill. Ambient hydrocarbon concentrations would be higher than with a crude oil spill, but would also persist for a shorter time. Also, since any such spill would probably be smaller than potential crude oil spills, any air-quality effects from a diesel spill likely would be even lower than for other spills.

Oil or gas blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of oil spilled into water (see the next paragraph). This type of burning would be less likely in case of oil spilled on land, but the effects on air quality if some of the oil should be burned would be similar. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions of other pollutants. If an oil spill were ignited immediately after spillage, the burn could combust 33 to 67 percent of crude oil or higher amounts of fuel oil (diesel) that otherwise would evaporate. On the other hand, incomplete combustion of oil would inject about 10 percent of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air.

(b) Effects of Oil-Spill Cleanup Activities on Air Quality

In situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily adversely affect air quality, but the effects would be low. For much greater detail, please see the article by M. Fingas et al. (1995). Extensive ambient measurements were performed during two experiments involving the in situ burning of approximately 300 bbl of crude oil at sea. During the burn, carbon monoxide, sulfur dioxide, and nitrogen dioxide were measured only at background levels and were frequently below detection levels. Ambient levels of VOC were high within about 100 m of the fire, but were significantly lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAH's) were found to be low, as it appeared that a major portion of these compounds was consumed in the burn. Effects of in situ burning for spilled diesel fuel would be similar to those associated with a crude oil spill.

An oil spill could be set on fire accidentally or deliberately. Air pollution would be limited because of atmospheric dispersion. Also, large fires create their own local circulating winds--toward the fire at ground level--that affect plume motion. Accidental emissions likely would have a minimal effect on air quality.

If an oil spill were ignited immediately after spillage, the burn could combust 33 to 67 percent of the crude oil or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air (see USDOI, MMS, 1996a:Table IV.B.12-4).

Additional work published in an article by McGrattan et al. (1995) reported that smoke plume models have shown that the surface concentration of particulate matter does not exceed the health criterion of 150 $\mu g/m^3$ beyond about 5 km downwind of an in situ burn. This is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off Newfoundland and in Alaska (McGrattan et al., 1995).

Other air quality effects from cleanup activities would include emissions from vehicles and equipment used in the cleanup effort; these should be very low.

(3) Effects of Accidental Emissions

Sources of air pollutants related to oil and gas operations include accidental emissions resulting from gas or oil blowouts. The number of blowouts on the U.S. outer continental shelf, almost entirely gas and/or water, averaged 3.3 per 1,000 wells drilled from 1956 through 1982 (Fleury, 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Typical emissions from such accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts produce other pollutants, such as nitrogen oxides, carbon monoxide, sulfur dioxide, and particulate matter. Statistical information from outer continental shelf blowouts is relevant for the Northwest NPR-A IAP/EIS only because of possible activity offshore from the Northwest (and Northeast) NPR-A and because it is recent enough statistical information that it may assist readers in becoming aware of how relatively infrequent such blowouts are in recent years. Please see also Section IV.A.2 , Section IV.A.3 , and Section IV.A.4 for a detailed discussion of oil spills. Table IV-19 and Table IV-20 show the estimates for large (greater than or equal to 500 bbl) and small (less than 500 bbl) oil spills for the life of Northwest NPR-A oil and gas activity. Accidental emissions likely would have little effect on air quality.

A gas blowout could release 20 tons per day of gaseous hydrocarbons, of which about 2 tons per day would be nonmethane hydrocarbons classified as volatile organic compounds. The probability of experiencing one or more blowouts in drilling the wells projected for the multiple-sale scenarios is estimated to be low. If a gas blowout did occur, it would be unlikely to persist more than 1 day; and it would very likely release less than 2 tons of volatile organic compounds. Since 1974, 60 percent of the blowouts have lasted less than 1 day; and 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. In addition, in situ burning is a technique for cleanup and disposal of spilled oil in oil-spill contingency plans. For catastrophic oil blowouts, in situ burning may be the most effective technique for spill control. Please see Section IV.C.6.b(2)(b) above for a discussion of in situ burning. While in situ burning would be considered and may be used in appropriate circumstances, the ADEC will require all permit applicants to provide oil spill contingency plans that rely on control, containment, and cleanup of spills as the primary response tool.

Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions--relative to quantities in other oil and gas industrial operations--of other pollutants (See Table IV.B.12-3 in Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement). For a major oil blowout, setting fire to the wellhead could burn 85 percent of the oil, with 5 percent remaining as residue or droplets in the smoke plume in addition to the 10-percent soot injection (Evans et al., 1987). Clouds of black smoke from a burning 360,000-bbl oil spill 75 km off the coast of Africa locally deposited oily residue in a rainfall 50 to 80 km inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that are two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the Trans-Alaska Pipeline, 500 bbl of spilled oil were burned over a 2-hour period, apparently without long-lasting effects (Schulze et al., 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983).

Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Coating portions of the ecosystem in oily residue is the major, but not the only, potential air-quality risk. Recent examination of polycyclic aromatic hydrocarbons (PAH's) in crude oil and smoke from burning crude oil indicates that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which often is used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately three times larger than in the unburned oil. However, the amount of PAH is very small (Evans, 1988). Investigators have found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of greater than 250 $\mu g/m^3$ to be a health hazard forbronchitis.

Because of the dispersal of airborne pollutants by winds, accidental emissions likely would have a minimal effect on air quality.

(4) Other Effects on Air Quality

Other effects of air pollution from oil and gas activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Arctic Slope), or local (near the activity only). Visibility may be defined in terms of visual range and contrast between plume and background (which determines perceptibility of the plume). For their proposed Liberty Project, BPXA had run the VISCREEN model and found noticeable effects on only a very limited number of days, ones that had the most restrictive meteorological conditions. No effects at all were simulated during average conditions. Those results would be expected to be typical of other development projects that could occur after any discoveries following the currently proposed lease sales.

A significant increase in ozone concentrations is not likely to result from exploration, development, or production scenarios associated with the proposal. Photochemical pollutants such as ozone are not emitted directly; they form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the Northwest NPR-A much of each day during the summer, temperatures remain relatively low (Brower et al., 1988). Also, activities occurring as a result of field development are separated from each other, diminishing the combined effects from these activities and greatly increasing atmospheric dispersion of pollutants. At a number of air-monitoring sites in the Prudhoe Bay and Kuparuk areas, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05 to 0.07 ppm, which is well within the existing maximum 1-hour-average ozone standard of 0.12 ppm. The highest 8-hour-average ozone concentration is always somewhat lower than the maximum 1-hour average. Therefore, ozone levels are expected to be within the revised 8-hour average ozone standard of 0.08 ppm. (Note: The 8-hour Federal ozone standard currently is under litigation. The EPA cannot enforce the standard until the legal issues are resolved.) Because the projected ozone precursor emissions from the multiple-sale proposal are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk oil fields, the proposal should not cause any ozone concentrations to exceed the 8-hour Federal standard.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that sulfur dioxide concentrations as low as 12.0 micrograms per cubic meter ($\mu g/m^3$) for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. In addition, the sensitivity of lichen to sulfate is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO_2 emissions, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under the multiple-sale scenario is expected to be minimal. For their proposed Liberty development project, BPXA had found that maximum modeled pollutant concentrations were well below levels that can damage lichens, according to laboratory studies. This likely would also apply to other development projects that could follow the currently proposed lease sales. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants there on vascular plants or lichens (Kohut et al., 1994). That research was conducted in areas typical of much of the Alaskan North Slope area. Monitoring the vascular and lichen plant communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

(5) Native Views on Air Emissions

Elder Bessie Ericklook from Nuiqsut has maintained that since the oil fields have been established at Prudhoe Bay, the foxes have been dirty and discolored near Oliktok Point (Ericklook, 1979, as cited in USDOI, MMS, 1979a). Leonard Lampe, then Mayor of Nuiqsut, more recently reported further air-pollution problems and habitat concerns, asserting that Nuiqsut has been experiencing such effects for some time: "A lot of air pollution, asthma, bronchitis - a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way..." (Lavrakas, 1996:1, 5). Because of the distances from the most likely developments to Nuiqsut and the relatively small sizes of these projects in comparison with the Prudhoe Bay complex, the BLM believes that the multiple sale proposal would have no significant effect with respect to these observations.

(6) Summary

In the unlikely event of a large oil spill from a facility or pipeline, such a spill could cause a small, local increase in the concentrations of gaseous hydrocarbons (volatile organic compounds or VOC) because of evaporation from the spill. The VOC concentrations would be very low and normally limited to only 1 or 2 km^2 (0.4 to 0.8 mi^2).

Moderate or greater winds would further reduce the VOC concentrations in the air.

Effects on air quality from air emissions likely would be only a very small percent of the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air- quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards. Principally because of the atmospheric dispersion of emissions, the other effects of air-pollutant concentrations from exploration and development and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires.

c. Effectiveness of Stipulations and Required Operating Procedures

Mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control discharges. None of the stipulations or ROP's is particularly applicable to air-quality impacts.

d. Conclusion--First Sale

The air-quality analysis is based on the specific emission controls and emission limitations that the operators would apply to meet the appropriate EPA regulations and permit requirements for any development and production activities. The effects of all these activities would cause only small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Ambient Air Quality Standards (NAAQS). Therefore, air-quality effects from Alternative A would be low.

e. Multiple Sales

Air quality impacts are determined by atmospheric transport and dispersion patterns and the relative locations of the emission sources and receptors (points where impacts are evaluated). These characteristics will vary to some extent in different locations within the NPR-A. Wind patterns are determined by large-scale circulation systems as well as by local topography and heat exchange between the atmosphere, ocean, and ice. Atmospheric dispersion patterns are very complex as well. The air quality modeling for the Outer Continental Shelf Lease Sale 144 and for the Northstar and Liberty projects used meteorological data from just a few stations, which are generally not representative of the whole Beaufort Sea area. Results for similar projects, such as Alternative A in the Northwest NPR-A, are likely to vary from one area to another, depending on local meteorological and topographical conditions. The air-quality modeling for the projects mentioned are based on the best available information for the Beaufort Sea; they can be thought of as providing a best "first guess" of conditions anywhere in the Planning Area. Since the predicted impacts are small, it can be reasonably assumed that the effects from facilities anywhere in the region would fall within the regulatory standards.

Because individual air masses move constantly with atmospheric circulation, the BLM expects that the major differences in effects of the different alternatives upon air quality would be in which specific geographic areas could be affected by air emissions.

f. Conclusion--Multiple Sales

None of the sales would result in significant effects different from those discussed in Section IV.C.6.b. Activities for multiple sales would cause small increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and NAAQS. Therefore, effects from the multiple sales under Alternative A would be low.

7. Vegetation

Ground-impacting management actions within the Northwest NPR-A Planning Area that may affect vegetation under Alternative A include those analyzed under the No Action Alternative and those resulting from exploratory drilling and development of oil and gas resources.

a. Effects of Non-Oil and Gas Activities

The impacts of management actions under Alternative A would be similar to those described under the No Action Alternative, except that the total areal extent of archaeological/paleontological excavations could increase to 6 acres per year.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

If it is assumed that impacts to vegetation from any of the disturbance factors below would occur to different land-cover classes in proportion to their occurrence in the Planning Area (Table III-06) (with the exception of the three water classes), then the percent chance of occurrence of these impacts to the various vegetation types is presented in Table IV-23. However, this assumption would be invalid under either of the two following potential scenarios.

As discussed in Section III.B.2 , over 95 percent of the Planning Area may be classified as "wetland" by some definitions. There are, however, some general differences between the northern and southern portions of the Planning Area. The northern area lies in the coastal plain and has a higher frequency of "marsh wetlands" (aquatic, flooded tundra, and wet tundra land-cover classes on Table IV-23), whereas the southern area lies in the foothills and has a higher frequency of "tussock wetlands" (tussock tundra and dwarf shrub land-cover classes on Table IV-23). If it is assumed that exploration or development activity is more likely to be concentrated in the northerly portion of the Planning Area, then the "marsh wetland" would be affected in greater proportion than suggested in Table IV-23 and the "tussock wetland" would be affected less. The comparative value of these two generalized wetland types depends on the context in which they are being evaluated. For instance, the "marsh wetlands" are generally of greater importance to waterbirds, whereas the "tussock wetlands" are generally of greater importance to some shorebirds and songbirds, and to caribou.

Development may be proposed for a location addressed by stipulation J-1 or ROP E-6 (see below). If this occurred, the location of the development may be shifted to some extent to avoid as much as possible the vegetation types considered of greater importance in that local area for the protection of specific resources. In this case, these would most likely be of either the "marsh wetland" type, or riparian shrubs (low or tall shrub on Table IV-23).

(a) Exploration

1) Construction of Ice Pads, Ice Roads, and Well Cellars

Construction with the potential to impact vegetation during exploration would be limited to the construction of ice pads for drilling exploratory or delineation wells, ice roads to access some ice pads, and well cellars. Because vegetation is dormant when frozen and the ice pads/roads melt during the spring thaw shortly after melt of snow and natural ice, this construction technique is more benign than building gravel roads. Observations by the BLM of ice roads and pads built in the Northeast NPR-A during 2000 and 2001 have shown that one common impact to vegetation is a green trail, where standing dead vegetation has been flattened. This occurs primarily in wetter areas. Another common impact is caused by the death of some plants, presumably from compression, resulting in a brownish hue in the first summer, followed by a gray hue in later summers. This occurs primarily in areas of tussocks or dwarf shrubs. Both green trails and brown/gray trails are apparent from the air at some angles, but sometimes difficult to observe from the ground. Additional damage observed to occur (though to a lesser extent) was the partial crushing of sedge tussocks and accidental scraping of the tundra surface. No studies have been carried on for long enough to know the duration of such impacts, but based on studies of impacts from seismic surveys (see below) the effects may be visible for at least a few years. It is assumed here that 0 to 3 ice roads, 25 to 50 mi long, would be built per year for a total of < 150 mi of ice road per year. If ice roads were 35 ft wide, the acres affected would be < 640 per year. Ice road construction may continue for up to 10 years following the first lease sale; ice roads that are rebuilt in multiple years are likely to be built along the same route.

Under Alternative A, it is assumed that 6 to 16 exploration wells and 2 to 24 delineation wells would be drilled in the Planning Area as a result of the first lease sale, for a total of 8 to 40 wells on ice pads. Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), these pads would add another 50 to 230 acres of impacts similar to those of ice roads. Some pads may be rebuilt in subsequent winters. This may increase vegetation recovery time, but not the areal extent of impacts.

A different impact from ice construction would occur if an ice pad were insulated so it could be used for a second winter. The vegetation would thaw underneath the timbers placed around the pad's perimeter to hold the insulating cover down. Because that thawed vegetation, about 1 ft in width, would receive no sunlight, it would die (Hazen, 1997; McKendrick, 2000). Assuming that the average ice pad is 500 ft by 500 ft, this perimeter death would impact about 2,000 ft^2 or 0.05 acres. If it is assumed that one in five ice pads would be maintained over the summer, this scenario could result in the death of 0.05 to 0.4 acres of vegetation spread among 1 to 8 different sites and over about 10 years. The vegetation would take 1 to a few years to recover.

Holes are dug in the earth for construction of well cellars, causing the destruction of vegetation on the 16 ft^2 of ground involved and causing thermokarsting around them, which could change some vegetation cover to a wetter type. For 8 to 40 wells, this could result in the destruction of 0.003 to 0.015 acres of vegetation.

2) Seismic Activities

Under Alternative A, it is assumed that three seismic surveys, in some combination of 2-D and 3-D surveys, would occur in the Planning Area during each winter season. Characteristics and areal extent of impacts from each survey would be the same as analyzed under the seismic option of the No Action Alternative: total area impacted per year by 2-D seismic surveys within the Planning Area would be < 67,500 acres if up to three crews are involved. Medium to high disturbance levels would occur on < 17,000 acres per year and--after 9 years of recovery for any single year's activity--that level of disturbance would remain evident on < 480 acres. The tundra area impacted by 3-D seismic surveys would be < 549,000 acres per year if up to three crews are involved. There would be < 137,000 acres of medium to high disturbance per year and < 180 acres remaining after 9 years.

Overall, depending on the combination of survey types and the number of line-miles actually accomplished per survey, the range of areas impacted per year by all seismic operations would be 33,800 to 549,000 acres.

(b) Development

There are four different aspects of development that could impact vegetation: 1) construction of gravel pads, roads and airstrips; 2) potential construction of a pump station within the Planning Area; 3) excavation of material sites; and 4) construction of pipelines.

1) Gravel Pads, Roads, and Airstrips

It is assumed that the gravel footprint for the average, mid-sized oil field development in the Planning Area would cover a total of 100 acres and that under Alternative A, 0 to 5 fields (Table IV-04) would be developed. This would result in the destruction of < 500 acres of vegetation.

The passage of vehicle traffic over gravel pads would result in dust and gravel being sprayed over vegetation within about 30 ft of the pad and a noticeable dust shadow out to about 150 ft or more. Beyond about 30 ft, the effects of dust on vegetation would be subordinate to those described below for changes in snow distribution and moisture regimes (Woodward-Clyde Consultants, 1983). Within 30 ft of pads, the dust and gravel may smother the original vegetation, altering the plant communities and at an extreme level eliminating all vascular plants (Jorgenson, 1997, pers. comm.; McKendrick, 2000). The buildup of dust and gravel could also cause thermokarsting, leading to the development of high-centered polygons with deep moats (Jorgenson, 1997, pers. comm.). For this analysis, it is assumed that the average oil/gas field development in the Planning Area would consist of 5 mi of some combination of pads, roads, and airstrip with the potential for dust effects along a 10-mi perimeter. This could result in a total coverage of the above impacts over 36 acres per development, corresponding to < 180 acres under Alternative A.

The type of material used for gravel fill also can impact vegetation, because the material sometimes has a saline source. Sources for material to be used in the Planning Area currently are undetermined. If the material is saline, water draining off or leaching through the pad can pick up the salinity and cause the death of plants near the pad. The area of plant death eventually would be colonized by more halophytic species, resulting in a change from one plant community to another.

The construction of gravel pads can result in a change in moisture regime of the nearby tundra through the accumulation of snow by drifting and the blockage of normal flow of surface water in summer. The latter can cause a wetter soil regime on one side of a pad or road and drier soil on the other. Wetter regimes can cause an increase in the depth of the active layer (soil that thaws during summer), which leads to an increase in graminoid and bryophyte production in wet habitats or a decrease in shrub and lichen production in moist or dry habitats within 164 ft (50 m) of the pad (Woodward-Clyde Consultants, 1983). In the extreme case, shrubs may disappear altogether and the vascular plant community may become a *Carex aquatilis* monoculture (Jorgenson, 1997, pers. comm.). If all such effects occur within 164 ft of the pads, the total area impacted could be up to 200 acres per oil/gas development, or < 1,000 acres under Alternative A.

Flooding caused the greatest indirect effect of construction on vegetation during the first 15 years (1968-1983) of development in the Prudhoe Bay area (Walker et al., 1986, 1987). Flooding resulted when roads and pads intercepted the natural flow of water and caused ponding. If lessees are not required to identify natural drainage patterns before construction, and maintain them during and after construction, then the land impacted would be the same land that was affected by dust and snow drifting, as described above. However, the change in vegetation type could be different than that caused by dust or snow drifting, resulting in more aquatic grasses and sedges.

2) Pump Stations

Depending on the number of fields produced, their location, and the diameter of pipe used to transport oil, pump stations may be needed within the Planning Area. A pump station with associated airstrip would result in about 40 acres of gravel fill. For this analysis, it is assumed the perimeter of this gravel fill would be 3 mi, resulting in 11 acres of potential dust effect or 60 acres of moisture-regime change for each pump station.

3) Material Sites

Any need for gravel fill in support of development would likely be met by existing borrow sites east of the NPR-A. However, if excavation of fill material were to occur within the Planning Area, vegetation would be destroyed over the area of the borrow pit itself as well as where the overburden is stockpiled. For this analysis, it is assumed that there would be one material site within the NPR-A for each oil/gas development, each with a surface disturbance of 20 to 50 acres (average 35 acres). It also is assumed that all associated work would occur in winter, resulting in no dust. Any moisture-regime changes as a result of snow drifting would be confined to about 5 acres per material site. Under Alternative A, this would result in the destruction of < 175 acres of vegetation and the alteration of the vegetation community on < 25 acres. If some or all of the gravel resources come from outside the Planning Area, the total acreage affected would be the same or less, but correspondingly distributed between the Planning Area and other lands to the east. Material sites outside the Planning Area would most likely be within the Colville River floodplain where vegetative cover may be naturally reduced or absent.

4) Pipelines

For this analysis, it is assumed that aboveground pipelines would involve a single VSM per pipe-supporting rack. The VSM's would have a diameter of 12 inches and would be placed 55 to 70 ft apart. Each VSM would have an approximately 20-inch wide zone of disturbance around it in addition to the vegetation displaced by the VSM (Jorgenson, 1997, pers. comm.). The zone of disturbance would result from deposition of spoil material and thermokarsting and would result in a change in plant species composition. The total area disturbed by each VSM would be about 14 ft^2 , 6 percent of which would be vegetation destruction/replacement by the VSM. This would result in 0.03 acres being disturbed per pipeline mile, or < 2.9 acres within the Planning Area under Alternative A (up to 95 mi of field gathering and trunk pipelines) (Table IV-29). In addition, another 100 mi of trunk lines would be built on Federal lands outside the Planning Area and 35 mi of trunk lines on state lands to get produced oil from the Northwest NPR-A to existing oil transportation infrastructure. This 135 mi of pipeline outside the Planning Area would disturb about 4.1 acres of tundra vegetation.

Pipelines would be constructed in the winter, either from ice roads or vehicles driving on the snow-covered tundra. Assuming that this traffic would cover an area up to 30 ft wide over 95 mi within the Planning Area and 135 mi outside of the Planning Area, about 350 acres and 490 acres, respectively, of tundra would receive impacts similar to those mentioned above for ice roads or seismic surveys.

Pipelines also could impact vegetation indirectly through snow drifting or shading. There is conflicting information about the occurrence of snow drifting associated with pipelines that have no parallel road. Jorgenson (1997, pers. comm.) has not seen drifting in such situations, but residents of Nuiqsut have said that it occurs. Insufficient information exists to describe any potential effects to vegetation.

Any vegetation under a pipeline would receive less direct sunlight during the growing season, potentially leading to a shallower active layer in the soil and reduced photosynthesis by the plants. No data exist to address this possibility. Many currently existing pipelines are associated with a parallel road, and any effects of snow drifting, gravel spray, or dust would mask an effect of shading.

Assumptions made for this analysis of impacts by pipelines would be invalidated by a decision to bury any portion of a pipeline under the tundra. Although not the preferred method for heated oil pipelines, it is preferred for gas transport pipelines. Gas pipelines would be supported above ground by the same VSM's as the oil pipelines, and would represent no additional impact to tundra vegetation other than the possible effects of increased area shaded or affected by snow drifting. Gas trunk pipelines would likely be buried, and vegetation would be destroyed above the trench and altered in the adjacent areas due to temporary storage of earth on top of vegetation and impacts from earth-moving machinery. The latter impacts would be ameliorated by winter construction, but would still occur. If the zone of impacts from pipeline burial would be up to 15 ft wide, then the total impacts to vegetation would affect < 1.8 acres per pipeline mile, or < 45 acres along the assumed 25-mi route within the Planning Area and about 310 acres along the 170-mi route beyond the Planning Area. With disturbed areas of this width, colonizing species would not be able to quickly reinvade the disturbed soil, suggesting a recovery time of several years or longer, though wetter areas would generally revegetate before drier areas (McKendrick, 2000).

(2) Effects of Spills

Most oil spills occur on gravel or ice pads: consequently, their effects do not reach the vegetation. About 20 to 35 percent of past crude oil spills, both large and small, have reached areas beyond pads. The corresponding proportion for refined oil spills probably is much less, but for this analysis it is assumed that 27 percent of all spills (except blowouts; see below) occur on or reach the tundra vegetation. Because during 60 percent of the year there is sufficient snow cover that cleanup efforts occur before spilled oil would reach the vegetation, for this analysis, it is assumed that 11 percent of all oil spills (except blowouts; see below) would affect vegetation.

Most oil spills would cover < 500 ft² (< 0.01 acres) with a maximum coverage of 4.8 acres if the spill is a windblown mist. For this analysis, it is assumed that the average spill would cover 0.1 acre (98% at 0.01 acre, 2% at 4.8 acres). Based on these assumptions, the total area of vegetation that would be impacted by spilled oil over the lifetime of oil/gas developments would be < 5.0 acres (454 spills x 11% chance of reaching tundra x 0.1 acre per spill).Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery with wetter areas recovering more quickly (Jorgenson, 1997; McKendrick, 2000).

The only reported blowout of crude oil on Alaska's North Slope occurred in 1950, and no crude oil was spilled off the pad during that blowout. The chance of a blowout occurring in the Planning Area, with subsequent damage to vegetation beyond the drill pad, is low (estimated at 1.5×10^{-5} per well drilled, or one in 67,000).

A pipeline spill of seawater used for waterflooding also has the potential to affect vegetation. The size of the area affected would depend on the terrain and land cover at the spill site and would be proportional to the amount of seawater spilled. If such a spill were to occur within a community of halophytic plantspecies, there could be little effect. Otherwise, depending on the specific situation under which the spill occurred, the result could vary from little impact to total plant death in the area affected with eventual replacement of the vegetation community by halophytic species.

(3) Summary

Under Alternative A, minor impacts to vegetation may occur from aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery could vary from 1 year to decades. Impacts also would occur from seismic work, ice road and pad construction, and the construction of well collars during exploratory drilling. The duration and recovery for seismic work and ice roads/pads would be similar to those for overland moves. The effects of well-collar construction would be permanent. The effects of development include the impacts of ice roads or off-road vehicles used for pipeline construction; the destruction of vegetation under gravel pads, material sites, pipeline VSM's, and spilled oil; and the alteration of vegetation communities resulting from dust, salinity of gravel fill, snowdrifts, and blockage of normal surface water flow. The impacts of gravel pads are considered permanent, while those of oil spills--which are cleaned up immediately--allow recovery within a few years to two decades.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's that would reduce the acreage of impacts to vegetation under Alternative A are those that would reduce the areal extent of gravel cover or alterations to tundra during exploration or development (ROP's E-2 and I-1) and those that would reduce the probability of oil spills reaching the tundra or spreading further once they reach the tundra (stipulations A-1 and A-2; ROP's A-3, A-4b and c, A-6, A-7, A-8, E-1, and I-1). Stipulation J-1 and ROP E-6 would not reduce the acreage of vegetation impacted by an action, but might shift the impacts from more valuable wetland or riparian vegetation types to habitats perceived as lesser in value.

Stipulations and ROP's that would reduce the level of impacts to vegetation--but not the areal extent of impacts --are stipulation A-1 and ROP's A-6 and A-7 (by providing better cleanup of spills), and stipulation C-1b and ROP's C-1c, d, and e, and ROP I-1 (by reducing impacts of off-road vehicles).

Stipulation G-1 and ROP E-7 may increase the probability that altered vegetation would eventually be returned to a natural (or at least more productive) state.

d. Conclusion--First Sale

Impacts to vegetation from activities other than oil exploration and development under Alternative A would involve either disturbance or destruction. Since destructive impacts would involve a small fraction of the 8.8-million-acre Planning Area, the overall impact to vegetation communities from these activities other than oil and gas exploration and development may be minor to negligible.

The impacts of oil exploration would include vegetation disturbance on 33,800 to 549,000 acres per year from 2-D and 3-D seismic surveys over the entire exploration period (10 years). About 25 percent of the disturbance from 2-D would be at a medium to high level, with perhaps more at that level for 3-D. After 9 years, recovery would be about 90 percent from 2-D seismic work and probably somewhat less from 3-D seismic activities.

Exploration would also include construction of ice roads, with impacts on < 640 acres per year, and ice pads with impacts on < 230 acres. Exploration activities also would result in permanent, minor vegetation destruction and alteration from the construction of exploration well collars.

The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oil/gas development; potential construction of one pump station within the Planning Area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on < 790 acres and the alteration in plant species composition of < 2,220 acres, for a total of effects over < 3,010 acres. The duration of most of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, but some plant species would be able to grow on the pads (McKendrick, 2000).

Since these impacts from development would affect less than 0.03 percent of the total area of the Planning Area, they would not be likely to adversely affect any plant species or communities. However, if a development facility were to be placed over a population of one of the rare plant species (see Sec. III.B.2.), the effects on that particular taxon could be severe. Oil spills are inevitable during exploration and development and would affect <5 acres of vegetation within the Planning Area. Spills would be cleaned up immediately, would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.

e. Multiple Sales

It is assumed that additional lease sales under Alternative A would result in additional exploration activities and another 0 to 5 oil/gas fields (total of 0 to 10 fields) being developed (Table IV-06). The annual level of seismic operations is assumed to stay the same, and it is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 18 to 48 from 6 to 16, and delineation wells to 6 to 48 from 2 to 24, for a total for all lease sales of 24 to 96 wells drilled from ice pads. Vegetation destruction from well collars would then increase to affect 0.009 to 0.035 acres, and vegetation death around ice pad perimeters would increase to 0.3 to 1.0 acres. Tundra would recover from the latter in 1 to a few years. Since the number of exploratory and delineation wells is assumed to be greater after the second and subsequent sales than after the first sale, it may follow that the area affected per year by ice roads and pads would increase proportionally to < 2,090 acres.

With the assumption of another 0 to 5 oil/gas fields developed (total of 0-10 fields; Table IV-06), the total vegetation that might be destroyed by burial under gravel fill would double to < 1,000 acres. The area of vegetation around gravel pads that would undergo change from dust- or moisture-regime impacts would double to < 2,000 acres. The impacts of developing material sites would increase correspondingly to the number of oil/gas fields. This would mean the destruction of vegetation on a total of < 350 acres and effects of moisture regime changes on a total of < 50 acres. If additional pump stations would be needed, the area of vegetation affected would increase accordingly. The number of VSM-supported-pipeline miles within the Planning Area would more than triple under multiple sales, from 95 mi to 295 mi, and those outside the Planning Area would increase to 135 mi to 245 mi. The number of miles of buried gas trunk lines would increase from 25 mi to 125 mi within the Planning Area and from 170 mi to 270 mi outside of the Planning Area. The resulting total for all sales, both inside and outside the Planning Area, would be 1,980 acres of vegetation destruction or alteration by off-road vehicle or ice-road use and 720 acres by trenched gas transport lines. The incidence of oil spills also would double, raising the total acres affected to < 10. The probability of a blowout would remain low.

f. Conclusion--Multiple Sales

The impacts of oil exploration would include about double the vegetation disturbance from seismic work as under a single-sale scenario. However, the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.1 to 0.6 acres of permanent vegetation destruction around well collars and alteration of < 2,090 acres per year around and under ice pads and roads.

The activities of development that would impact vegetation include: construction of gravel pads, roads, and airstrips for each oil/gas field developed; potential construction of one pump station within the Planning Area; excavation of material sites; and construction of pipelines both within and outside the Planning Area.

The combined effect of these exploration and development activities over all lease sales would cause the destruction of vegetation on < 1,530 acres and the alteration in plant species composition of < 4,660 acres, for a total of effects on < 6,190 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. The portion of these impacted areas within the Planning Area (4,810 acres) represent about 0.05 percent of the total land cover. As such, they would not be likely to adversely affect any plant species or communities. However, if a development were placed over a population of one of the rare plant species, the effects on that particular taxon could be severe. Oil spills would affect < 10 acres of vegetation within the Planning Area. Recovery from spills would take a few years to two decades.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Actions within the Planning Area that may affect fish under Alternative A include those analyzed under the No Action Alternative, increased activity related to seismic operations, and those actions related to exploratory drilling and development of oil and gas resources.

Fish found in the Planning Area that may be impacted from these actions include freshwater species such as lake trout, arctic grayling, Alaska blackfish, northern pike, longnose sucker, round whitefish, burbot, ninespine stickleback, slimy sculpin, and Arctic char and anadromous/amphidromous species including arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, Dolly Varden, inconnu, and chum and pink salmon (Morrow, 1980). Figure III-25 depicts many of these species. The Fish Species section in Chapter III provides details on their distribution and habits. Since the actions listed above frequently have similar impacts on these species, the following analysis often discusses effects on arctic fish as a group.

(1) Effects of Non-Oil and Gas Activities

Non-oil and gas actions associated with Alternative A that could cause disturbance to fish are similar to those described under the No Action Alternative. Measurable effects on arctic fish populations in,and adjacent to, the Planning Area over the life of this plan are not expected.

(2) Effects of Oil and Gas Activities

The following discussion of oil and gas exploration and development encompasses impacts to fish found within, and adjacent to, the Planning Area. Waterways that border the Planning Area are included in this analysis because freshwater and anadromous/amphidromous species can migrate between connected rivers and lakes.

If there are impacts to fish outside the Planning Area, they are most likely to occur near the borders of the Planning Area (i.e. Ikpikpuk River) during oil and gas development. Material site excavation, construction of pads, roads, airstrips, and spills (oil, gas, sea water) could have direct and indirect impacts on fish. However, the effects are the same as discussed for those species in the Planning Area. The reader is referred to the discussion below for a detailed analysis.

(a) Effects of Disturbances

1) Exploration

a) Effects from Seismic Surveys

Under Alternative A, it is assumed that three 2-D or 3-D seismic operations would occur each year in the Planning Area. Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress. While Alternative A is likely to involve more seismic surveys than the No Action Alternative, and thereby increasing the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. As a result, seismic surveys under Alternative A are expected to have the same overall effect on fish as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations).

While under Alternative A fuel spills associated with seismic surveys (e.g., refueling of equipment) are more likely than under the No Action Alternative, the amount of fuel entering fish habitat is not expected to significantly increase since spills are anticipated to be small (< 5 gallons) and are unlikely to reach fish habitat. Hence, fuel spills associated with Alternative A are expected to have the same overall effect on fish populations as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations).

b) Effects from Construction

Construction-related activities that may affect arctic fish include water withdrawal for construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling.

Under Alternative A, it is anticipated that 6 to 16 exploration wells and 2 to 24 delineation wells would be drilled in the Planning Area as a result of the first lease sale, for a total of 8 to 40 wells on ice pads (drill pads). Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), water needs would equate to approximately 2 million gallons for each drill pad, for a total of 16 to 80 million gallons of water. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that 0 to 3 ice roads, 25 to 50 mi long, would be built each season, for a maximum annual water need of 225 million gallons. Water needed for four drilling rigs, the associated camps and airstrips, and the maintenance of roads, drill pads, and airstrips would add another approximately 119 million gallons to the annual water use budget. Total annual maximum water need is estimated at 424 million gallons.

Drill pads, roads, and airstrips (if needed) would be constructed of ice. These activities occur in the winter and could adversely affect arctic fish depending on the location of the construction and the quantity of freshwater withdrawn. For example, estimates by Craig (1989a) suggest that substantially less than 5 percent of the stream habitat on the North Slope is available to fish at the end of the winter season. In the Northwest NPR-A Planning Area, fish, such as grayling and whitefish species, that inhabit rivers in the winter, are limited to deeper pools that do not freeze. These pools provide a much smaller habitable space for fish than lakes. The amount of available overwintering habitat in any given pool varies naturally each year depending on the severity of the air temperatures and the amount of snow cover. Colder temperatures and lack of snow cause increased ice formation. This condition decreases available water in any given pool and can restrict flow which forces water to the surface and eliminates flow to downstream pools. Given that fish are essentially "confined" to overwintering sites, the severity of the weather, and in turn, a decreased water supply, can cause stress and mortality from overcrowding and oxygen depletion. Reproductive success can also be affected if eggs are frozen on the spawning grounds. If water were to be withdrawn from rivers for exploration purposes, the conditions described above would be exacerbated. The concern lies in that, although the amount of free water and oxygen conditions may be adequate for fish survival at the time water is withdrawn in December and January when water is needed for pads, roads, and other construction, the fish are dependent on suitable living conditions of a particular pool until spring break up. Not being able to predict the severity of the freezedown (which is weather dependent), and thus the living conditions from time of use until breakup, may cause increased or complete mortality at overwintering pools. Dissolved oxygen concentrations could be reduced below the 7 ppm dissolved oxygen standard needed to sustain fish species (Alaska Department of Environmental Conservation, 1999) and the increase in metabolic by-products may be fatal. Schmidt, McMillian, and Gallaway (1989) reported such a loss under natural conditions in the Sagavanirktok River. Adverse effects of dewatering pools are also known from the Sagavanirktok River during early development of the Prudhoe Bay oil field.

Total fish loss in a river would be dependent on how many pools are tapped. Assuming that the entire population of any given species in a drainage is spread out between overwintering sites in a river or adjacent lakes, the loss in any given pool would not eliminate a population. Tapping multiple pools increases losses and recovery times for populations. Though reproductive strategies for arctic species are known, recovery times are difficult to predict given the uncertainty of the numbers associated with any given loss(es) as compared to the total population abundance in the system.

Fish have also responded to habitat reductions in winter by adopting migration patterns that take them to deep lakes. Fish overwintering in these lakes have a restricted supply of fresh water. Under natural conditions, most lakes in the NPR-A coastal plain tend to be supersaturated with oxygen (USDOI, BLM 1998).

Construction activities such as airstrip or road construction over a lake, or water withdrawal to build pads, roads and airstrips, have the potential to impact all planning area freshwater and anadromous/amphidromous fish that inhabit these overwintering sites. The construction of an ice road or airstrip over a lake with minimal free water could cause freezedown to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the overwintering fish affected by the barrier. Also, freshwater withdrawals may adversely affect fish if the water is taken from areas where they are overwintering. Their survival at these overwintering sites depends on an adequate supply of freshwater and dissolved oxygen.

Sources of freshwater within the Planning Area vary greatly in the amount of under-ice water available for construction during winter. Many lakes along the coastal plain are relatively shallow (6 ft), do not support fish populations, and are frozen to the bottom in winter. These lakes are a possible source of ice chips for winter construction. Use of ice chips would lessen the need for fresh water withdrawal. Shallow lakes may also provide water for construction in December and January (before complete freezedown) since ice depths are likely to be approximately 3 ft at this time of the year. Withdrawals from these lakes would not impact fish.

Those lakes deep enough to permit under-ice withdrawals for construction are also likely to support overwintering fish. Under-ice withdrawals from areas having water levels that are barely to moderately sufficient to support overwintering fish could negatively change the water chemistry to a point where a fish kill is possible. Alternative A requires a water withdrawal proponent to demonstrate that water removal would not endanger fish populations. "Best Management Practices" implemented by Federal and State agencies commonly provide protection by monitoring withdrawals through a sampling program that ensures water quality standards are met and by limiting water withdrawal to 15 percent of the estimated free water volume (excluding ice) in lakes > 7 ft in depth. Additional drawdown is possible if no fish are known to inhabit the lake or if the proponent demonstrates that use beyond 15 percent would cause no harm. Lakes (< 7 ft deep that are interconnected with streams are also in need of protection when inhabited by fish.

Assuming that the Authorized Officer follows the above common practices when approving water withdrawals, lake water withdrawal associated with Alternative A might be expected to kill a small number of individual fish but is expected to have no measurable effect on arctic fish populations in the Planning Area.

Exploratory drilling on lakebeds and streams could also impact fish under Alternative A. Drilling fluids could cause impacts depending on storage and disposal. In most instances, drilling wastes are reinjected into the wells immediately. However, if cuttings were allowed to be temporarily stored to facilitate reinjection or backhaul, water quality could be degraded. The impact to fish is indirect. Results of past studies have shown toxicity to sensitive zooplankton, which, as a group, are prey species to fish (Woodward et al, 1988, in USDOI, BLM 1998). Proper and immediate disposal would minimize impacts.

2) Development

Activities related to development that could impact fish include excavation of material sites; construction of pipelines, pads, roads, airstrips, and causeways; and water withdrawals.

Material sites (for gravel extraction) needed for construction of roads, pads, pipelines, and airstrips have not been identified in the Northwest NPR-A Planning Area. A likely source includes river drainages. Other possibilities include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, and using ice or composite pads. For this analysis, it is assumed that 5 oil and gas fields would be developed (Table IV-04). Each field is expected to have a footprint of 100 acres requiring one million square yards of gravel. Total gravel needs would equal five million cubic yards if 5 fields were developed. Using composite (blended mixtures of sand/silt/foam) could potentially reduce gravel needs by 33 to 50 percent. Decisions regarding future gravel use and location of pits would be made on a case-by-case basis.

From a broad perspective, gravel extraction from or near overwintering and spawning habitat is likely to adversely affect arctic fish by reducing the amount and quality of habitat available to them. Because overwintering and spawning habitat represent a small percentage of the Planning Area, gravel removal from these areas would be likely to result in spawning failure (loss of suitable substrate) and mortality (loss of overwintering pools) for many fish within the affected area. Gravel removal from non-overwintering or non-spawning areas of low fish density would likely have little to no adverse effect on arctic fish populations. The same applies to gravel extraction activities that might occur outside of the Planning Area.

Direct and indirect impacts to fish from gravel extraction are most likely to occur within the floodplains of rivers. Detrimental effects could include: loss of spawning and overwintering habitat (if not identified before extraction); blocking and rerouting of stream channels; and high silt concentrations resulting in reduced primary production, loss of invertebrate prey species, mortality of fish eggs and larvae, and disruption of feeding patterns for sight dependent feeders (USDOI, BLM, 1989).

Within the Planning Area, gravel has been mined from the Meade River, near Atqasuk, and from lagoons near Barrow and Wainwright. Impacts were reported by Sekerak et al. (1985) for dredging in the Meade River. They noted that size composition, not quantity of sediments, was the most important determinant in effects on water quality (the Meade River is heavily laden with clay deposits). Disturbance during dredging led to fine sediment draining from the stockpile and flowing in suspension at least 60 km downstream. Turbidities and suspended sediments were approximately 20 and 50 times greater, respectively, than background levels. The authors of this study reported that effects of dredging on turbidity and sediment loads were unusually high in the Meade River compared to other North Slope dredging operations. Differences were attributable to the high amount of fine sediment (clay) in the mined product. Impacts to specific fish habitat and fish species from future gravel mining are unknown at this time due to uncertainty of mining locations.

One of the beneficial aspects of gravel extraction mining in or near floodplains has been the creation of deep pits that can be used by fish as overwintering habitat. In one instance, two pits were connected to small tundra streams, Arctic grayling were introduced, and the fish developed reproducing populations (Hemming, 1995).

Least cisco, grayling, and broad whitefish have been also been documented using abandoned gravel pits connected to streams (Hemming, 1988). Based on the documented successful use of reclaimed gravel pits by fish, future mitigation of gravel pits should incorporate prescriptions to create fish habitat when feasible.

During production operations, drill pads, roads, and airstrips would be constructed of gravel. One impact related to these structures is the potential to alter flow patterns to, and within, waterbodies. Bridges, culverts, and low-flow crossings are integral features to road development. They can also interfere with migrations to spawning, feeding, and overwintering sites if improperly designed. Examples of problems in maintaining adequate flows for fish passage from past oil field development include placement of under-sized culverts and perching of culverts. Current concerns related to pad and road placement include diverting or eliminating flow from small tributaries that connect lakes or connect lakes and rivers. Whitefish species found in the planning area that move between these habitat types are vulnerable to impact. Potential loss of migratory capacity could stress or kill these fish if they are unable to migrate to food-rich habitat in the summer, reach spawning areas, or move into overwintering habitat. Proper placement of these structures is critical in minimizing impacts to fish.

A second impact related to drill pads, roads, and airstrip construction is erosion and subsequent in-stream sedimentation. Destructive effects are similar to those discussed in the gravel-mining portion of this section and would be prevalent in river systems. All members of the biotic community could be affected. Potential effects of sedimentation on benthic macroinvertebrates--which are prey species for fish--include interference with respiration and interruption of filter feeding insects' capability to secure food. A more important impact to benthic invertebrates would be smothering of physical habitat (the streambed) by heavy sediments. A loss of interstitial space in the substrate would be highly detrimental to burrowing species. A decrease in abundance could be expected in these situations. In arctic environs, where fish depend on summer food sources to grow and, if food is abundant, to reproduce, a reduced prey base may preclude fish from directing energy towards spawning.

Direct threats to fish from sediment include changes to physical habitat, subsequent decreased reproductive success and loss of rearing habitat. Physical habitat changes from sediments are most often attributed to finer size particles. Developing eggs can be smothered and newly hatched fry can be killed by suspended sediment that prevents emergence from spawning gravels and interferes with respiration. Embedded sediments fill interstitial spaces and essential winter habitat used by juvenile fish. Filling of pool habitat further limits overwintering sites for adult and juvenile fish. In instances where stream reaches are aggrading due to heavy sediment loading, physical habitat is further degraded when flows are redirected and erode channel banks.

Sublethal impacts to fish from sedimentation are a further concern in stream environs. Effects such as avoidance, reduced feeding, and lessened tolerance to disease can work in combination to reduce fitness and survival. Habitat fouling would be especially detrimental if it occurred in a critical habitat segment of a river.

To minimize impacts to fish from unwanted erosion and sedimentation, construction activities require adequate controls. Proper road surfacing and drainage, adequate cross-drainage, minimal number of stream crossings, and armoring and vegetation planting are some of the key features needed to minimize sedimentation and subsequent impacts to fish. Overall, impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be minor if adequate controls are in place. Impacts from erosion should be short term and proper placement of these structures, in combination with adequate and properly sited drainage systems, should minimize fish loss.

During production, up to 230 mi of pipeline (Table IV-29) within and east of the Planning Area to the Kuparuk oil field are projected to be constructed as a result of developing leases sold during the first sale under Alternative A. It is assumed pipelines would be constructed in winter, either from ice roads or via vehicular travel on the tundra. Pipeline alignments would generally be routed to avoid crossing lakes, though small shallow lakes may have elevated VSM's across them. New pipelines constructed on land and around the shoreline of deeper lakes would be suspended on VSM's. Pipe crossing wide, deep rivers would be horizontally tunneled approximately 100 ft beneath the riverbed. Pipelines constructed in this manner are not likely to have an effect on arctic fish.

New pipelines crossing wide, shallow rivers would be trenched and buried within the streambed during winter. Pipelines constructed in this manner could adversely affect fish if the trenching is done in or near overwintering or spawning habitats. Effects would be the degradation or loss of overwintering and spawning habitat, resulting in spawning displacement and mortality for those fish near the disturbance. Because overwintering and spawning habitats normally are located in deepwater environments, the trenching of shallow rivers during pipeline construction is not likely to adversely affect these habitats. Pipeline trenching through non-overwintering and/or spawning areas (> 95% of the Planning Area) is not expected to have a measurable effect on arctic fish populations.

The construction of overland gas pipelines through waters supporting fish is likely to displace small numbers of fish short distances. However, those affected would soon reoccupy that habitat upon completion of the activities and would be otherwise unaffected. For these reasons, natural gas exploration and development is not likely to have a measurable effect on fish populations.

Given that construction activities are in the winter and overwintering habitats would be largely avoided, it is expected that pipeline construction under Alternative A would have no measurable effect on arctic fish populations in the Planning Area.

Alternative A would also result in the construction of a coastal docking facility to off-load supply barges into the Planning Area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters and requiring a long access road could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow draft vessels, the docking facility is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility is expected to be relatively small (up to several hundred feet), and to provide for the movement of coastal fish. Hence, the construction of a coastal docking facility under Alternative A is not expected to have a measurable effect on arctic fish.

Water is needed during development for drilling, camp use, and ice roads for staging materials and equipment used in constructing new fields. Estimated quantities that may be required are derived from analysis of Alpine field development. Potable water demand (350-person crew) would be 35,000 gallons/day. Drilling water demand is estimated at 21,000 to 63,000 gallons/day. Since drilling locations are unknown, water demand for ice roads is not estimated. Impacts of water withdrawal are similar to those discussed in the exploration portion of this analysis.

(b) Effects of Spills

For the Northwest NPR-A Planning Area, the total estimate of oil spilled under Alternative A is given as a range based on an \$18/bbl or \$30/bbl scenario. Assumed crude spill sizes include 500 or 900 bbl for large spills ($\geq$ 500 bbl) (Table IV-19) and zero to 393 bbl for small spills (< 500 bbl) (Table IV-20). Total amount of spills is estimated at 500 to 1,293 bbl. For small spills, an estimated 130 spills might occur at an assumed size of 3 bbl/spill (Table IV-17). Refined oil spill amounts are estimated at zero to 226 bbl (Table IV-20). The oil spill analysis estimates that 65 to 80 percent of the crude oil spills associated with oil production in the Northwest NPR-A would occur on a drilling pad. Most of the refined spills are likely to occur on pads. Because drilling-pad oil spills typically are small in size and easily cleaned up, they are not expected to come in contact with fish habitat and would have no perceptible effect on arctic fish. The oil-spill analysis also estimates that 20 to 35 percent of the oil spills would occur off drilling pads in the surrounding environment. Most of these cover a small area (about 500 ft^2). Impacts of these spills are discussed below.

The effects of oil spills on fish have been discussed in previous Beaufort Sea EIS's (e.g., Sale 144 final EIS

[USDOI, MMS, 1996a]), which are incorporated here by reference and summarized. Oil spills have been observed to have a range of effects on fish (see Starr, Kuwada, and Trasky, 1981; Hamilton, Starr, and Trasky, 1979; and Malins, 1977, for more detailed discussions). The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered (or sublethal concentrations over a long enough period), fish mortality is likely to occur. However, mortality caused by a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50 percent of test organisms [LC50]) for fish generally are on the order of 1 to 10 ppm. Concentrations observed under the oil slick of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations observed 0.5 to 1.0 m beneath a slick from the Tsesis spill (Kineman, Elmgren, and Hansson, 1980) ranged from 50 to 60 ppb. Extensive sampling following the *Exxon Valdez* oil spill (about 260,000 bbl in size) also revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in plankton (Neff, 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

If a fuel spill of sufficient size were to occur in a small body of water containing fish with restricted water exchange, lethal and sublethal effects would be expected on most of the fish and food resources in that waterbody. Toxic concentrations of oil in a confined area would have greater lethal impacts on larval fish versus adults. McKim (1977) reviewed results from 56 toxicity tests and found that, in most instances, larval and juvenile stages were more sensitive than adults or eggs. Increased mortality of larval fish is expected since they are relatively immobile and are often found at the water's surface where contact with oil is most likely. Adults may be able to avoid contact with oiled waters during a spill in the open water season but survival would be expected to decrease if oil were to reach an isolated pool of ice covered water. An example of the impacts to fish food resources is provided by Barsdate et al. (1980), who studied the limnology of an arctic pond (490 m^2) (near Barrow) with no outlet, after an experimental oil spill. They found that half of the oil was lost during the first year. The remaining oil was trapped along the edge of the pond with most of it sunk to the bottom by the end of summer. Researchers found no change in pH, alkalinity, or nutrient concentrations. Photosynthesis was briefly reduced and then returned to normal levels after several months. Carex aquatilis, a vascular plant, was impacted after the first year due to emerging leaves encountering oil. Certain aquatic insects and invertebrates that lived in these plant beds were reduced in numbers, presumably due to entrapment in the oil on plant stems. Some of the insects were still absent six years after the spill. Since there were no fish in this pond the impact of the loss of a prey base to the fish could not be measured. However, reducing food resources in a closed lake, as described above, would decrease fitness and potentially reduce reproduction until prey species recovered.

Though lethal effects of oil on fish have been established in laboratory studies (Rice et al., 1979; Moles, Rice, and Korn, 1979), large kills following oil spills are not well documented. This is likely because toxic concentrations are seldom reached (Rice, 1985). For the Planning Area, most fuel spills are expected to occur on the pad where the fuel is stored and would not come in contact with fish habitat. In instances where oil does reach the water, sublethal effects are more likely to occur, including changes in growth, feeding, fecundity, survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas, localized reduction in food resources, and consumption of contaminated prey. Areas of high fish concentration, including overwintering and estuarine feeding sites, provide the most potential for impact. Amphidromous species that inhabit Planning Area waters have a higher risk of impact due to their use of both of these habitat types.

Given the small size of the fuel spills anticipated and that occurrence is most likely on pads, fuel spills associated with Alternative A are not expected to have a measurable effect on arctic fish populations in the Planning Area over the life of this plan. Fuel spills occurring in a small body of water containing fish with restricted water exchange might be expected to kill a small number of individual fish, but are expected to have no measurable effect on arctic fish populations.

Natural gas exploration and development could adversely affect arctic fish from a natural gas blowout. In the unlikely event a natural gas blowout were to occur, some fish in the immediate vicinity might be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. In general, very few fish are likely to be affected by a blowout, and any effects would not be measurable at the population level.

The effects of a seawater pipeline spill on freshwater fish populations would depend on the specific location, size, and timing of the spill. No effect would be expected during the winter period when the surface is already covered by ice. During the spring and summer large quantities of seawater entering a fish-bearing freshwater environment would have from no effect on freshwater fish to lethal effects, depending on the specific waterbody involved, the size of the seawater spill into that waterbody, and the rate of freshwater exchange within that waterbody. Migratory fish are less likely to be affected by seawater spills because of higher tolerance to seawater, and the probability that most would have already left the freshwater environment by spring in their migration to sea. In large water bodies seawater spills are expected to have from no effect to sublethal effects on freshwater fish. In small water bodies with restricted water exchange, lethal effects are more likely to result from a medium to large seawater spill. Because of the small size of the seawater spills anticipated, and the low diversity and abundance of freshwater fish in most of the Planning Area, seawater spills are not expected to have a measurable effect on arctic fish populations in the Planning Area over the production life of the field.

(c) Summary

The primary effects of Alternative A involve water withdrawal from rivers and lakes. Potential loss of fish is highest for river withdrawals. Activities related to development that could impact fish include excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways. Gravel extraction has potential for habitat creation and enhancement. Impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be minor if adequate controls are in place. Given the small size of the fuel spills anticipated and that such spills are most likely to occur on drill pads, fuel spills associated with Alternative A activities are not expected to have a measurable effect on the arctic fish populations in the Planning Area. Fuel spills occurring in a small fish-containing body of water with restricted water exchange might be expected to kill a small number of individual fish. In the event a natural gas blowout occurred, some fish in the immediate vicinity might be killed.

(3) Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, and A-3, and ROP's A-6, A-7, and A-8 would provide increased protection to fish and fish habitat during fuel use, handling, and storage. ROP E-6 and ROP E-8 would be beneficial to fish habitat and fish. Stipulation B-1 would provide protection for water withdrawals from rivers and certain lakes but does not address water withdrawal from lakes less than 7 ft in depth. ROP C-1would protect rivers and lakes from additional freezedown. Stipulation D-1would reduce impacts during oil and gas exploratory drilling. ROP E-3 would reduce potential for disruption of fish passage.

(4) Conclusion--First Sale

Based on the discussion in the text, construction of pads, roads, and airstrips, and fuel spills associated with Alternative A activities might be expected to kill a small number of individual fish, but are expected to have no measurable effect on arctic fish populations. Increased mortality is anticipated when water withdrawals occur in river pools. Potential mortality from water withdrawals in lakes is also possible, although limits on withdrawal and monitoring of water quality should minimize concerns. Gravel extractions can lead to habitat enhancement under certain situations. Seismic surveys, non-oil and gas activity, causeways, and seawater spills under Alternative A are not expected to have a measurable effect on arctic fish populations in the Planning Area over the production life of the oil fields.

(5) Multiple Sales

It is assumed multiple sales under Alternative A would result in an increase in the number of exploratory wells from 6 to 16 under a single sale to 18 to 48, and delineation wells would increase from 2 to 24 under a single sale to 6 to 48 (Table IV-07). Total pipeline mileage for new oil, gas, and service lines would range up to 740 mi (Table IV-29). Seismic surveying activity would remain the same.

Water withdrawals would increase in proportion to the activity level. Given the large quantity of lakes in the area likely to be developed, water withdrawal could be spread across a number of lakes. Increased water use is not expected to impact fish more severely than under a single sale. Gravel pads and roads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. It is estimated that the amount of crude oil spilled would double. The impacts would also double though they would still be minor. However, if there were not enough time between activities to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

(6) Conclusion--Multiple Sales

Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads and roads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater, though still minor, effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

b. Marine Fish

Under Alternative A, the northern coast of the Planning Area, extending from Smith Bay-Dease Inlet to west of Barrow, would be open to leasing. Several species of marine fishes (see Figure III-25) occur year round or seasonally in the marine waters adjacent to the Planning Area. Under Alternative A, some individual marine fish may be exposed to effects from oil and gas exploration and development and other activities. The activities and events most likely to have some effect on marine fishes would be those of vessel traffic, seismic surveys, and oil or diesel fuel spills.

(1) Effects of Non-Oil and Gas Activities

Non-oil and gas activities are not likely to have a measurable effect on marine fishes.

(2) Effects of Oil and Gas Activities

Marine fishes could be affected by marine seismic surveys, marine construction, and marine oil or fuel spills.

These activities and their potential effects are discussed below. A more detailed discussion of these activities and their potential impacts can be found in the *MMS Beaufort Sea Sale 144 final EIS* (USDOI, MMS, 1996a).

(a) Effects of Disturbances

Marine fishes and their habitat may be affected by the following routine impact-producing factors: seismic surveys, coastal construction and development, and marine vessel traffic. Such routine activities may result in lethal and/or sublethal impacts to marine fishes. Some species may be adversely impacted, while others may benefit from the impact-producing factors, although those species benefiting and those suffering adverse impacts would depend on a suite of dynamic variables. For example, the construction of a coastal docking facility may temporarily displace individuals of a species (e.g., arctic flounder) from the seafloor where construction is occurring, however, after construction ceases, the underwater footprint and structure of the docking facility may offer new heterogeneity refugia or habitat that could be exploited and repopulated by the displaced species and/or utilized by other species (e.g., snailfishes, prey species).

Seismic surveys in coastal waters of the Planning Area are conducted during colder months. Vibroseis is a commonly used sound source for seismic surveying in the arctic. Vibroseis, if used on sea ice, may temporarily disturb marine fishes that are in the proximate area, likely effects would include avoidance behavior and short-term added stress but also could result in the death of some individuals of the more sensitive life stages (e.g., juveniles). However, such impacts on most overwintering marine fish are expected to consist of short-term, sublethal effects and are not regarded to be biologically significant. No measurable effect on marine fish populations would be expected. While there is no stipulation that precludes seismic surveys above overwintering areas for marine fish, the likelihood of their occurrence in such areas is considered very low.

Drilling inland is not expected to yield measurable impacts to marine fishes or their habitats. However, onshore and offshore coastal lands are available for leasing, thereby probably leading to exploration and development; drilling in coastal waters may impact marine fishes and their habitat. Drilling introduces noise into the coastal/marine environment that may temporarily disturb marine fishes (e.g., arctic cod, fourhorn sculpin, or arctic flounder) or their prey (e.g., mysids and amphipods). Such effects are not expected to be biologically significant or measurable. Such disturbance may be advantageous to some individual fishes or species, or adverse for some species--or both. The North Slope is a zero discharge area, hence, drilling muds and cuttings are not expected to be introduced into coastal/marine waters where they might impact early life stages of marine fishes or introduce constituents into the food web for bioaccumulation or biomagnification.

The construction of various facilities associated with the Preferred Alternative may impact marine fishes. Those construction projects most likely to impact marine fishes include: coastal staging facilities, particularly docking facilities; coastal drilling or production facilities; waterflooding intake and treatment plants; causeways; and pipelines.

Alternative A also may involve the construction of a coastal docking facility to off-load supply barges adjacent to the Planning Area. Construction of docking facilities and similar staging facilities, particularly if they are located in coastal/marine waters would diminish the area available as fish habitat, yet also possibly create new habitat (most notably refugia) Also like coastal drilling, construction in coastal/marine waters would introduce additional noise into marine fish habitat, thereby possibly disturbing fishes or their prey. Such acoustic disturbance is expected to be localized and limited to the periods of noise production. The effect of a docking facility on marine fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory marine fish. However, the construction of a facility that provides for the movement of these marine fish is not likely to adversely affect them. Because supply barges are shallow-draft vessels, the docking facility for Alternative A is expected to be constructed in shallow, nearshore waters. Additionally, the size of the facility for Alternative A is expected to be relatively small (up to several hundred feet) and to provide for the movement of coastal marine fish. Hence, the construction of a coastal docking facility associated with Alternative A is not expected to have a biologically significant or measurable effect on marine fish populations.

Waterflooding intake and treatment plants may entrap and impinge marine fishes, if the intake is located where such fishes occur. Approximately 1.5 million fish larvae of 9 fish species were estimated to have been entrained in the Prudhoe Bay facility in 1985 (NRC, 2003). The cumulative impacts to marine fish populations in the region as a result of constructing additional waterflood intakes from coastal waters is difficult to predict, since the abundance and population dynamics of the various marine fishes inhabiting the Planning Area and adjacent waters are poorly known or understood.

Construction of causeways may impact marine fishes. Causeways in the Beaufort Sea are among the most intensively studied anywhere (NRC, 2003). According to the NRC (2003), causeway studies revealed that, when wind is from the east, a wake eddy forms on the west side of the causeways that allows cold, high-salinity water to reach the surface. The cell of cold water on the west side of West Dock (a causeway on the Beaufort Sea) is the mechanism that most likely impedes fish movements. However, the issue of whether such impedance of fish movements by causeways is biologically significant is heavily disputed. The NRC (2003) cited Gallaway and Fechhelm (2000) as concluding that fish populations in the region appear to be fluctuating in response to naturally occurring physical phenomena, and that effects of existing causeways have been at least partially mitigated with retrofitted breaches, thereby permitting fish movement through the causeways. If causeways are constructed they may impact some marine fish species, but their impacts may be mitigated by incorporating breaches that permit fish movement. Causeways may also provide new habitat and refugia to marine fishes and their prey.

The construction of pipelines in coastal/marine waters may temporarily disturb marine fishes and their prey. Emplacement of a pipeline in coastal waters may destroy habitat or result in lethal and sublethal impacts to prey. Such impacts are expected to be localized and limited to the period of physical disturbance caused by pipeline construction. Marine fishes may scatter from the area of physical disturbance for a short period, and return following the abatement of disturbance. Some marine fish species may return to the disturbed area to scavenge on benthic invertebrates that are displaced, killed or injured by the placement of the pipeline (a beneficial impact to some marine fishes).

Decommissioning and abandonment of facilities involves the removal of equipment and restoration of the facility site. Associated abandonment activities may result in disturbances of coastal/marine waters (e.g. decommissioning of a docking facility). Abandonment operations may occur over a period of years, although timing and scope of actual disturbances as a result of the operations may vary. Decommissioning and abandonment operations may result in lethal or sublethal effects to marine fishes and their prey, as well as destroy marine fish habitat created by the structures being decommissioned and dismantled. Some marine fishes may be opportunistically consumed by various predators, including other marine fishes, as individuals are suddenly exposed as a result of destroying refugia (e.g. pipes, braces, pilings, etc.) during decommissioning operations. In such cases, decommissioning and abandonment operations may be beneficial to some individual marine fishes, and/or adverse for other marine fishes.

Inland and coastal oil and gas exploration and development operations are contingent on logistic supplies and equipment barged into the region. Marine vessel traffic introduces ancillary acoustic noise and physical disturbances into the coastal/marine environment. Such acoustic or physical disturbances may be adverse and/or beneficial to marine fishes and their habitats, however, the disturbances are not believed to be biologically significant or measurable.

(b) Effects of Spills

Hydrocarbon spills may adversely impact marine fishes of any life stage. Such impacts may include sublethal and/or lethal effects. The intensity of the effects upon a marine fish population or assemblage of species is dependent on a suite of dynamic factors. The size of the spill does not necessarily directly relate to the number of individuals that may be impacted. Hydrocarbons may be introduced into the coastal/marine environment as a result of facility spills, pipeline spills, or marine vessel overboard discharges.

Oil spills can more specifically affect marine fishes and their habitat in many ways, including the following:

- cause unnatural mortality to eggs and immature stages, abnormal development, or delayed growth from acute or chronic exposures in spawning or nursery areas;
- impede the access of migratory fishes to spawning habitat because of contaminated waterways;
- alter behavior;
- displace individuals from preferred habitat;
- constrain or eliminate prey populations normally available for consumption;
- impair feeding, growth, or reproduction;
- contaminate organs and tissues and cause physiological responses, including stress;
- reduce individual fitness and survival, thereby increasing susceptibility to predation, parasitism, zoonotic diseases, or other environmental perturbations;
- increase or introduce genetic abnormalities within gene pools, and
- modify community structure that benefits some fisheries resources and detracts from others.

Concentrations of petroleum hydrocarbons are acutely toxic to finfishes a short distance from and a short time after a spill event (Malins, 1977; Kinney, Button, and Schell, 1969). However, the majority of adult finfish are able to leave or avoid areas of heavy pollution and thus avoid acute intoxication and toxicity. Evidence indicates that populations of free-swimming finfish are not injured by oil spills in the open sea (Patin, 1999). Conversely, floating eggs, and juvenile stages of many species can be killed when contacted by oil (Patin, 1999), regardless of the habitat. In coastal shallow waters with slow water exchange, oil spills may kill or injure demersal finfish, shellfish, and other invertebrates in addition to cultivated species.

The contact of aquatic organisms with oil most often results in the appearance of oil odor and flavor in their tissues (Patin, 1999). In the case of commercially valued fishery resources, this certainly means the loss of their value and corresponding fisheries losses. Experimental studies show that the range of water concentrations of oil causing the taint in fish, crustaceans, and mollusks is very wide. Usually these concentrations vary between 0.01 and 1.0 milligrams per liter, depending on the oil type, composition, form (dissolved, slick, emulsion), duration and conditions of exposure, kind of organism, and other factors (Patin, 1999). Migratory fishes (for example, salmon or herring) tainted by oil in one location may move well beyond the recognized boundaries of an oil spill, thereby becoming available for harvesting elsewhere. Patin (1999) drew the following conclusions from various studies devoted to the tainting of commercial organisms in oil-polluted areas:

- The contact of commercial fish and invertebrates with oil during accidental oil spills practically always leads to accumulation of oil hydrocarbons in their tissues and organs (usually within the ranges of 1 to 100 milligrams per kilogram). In most cases, the organisms acquire an oil odor and flavor. This fact is the main reason for closing fisheries in the affected area.

- Species reared in coastal mariculture/aquaculture facilities can be exposed to severe impact of accidental oil spills. Observations showed that several months after the spill, salmon cultivated at facilities still had elevated concentrations of oil hydrocarbons in their tissues and suffered diseases and increased mortality (citing MLA, 1993a).

While tainting of fisheries resources in some regions may not pose a real threat to consumers (for example, the

North Sea), fish tainting can be a real problem, especially for coastal fishing and aquaculture (Patin, 1999).

The most serious concerns arise regarding the potential sublethal effects in fisheries resources (including commercially valued species) when exposed to chronic contamination within their habitats (Patin, 1999). It is striking that the toxicity of oil pollution to aquatic populations has been seriously underestimated by standard short-term toxicity assays, and the habitat damage that results from oil contamination has been correspondingly underestimated (Ott, Peterson, and Rice, 2001). Research studies show that intertidal or shallow benthic substrates may become sources of persistent pollution by toxic polycyclic aromatic hydrocarbons following oil spills or from chronic discharges (Rice et al., 2000). Bivalves exposed to background contamination of polycyclic aromatic hydrocarbons may experience biological responses at the cellular level, disease, and histopathological changes (Patin, 1999). Finfish sublethal responses include a wide range of compensational changes (Patin, 1999). These start at the subcellular level and first have a biochemical and molecular nature. Recent research, mostly motivated by the *Exxon Valdez* oil spill, has found 1) polycyclic aromatic hydrocarbons are released from oil films and droplets at progressively slower rates with increasing molecular weight, leading to greater persistence of larger polycyclic aromatic hydrocarbons; 2) eggs from demersally spawning fish species accumulate dissolved polycyclic aromatic hydrocarbons released from oiled substrates, even when the oil is heavily weathered; and 3) polycyclic aromatic hydrocarbons accumulated from aqueous concentrations of less than 1 part per billion can lead to adverse sequelae appearing at random over an exposed individual's lifespan (Rice et al., 2000). These adverse effects likely result from genetic damage acquired during early embryogenesis caused by superoxide production in response to polycyclic aromatic hydrocarbons. Therefore, oil poisoning is slow acting following embryonic exposure, and adverse consequences may not manifest until much later in life. The frequency of any one symptom usually is low, but cumulative effects of all symptoms may be considerably higher (Rice et al., 2000). For example, if chronic exposures persist, stress may manifest sublethal effects later in a form of histological, physiological, behavioral, and even populational responses, including impairment of feeding, growth, and reproduction (Patin, 1999). Chronic stress and poisoning also may reduce fecundity and survival through increased susceptibility to predation, parasite infestation, and zoonotic diseases. These can affect population abundance and subsequently community structure. For more information summarizing the various adverse effects (both individual and population level) to ichthyofauna or their habitats (see Patin, 1999:tbls 29 and 30).

If spills were to occur near the Dease Inlet/Admiralty Bay/Elson Lagoon area, some of the oil could reach coastal/marine waters, thereby exposing marine fishes, their prey, and habitats to hydrocarbons.

Small onshore spills are expected to have little effect on marine fishes. However, some of these spills could enter the Dease Inlet/Admiralty Bay/Elson Lagoon area, thereby exposing some marine fishes, their prey, and habitats to contamination. In the arctic environment, the potential for an oil- or fuel-related spill to persist for long periods is high. Coastal bays and lagoons sheltered by barrier islands may naturally confine oil and fuel spills. Any oil moving under ice or in broken-ice flows has a high chance of persisting (NOAA, NMFS, 1976).

Modeling projections of spill movement after entering coastal waters and its subsequent fate are unavailable at this time. Marine fish species (particularly eggs, larvae, and juvenile fishes) inhabiting shallow intertidal and subtidal waters are believed most vulnerable to the acute and chronic effects of oiling, although fishes with early life stages that frequent the upper few meters of the water column also may be acutely and adversely impacted by spilled hydrocarbons. There is a low likelihood that an inland spill may reach coastal/marine waters of the Planning Area, hence, it appears unlikely that a spill would result in a biologically significant or measurable impact to marine fishes. If a spill adversely impacted a rare and native marine fish species or its habitat, it might constitute a biologically significant impact.

A variety of toxic chemicals is used for exploration and production operations. Chemical spills (other than hydrocarbons) may occur. However, their introduction into coastal/marine waters inhabited by marine fishes is regarded as unlikely.

(3) Effectiveness of Stipulations and Required Operating Procedures

Waste prevention, handling, and disposal and spills stipulations (A-1 through A-3) and ROP's (A-3 through A-8) reduce the potential for introducing fuel and oil spills into environments inhabited by marine fishes. Because accidental spills occur, the preparation for, and response thereto has the potential to greatly mitigate the magnitude of potentially adverse effects of petrochemical spills on marine fishes. Hence, the stipulations and ROP's may reduce the number of individual fishes impacted by a spill and the degree of lethal and sublethal effects upon them.

(4) Conclusion--First Sale

Based on the assumptions discussed in the text, seismic surveys, construction, and oil or diesel fuel spills associated with Alternative A are not expected to have a measurable effect on marine fish populations.

(5) Multiple Sales

The actions most likely to affect marine fish for the first lease sale have been discussed herein and include seismic surveys, construction-related activities, fuel spills, and oil spills. While additional Northwest NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative A are expected to have the same overall effect on marine fish as discussed for the first sale. If several lease sales were to occur under Alternative A, considerably more exploration activity would be expected to occur in the southern and central part of the Planning Area. The number and volume of spills estimated for multiple-sales scenario are the same as those estimated for the single-sale scenario.

(6) Conclusion--Multiple Sales

Seismic surveys and construction activities are likely to have a slightly greater overall effect on marine fish for multiple sales under Alternative A than the first Alternative A sale. Insufficient recovery time between sales and/or greater levels of activity for multiple sales would be likely to result in greater effects than for a single sale.

c. Essential Fish Habitat

As discussed in the No Action Alternative, EFH is unlikely to be affected. The potential impacts to the few salmon that are present in the Northwest NPR-A Planning Area are much the same as those for all other fish species. Consequently, impacts on salmon, as part of EFH, are evaluated in the freshwater fisheries analysis for this alternative.

9. Birds

This section discusses potentially adverse effects of management actions on non-endangered birds within the Northwest NPR-A Planning Area under Alternative A. Such actions, including oil and gas exploration and development, potentially may result in: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by crude oil or refined products, wastewater, and solid/liquid wastes of varying toxicity. This analysis assumes stipulations in Table II-02 are in place. Nearly all of the approximately 70 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northwest NPR-A portion of the Arctic Coastal Plain (ACP). Principal bird groups considered include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Non-Oil and Gas Activities

Effects--summarized below--from management actions other than oil and gas exploration and development under Alternative A are likely to be somewhat greater than those discussed under the No Action Alternative, Section IV.B.9. This is because several categories of anticipated non-oil and gas activities, including aircraft use and duration of camp occupation, are elevated under Alternative A. The two alternatives are similar in that neither proposes new protective land designations, and anticipated numbers of overland trips and Colville River float trips are the same.

Most ground transport activities occur in winter and thus would not disturb most bird species or affect their habitats. Ptarmigan, gyrfalcon, and snowy owl may be displaced temporarily from vehicle routes, a negligible effect.

Bird species are likely to display variable displacement from within 700 ft to about 3,000 ft of large summer encampments (Grubb et al., 1992; Johnson et al., 2003; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978), causing a local decline in nest attempts and success. Of particular concern are species that are sensitive to disturbing activities, and are uncommon and/or have shown general or ACP population declines, such as red-throated loon and Sabine's gull. Local breeding pairs of affected species are likely to experience minor declines in breeding attempts or success from disturbance in summers when camps are occupied. This is likely to vary depending upon the availability of appropriate habitat in the vicinity. Under Alternative A, occupation of large camps is anticipated to be 12 weeks rather than 6 weeks as under the No Action Alternative (Table IV-28). However, this difference is not likely to alter the disturbance effects on birds substantially because in the context of the short arctic breeding season, those that are displaced when the camp is first occupied probably would not return to the area to renest after 6 weeks any more than after 12 weeks because of insufficient time remaining in either scenario to raise a brood. Also, those individuals that are tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks.

Effects of a few small camps that are in place for a period of 6 to 12 weeks are likely to be negligible for most activities and species, but potentially could cause a minor loss of productivity if larger numbers of camps affect a larger area of habitat occupied by some species that are uncommon, decreasing, or recently declined, as discussed above for large camps. If predators such as foxes and ravens are attracted to temporary, isolated camps, they may decrease breeding success of local bird communities. For most species, this is likely to be a negligible effect; species with small world populations--such as the buff-breasted sandpiper--may experience more severe effects if predator populations increase. Overall habitat loss from non-oil and gas activities in Northwest NPR-A, though somewhat greater under Alternative A than the No Action Alternative, is expected to be negligible. Solid material removal and fuel-spill cleanup and remediation may disturb local nesting, brood-rearing, or molting birds for varying periods, resulting in some failed nests or decreased productivity. However, spills of refined-oil products are likely to be contained and cleaned up before contacting birds. Small groups traveling on the Colville and other rivers at the frequency anticipated are expected to cause negligible disturbance of nesting raptors or passerines. Except for the presence of large camps (and small camps if occupied in numerous locations), which is likely to result in minor impacts, the overall effect of ground-based activities is expected to be negligible.

Effects of routine aircraft flights into large camps may range from causing avoidance of certain areas by birds to abandonment of nesting attempts or lowered survival of young. As a result of the temporary occupancy and scattered locations of such camps and the relatively small area overflown at a sufficiently low altitude to cause brief episodes of disturbance, it is not likely that air support traffic would affect the productivity of a substantial proportion of their regional populations--a minor effect with regard to such populations. Regardless of where they originate, such flights may pass over relatively high-density areas of one or more species, although most species are scattered in distribution for much of the breeding season. Aerial survey flights for monitoring bird or caribou populations have potential for disturbance of birds because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the ACP per season, so that areawide disturbance effects are likely to be minimal. Other aerial surveys also cover small percentages of the Planning Area. For this reason, the increase from 2 weeks of wildlife surveys under the No Action Alternative to 3 weeks under Alternative A--or increase of other surveys from occasional to several 1- to 2-week periods--is not likely to substantially increase disturbance in any given area (Table IV-28). In isolated areas aircraft effects are likely to be negligible.

Quantitative effects of most factors may be difficult to separate from natural variation in population numbers. Stipulations would minimize disturbance from most factors, prevent spilled fuel from reaching surrounding habitats, and help prevent pollution and degradation of essential bird habitats.

b. Effects of Oil and Gas Activities

Oil and gas leasing, exploration, and development/production would be allowed throughout the Planning Area under Alternative A (Map 15). Exploration and development/production activity could vary substantially depending on the per barrel price of oil (Table IV-05 and Table IV-07). Thus, the number of exploration wells could range from 6 to 16, delineation wells from 2 to 24, exploration/delineation rigs from 1 to 4, production pads from 0 to 8, staging bases from 1 to 2 (Table IV-05) and 230 new pipeline miles (Table IV-29). If only exploration were to occur, activities would be expected to take place over a period of 7 years. If development were to follow, 10 years would be required. Production is estimated to last 22 years. Development in the Planning Area is expected to involve relatively small, interconnected gravel structures. The area covered may range from 10 acres for a single pad to about 100 acres--including pad(s) with short roads (5 to 7 acres/mi) and airstrip (5,00 to 6,000 ft)--for an Alpine-like field development.

(1) Effects of Disturbances

(a) Seismic Exploration

Seismic surveys occur during winter months (December-April) when nearly all birds are absent from the region. Under Alternative A it is assumed that three seismic survey operations would occur during each winter season in the Planning Area. A typical 2-D operation consists of 10 vehicles with a crew of 40 to 60 people traversing 200-ft-wide gridlines 5 to 10 mi apart, and may cover about 500 line-miles (804.5 km) in an area of about 1,200 mi² (3,108 km²), which represents about 8.8 percent of the Northwest NPR-A Planning Area. Such an operation could displace small numbers of ravens, ptarmigan, gyrfalcons, and snowy owls temporarily from within 700 ft (213 m) to about 3,000 ft (1 km or 0.6 mi) of the local activity area around each 5- to 10-mi segment of the survey grid as it is occupied in sequence during the winter season, as well as around the mobile camp (moved every 3 to 7 days) that houses the crew during the survey. At average snowy owl densities of 0.023/km² (Larned et al., 2003), for example--and assuming most individuals stay in the same general area for most of the winter--potential maximum of 1 owl could be disturbed temporarily in sequence along the entire survey route traveled during one winter season. A 3-D operation (involving a crew of 50 to 80 people collecting 2 to 4 mi² (5.2 to 10.4 km²) of data per day) can cover about 450 mi² (724 km²) per winter season, and could displace a maximum of 23 owls in sequence along the survey route.

However, because the camp sites and survey areas are occupied for relatively brief periods, and most of the birds are dispersed in relatively low numbers over a large area, the duration of disturbance incidents is likely to be brief and infrequent. Thus, although there is likely to be a brief displacement of birds from each local area occupied--causing a slight momentary increase in energy requirement--this would not result in a substantial adverse effect, and the overall population effect from this activity is likely to be negligible. Disturbance from tanker trucks, other vehicles, and aircraft supplying seismic operations may displace individuals of these species from the immediate area of the route from Kuparuk or other fuel and supply depot, but this effect also is likely to be negligible. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early breeding season activities of these species could occur, causing some negligible decline in breeding success by the snowy owl and gyrfalcon. Seismic crews are required by stipulation to incinerate and remove waste materials from BLM lands; hence this activity is not expected to enhance the survival of predatory arctic foxes.

(b) Oil and Gas Development

Responses to disturbance can be categorized as 1) causing injury or death, 2) causing increased energy expenditures that affect physiological condition and rate of survival or reproduction, or 3) causing long-term changes in behavior including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect from oil and gas development and production in Northwest NPR-A although careful planning and scheduling could avoid most serious effects. Depending on location and season, oil and gas activities in areas where waterfowl and other species occur could potentially cause increased disturbance from routine aircraft operations, gravel-mining operations, presence of gravel pads and facilities, and associated vehicle and foot traffic. Initial developments are likely to occur in the extreme northern portion of the Planning Area, generally surrounding the Dease Inlet/Admiralty Bay area and to Smith Bay and the Chukchi coast. Various species could be affected to some extent by disturbance events (e.g., passage of aircraft), although most incidents are expected to result in negligible effects from which individuals would recover within hours to 1 day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially may adversely affect physiological condition, molt, nest success, and productivity. Ultimately this could result in minor local and regional population-level effects although these usually are difficult to separate from natural variation in population numbers and nesting productivity. The presence of facilities and construction of gravel structures would result in displacement from favored habitats and associated energy costs which could result in short-term, negative effects during breeding, brood-rearing, or migration; however, the footprint of such structures is quite small, so effects are not likely to be evident at the regional population level.

1) Bird Concentrations

Repetitive disturbance events are expected to produce a more evident local--or potenially a regional--population effect where higher densities of bird species occur that are sensitive to disturbance during certain periods of the annual cycle, or whose population has declined or is declining. Such areas include east, south, and west of Dease Inlet/Admiralty Bay; the south-central portion of the Planning Area to its southern boundary; the western Planning Area in the vicinity of Peard Bay, Wainwright, Icy Cape/Kasegaluk Lagoon; and to some extent the area south and southwest of Smith Bay. Species at particular risk from disturbance effects in the Dease Inlet/Admiralty Bay area include red-throated loon, tundra swan, brant, long-tailed duck, king eider, and Sabine's gull (Map 39, Map 40, Map 42, Map 43, and Map 46); in the vicinity of Smith Bay, yellow-billed loon, tundra swan, and Sabine's gull (Map 39 and Map 46); in the south-central area, yellow-billed and red-throated loons, king eider, and Sabine's gull (Map 37, Map 43, and Map 46); and in the western area, red-throated loon, long-tailed duck, and king eider (Map 42and Map 43).

2) Air-Traffic Effects

Air traffic is likely to be the most important source of disturbance associated with oil and gas development; helicopters are the most disturbing type of aircraft. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992; Jensen, 1990; Miller et al., 1994; Ward et al., 1999), few comparable studies have been done of effects on other species at other phases of the annual cycle, or long-term effects on populations. When exposed to helicopters at typical altitudes and take-off or landing, behavioral responses of brant to the aircraft passage could be observed for about five minutes. Increased lateral distance from the aircraft reduced the duration of response. Brant exposed to helicopter flights moved five times farther than those not exposed, and this effect persisted at least for the number of days that similar disturbance was experienced. The authors thought it likely that such increased patterns of movement ultimately could affect habitat use. Brant responded to each aircraft overflight equally showing no evidence of habituation to this disturbance.

In studies at the Alpine Development on the Colville River delta Johnson et al. (2003) found that distributions of most species relative to the airstrip did not show detectable differences. Only trends in abundance of white-fronted geese, and ducks as a group, suggested a decline from pre-construction (pre-1999) to construction (1999-2001), although cool weather during the latter period was a potentially influential factor. When high levels of air traffic supporting heavy construction activity occurred, waterfowl nest density--particularly of white-fronted geese--was lower within 1,000 m of the strip than at more distant sites. However, over the course of the study, densities occasionally were lower farther from the strip rather than closer, and higher closer to the strip rather than at greater distances, somewhat confounding conclusions regarding disturbance. These latter results may reflect differences between the areas sampled to some extent since it was a requirement to include the area adjacent to the airstrip, for which closely comparable habitat areas may not have existed nearby. There was no significant difference in average distance of nests from the airstrip between 1996 when there was little or no construction activity, and 1999-2001. White-fronted goose nests were redistributed relative to the airstrip during heavy construction years, although their use of habitats remained the same. Distance of tundra swan nests from the airstrip also did not differ significantly between pre-construction and construction, nor did aircraft or vehicle activity appear to negatively affect goose nest attendance. Nest densities of shorebirds and songbirds were higher nearer the airstrip. However, TERA (1993b) found reduced density of shorebird nests within 100 m of a heavily used road, and Troy and Carpenter (1990) found that birds displaced by pad construction nested in adjacent similar habitat. These results support both the assumption that birds generally would avoid areas with potentially disturbing activity to some extent, and that they are more tolerant of such activity than might be expected. Evidently, the response of birds to potentially disturbing factors is complex, representing a synthesis of competing habitat requirements and behavioral factors.

Aircraft routinely flying over areas of higher bird density in the Planning Area (see Maps 36-46) are likely to cause minor effects in the local populations of several species. For example, disturbance associated with developments in the northern area (where the first are likely to occur) could adversely affect higher concentration areas of red-throated loon, yellow-billed loon, tundra swan, brant, long-tailed duck, king eider, and Sabine's gull. In the past, red-throated loon numbers have shown a significant decline, as have king eider; and yellow-billed loon and Sabine's gull are declining at a non-significant rate (Larned, Stehn, and Platte, 2003). The brant studies noted above suggest that if 1) aircraft are flown at higher altitude (e.g., 3,000 ft), 2) the frequency of flights is reduced during periods when serious effects from disturbance are most likely, and 3) known high-density/critical activity areas are avoided, effects of aircraft operations are likely to be reduced substantially.

3) Structures

Heavy equipment would be transported to staging areas or development sites in winter, with potentially the same effects on ptarmigan, gyrfalcon, and snowy owl as noted in the seismic discussion above. The presence of pads, short connecting roads, facilities, and drilling operations would displace all but the most tolerant individuals of species breeding locally from the affected site, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat, as suggested by studies at Prudhoe Bay (Troy and Carpenter, 1990). Such displacements are not expected to cause long-term effects on population productivity given the relatively small areas likely to be involved at a particular site (TERA, 1993b; Troy and Carpenter, 1990), but would be a long-term or permanent local result. Overall effect is likely to be negligible.

4) Raptors

Hawks, eagles, or falcons nesting along the Colville and other rivers could experience adverse effects under this alternative, principally because of potentially greater levels of activity in the general vicinity of nest sites. However, there is little reason to expect more oil and gas activity near rivers than in other areas, and location of the Colville at the southern Planning Area boundary probably economically limits the likelihood of its use as a transport corridor for oil and gas development. Overall effect in Northwest NPR-A is likely to be negligible.

5) Gravel Operations

Gravel within the Planning Area is expected to be mined from river drainages in winter and be transported to development sites via ice roads. This activity would displace any nesting species from the mine area (up to 50 acres per gravel mine) to undisturbed habitats, although few species are expected to be nesting on gravel bars in rivers where most gravel extraction is likely to occur. Mining could cause local disturbance and temporary displacement of the 3 resident species along the ice road transport route and at the mine site in winter. Because primary development is likely to be confined to the northern portion of the Planning Area, raptor habitat areas in the southern NPR-A (e.g., Colville River, Ikpikpuk River) with high raptor populations are not expected to be disturbed by gravel mining. Depending on location and extent of the mine site, the overall effect of habitat loss is likely to be negligible for species with abundant, stable or increasing populations. Potentially minor effects could result if mining were to become widespread and eliminate specific areas of habitat used by species that have small populations and/or are declining (e.g., buff-breasted sandpiper).

6) Pipelines

Because construction of pipelines east to connect with Kuparuk and TAPS is likely to take place entirely during winter, effects on the three resident species may be similar to those discussed above under seismic effects. Presence of an aboveground pipeline is not likely to represent a significant collision hazard since migrating birds generally fly well above pipeline elevation, and much of the movement during the breeding season is by swimming. A gas pipeline leak is likely to cause only minor effects on local bird populations, mainly from presence of response personnel and equipment (see below for effects of crude-oil spills). Overall impact of pipelines is likely to be negligible.

7) Predation

Potential predator enhancement at the level of development envisioned for NPR-A is not likely to approach that of the Prudhoe Bay area. This is because a) development sites are likely to be few (10 fields) and relatively small and scattered so they are not as likely to concentrate predators, and b) practices that have allowed artificially enhanced predator populations in the past are expected to be tightly controlled. At the Alpine Development, Johnson et al. (2003) found that predator numbers remained stable from pre-construction through construction periods. They also found no clear evidence that predation rates by either foxes or avian predators changed during their study. Thus, predator populations in the vicinity of small footprint developments are not expected to increase significantly. In addition, few of the species present on the western ACP nest in colonies, which would make them prone to substantial losses if discovered by predators. Brant are present on the western ACP in 30 to 40 colonies, most averaging 10 or fewer nests (Ritchie, Lovely, and Knoche, 2002). White-fronted geese, nesting in small loose colonies or as single pairs, would not be as subject to high predation losses. Overall, effects of predators on regional populations of most species are likely to be negligible; effects on brant could be more substantial in some years and/or colonies, representing minor losses on a subjective scale. Species whose world populations are small, such as the buff-breasted sandpiper, would experience disproportionately large effects if predator populations were artificially enhanced.

(2) Effects of Spills

A 500- or 900-bbl crude-oil spill asumed for purposes of analysis (see Table IV-17 and Table IV-19) from a pad or pipeline onto tundra would be likely to cause mortality of small numbers of shorebirds and passerines. If it were to enter local lakes or interconnected wetlands, small numbers of loons and waterfowl--and possibly additional shorebirds--could be contacted. Numbers of individuals oiled would depend primarily upon wind conditions and numbers and location of birds following entry of the spill into the water. If the spill were to enter a river, a variety of waterfowl and shorebird species could be present, particularly where the river empties into the marine environment. For most species, such losses are likely to represent negligible impacts at both the local and regional population level. Effects could be elevated to minor if small and/or declining populations were involved.

If gyrfalcons, peregrine falcons, or rough-legged hawks were nesting in the vicinity, they could become secondarily oiled by preying on oiled birds. Mortality of breeding falcons, for example, likely would represent a minor loss for the local population, but still would likely represent a negligible effect on the regional populations.

Because of the oil-absorptive capacity of tundra habitats, it is likely that only a small part of a spill would enter a river or the marine environment. As a result of their small average size, onshore oil spills reaching aquatic habitats could be expected to cause losses of only up to a few tens of individuals. However, a few hundred individuals potentially could be killed by cumulative mortality from many small spills. The effect of such losses may not be detectable above the natural fluctuations of the populations. Under Alternative A, the entire Northwest NPR-A coastline could be available for oil and gas leasing. If a spill were to move into a delta area or into Admiralty Bay, Elson Lagoon, Dease Inlet, Peard Bay, Kasegaluk Lagoon, or other coastal waters, additional waterfowl species that breed, molt, or stage before or stop during migration would be at risk. A spill entering a river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate before occupying nesting areas. If either of these scenarios were to involve yellow-billed or red-throated loons, brant, king or common eiders, black guillemots, or Ross' gulls the effect could potentially elevate to a moderate level.

Loons and flocks of brant, long-tailed duck, and eiders staging before or stopping during migration in protected coastal habitats--as well as black guillemots year-round or Ross' gulls in fall--could come into contact with a crude-oil spill from an offshore site (however, offshore rigs may not be used) during August or September when ice cover is less than 50 percent. An onshore spill of crude from a pad or fuel-oil from a tank near the coast that reaches the marine environment, could contact loons and flocks of brant, long-tailed duck, and eiders staging before or stopping during migration in protected coastal habitats (e.g., Elson Lagoon, Dease Inlet, Smith Bay, Kasegaluk Lagoon, and nearby barrier islands), as well as black guillemots year-round or Ross' gulls in fall. Likewise, a fuel spill from hypothetical onshore staging sites at Cape Simpson, Barrow, or Peard Bay (Map 107), or from fuel barges supplying these sites, could contact these species with similar effects. Because of numbers of birds present, risk would be greatest from June through October. Although small spills likely would be contained near the site, the probability of escaping fuel contacting nearshore lagoon areas and barrier islands within 30 days is less than 22 percent in summer (USDOI, MMS, 2003:Table A2-21). Physiological effects on individual birds would be as described in the Northeast NPR-A IAP/EIS (USDOI, BLM and MMS, 1998). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects that interfere with the reproductive process caused by oil ingested by adults during preening or feeding.

Some brood-rearing, molting, or staging loons, brant, long-tailed ducks, or other waterfowl could contact oil in coastal habitats. Large numbers of staging brant, molting king eiders, and nesting or staging common eiders in Kasegaluk Lagoon would be at risk. Mortality of molting long-tailed ducks from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers of that species are stable, declining, or increasing in various areas (Conant, 1997; Larned, Stehn, and Platte, 2003). Flocks of staging eiders could contact oil in nearshore or offshore areas. The king eider population has declined 50 percent in 20 years, with the result that substantial mortality from a spill could have a significant impact on the population. Likewise, barrier island and coastal nest sites of common eiders, whose population also has declined significantly, could be contacted by a marine spill causing substantial losses. Substantial mortality of yellow-billed or red-throated loons probably would represent a serious loss, but of unknown population consequences. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., river deltas); and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off river deltas in spring could contact migrant loons and eiders. Because relatively small areas of terrestrial or marine environments are likely to be oiled, a spill is likely to contact relatively small numbers of birds, and thus primarily cause minor effects.

A pipeline spill of seawater used in the waterflood enhancement stage of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is expected to be no more than a few acres; such a small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

(3) Summary

Principal bird groups inhabiting the NPR-A or nearby marine waters are loons, waterfowl, shorebirds, raptors, passerines, and seabirds. Most ground transport activities, including those associated with oil and gas development under Alternative A, occur in winter and thus would not disturb most bird species. Ptarmigan, gyrfalcon, and snowy owl may be displaced temporarily from vehicle routes. The effects from seismic exploration activity in winter and small camps in summer are likely to be negligible. Most bird species are likely to be displaced from within 700 to 3,000 ft of large encampments that are in place for up to twelve weeks during the summer, causing a minor local decline in nest attempts and productivity in some species. Minor population effects most likely would occur through exposure of species that are uncommon, decreasing, or recently declined. Of particular concern are species that have shown general or ACP population declines such as yellow-billed loon, red-throated loon, king eider, common eider, and Sabine's gull. Impacts on regional populations of species not showing declines likely would be negligible.

Although predators attracted to camps may decrease breeding success of local bird communities, this is likely to be a negligible effect. Fuel spill cleanup may disturb birds in the local area. Small survey parties on the Colville and other rivers are expected to cause negligible disturbance of nesting raptors, waterfowl, and passerines.

Frequent aircraft flights into large camps may result in minor effects ranging from avoidance of certain areas by birds to local abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights are likely to pass over high-density areas of one or more species; however, the effect on regional populations is likely to be negligible. Aerial survey flights for monitoring bird or caribou populations have potential for disturbance of birds because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects are likely to be negligible. In isolated areas aircraft effects are likely to be negligible. Altitude and distance of aircraft from individual birds determines the duration of adverse response. Helicopter traffic is likely to be the greatest source of disturbance associated with oil and gas development. Regional populations of species such as loons, swans, brant, long-tailed duck, king eider, and Sabine's gull--all with high density areas in the northern Planning Area where development may first occur--could experience potentially minor effects from frequent aircraft overflights.

Habitat eliminated by gravel mines, pads, roads, and airstrips is likely to represent a negligible loss. An oil spill that reaches tundra could cause mortality of small numbers of waterfowl, shorebirds and/or passerines but spills are likely to be contained and cleaned up before contacting birds, resulting in a negligible effect. Oil entering ponds, lakes, or rivers may contact small numbers of loons and waterfowl--a negligible effect for most species other than red-throated loon, yellow-billed loon, brant, and king eider where the effect could be minor. A large spill entering the marine environment or river delta areas could contact molting, staging, or migrating loons, brant, long-tailed ducks, eiders, and possibly Ross' gulls, resulting in minor to moderate impacts depending on population status and extent of mortality of the particular species. Substantial mortality of king and common eiders and yellow-billed and red-throated loons would be effects of concern. In most instances, activities and actions are likely to affect only a relatively small proportion of available habitat of the type indicated and/or a relatively small proportion of a given species' regional population. Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations would decrease disturbance from most factors for most species, prevent spilled fuel and oil from reaching surrounding habitats, and help prevent oil pollution and degradation of important bird habitats.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate effects on birds of four types of problems that may result from oil and gas development activities: 1) disturbance from noise or activity, 2) adverse alteration of habitats, 3) contamination of waterbodies occupied by birds, and 4) mortality of fish that are prey for fish-eating birds.

ROP C-1f, by requiring that motorized ground-vehicle use be minimized within 1 mi of any raptor nest during the nesting season 15 April through 15 August (gyrfalcon nesting beginning 15 March), and possibly prohibiting such use within ½ mi of active raptor nests, could mitigate disturbance of nesting raptors and other birds occupying surrounding areas.

ROP E-6, by restricting approval of permanent oil and gas facilities within 500 ft of the floodplain of various waterbodies to those that would cause minimal impacts to wildlife, could mitigate disturbance of breeding waterfowl and shorebirds, including reduction of vehicle and aircraft noise and activity.

ROP F-1, by requiring that aircraft use be conducted so as to minimize impacts to birds, could mitigate aircraft disturbance of birds.

Stipulation J-1 requires that all reasonable efforts be made to locate permanent oil and gas facilities as far from raptor nests as feasible, which could mitigate disturbance of raptors and other birds occupying surrounding areas in the Colville River Special Area, including reduction of vehicle and aircraft noise and activity.

ROP E-6, by restricting approval for location of permanent oil and gas facilities within 500 ft of the floodplains of various wetlands to those that are likely to cause minimal impacts to wildlife, could reduce the loss (burial) of wetland habitats important for breeding waterfowl and shorebirds.

Stipulation J-1, by requiring permittees to minimize alteration of high-quality raptor foraging habitat, particularly in wetland and riparian areas, could reduce impacts on important habitats of raptors and other birds occupying surrounding areas in the Colville River Special Area.

Stipulation A-2, by requiring fuel storage and fueling to take place in diked and impermeably lined areas at least 100 ft from the active floodplain of non-fish-bearing and 500 ft from the active floodplain of fish-bearing waterbodies, could prevent spilled fuel, other petroleum products, and other liquid chemicals, from contacting nesting or brood-rearing birds, or from entering waterbodies where waterbirds could become contaminated and die.

Stipulation A-3, by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing and 100 ft of the active floodplain of non-fish-bearing waterbodies, may prevent spilled fuel from contacting nesting or brood-rearing birds, or entering waterbodies where waterbirds could become contaminated and die.

ROP C-1, by recommending that refueling of most equipment take place at least 500 ft from the active floodplain of fish-bearing and 100 ft from the active floodplain of non-fish-bearing waterbodies, may prevent spilled fuel from entering waterbodies where waterbirds could become contaminated and die.

ROP E-6, by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife, may prevent spilled fuel or leaking pipeline oil from contacting nesting or brood-rearing birds, or entering waterbodies where waterbirds could become contaminated and die.

Stipulation A-2, by requiring storage and fueling to take place in diked and impermeably lined areas at least 100 ft from the active floodplain of non-fish-bearing and 500 ft from the active floodplain of fish-bearing waterbodies, could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die, adversely affecting the breeding success of these waterbird species.

Stipulation A-3, by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing and 100 ft of the active floodplain of non-fish-bearing waterbodies, may prevent spilled fuel from entering waterbodies where prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die, adversely affecting the breeding success of these waterbird species.

ROP C-1, by recommending that refueling of equipment take place at least 500 ft from fish-bearing and 100 ft from other waterbodies, may prevent spilled fuel from entering waterbodies where prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die, adversely affecting the breeding success of these waterbird species.

ROP E-6, by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife, may prevent spilled fuel or leaking pipeline oil from entering waterbodies where prey of fish-eating waterbirds could become contaminated and die, adversely affecting the breeding success of these waterbird species.

Stipulation B-1, by prohibiting water withdrawal from shallow, fish-bearing lakes in winter, could prevent winter die-off of prey of fish-eating birds (e.g., loons, mergansers, terns), adversely affecting the breeding success of these waterbird species.

These stipulations and required operating procedures would minimize disturbance of most bird species from most factors; minimize adverse alteration of habitats; and could help prevent spilled fuel or other toxic materials from reaching waterbodies where waterbirds, or prey of fish-eating birds, or surrounding nesting and brood-rearing habitats, could become contaminated. The measures do not specifically establish minimum aircraft altitudes for routine flights over areas of high bird density. Also, the lack of a specific stipulation for summer use of ground vehicles in high bird density areas, except in the vicinity of raptor nest sites, could result in lowered nest success in local areas. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a given species' regional population.

d. Conclusion--First Sale

Under Alternative A, disturbance effects from transport operations, seismic exploration activities and gravel mining in winter; and small camps, waste/fuel spill removal, river transport activity, and aerial surveys in summer are likely to be negligible for most local and regional bird populations. Elevated activity and air traffic in the vicinity of large summer camps may result in minor impacts on local populations. Regional populations are expected to experience negligible effects from such activity, except those of species that are uncommon, decreasing, or recently declined (e.g., loons, eiders) where a minor effect may occur. Effects of wildlife or other survey air traffic are likely to be negligible. Routine air traffic to oil and gas development sites in summer, especially over higher-density areas, is likely to result in minor impacts. Gravel mining, pads, roads, airstrips, and pipelines, although eliminating small areas of breeding habitat and displacing small numbers of nesting birds, are likely to result in negligible population effects.

Effects from crude-oil spills confined to terrestrial and freshwater aquatic habitats, where mortality of waterfowl, shorebirds, raptors, and passerines is likely to be relatively low, could range from negligible for most species to minor for rare or declining species. If a spill were to enter a river delta or nearshore marine habitats occupied by substantial numbers of loons, sea ducks, or Ross' gulls, effects on stable/increasing and declining species populations, are likely to be minor and moderate, respectively.

Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations and required operating procedures would decrease disturbance from most factors for most species and help prevent fuel and oil pollution and degradation of important bird habitats.

e. Multiple Sales

If multiple sales occur under Alternative A, construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under a multiple-sale scenario, depending on the price of oil, up to 2 times the number of exploration and delineation wells may be drilled (24 to 96 for multiple sales versus 8 to 40 for the first sale; see Tables IV-07 and IV-05); the number of fields developed could increase from 5 for a single sale to as many as 10 for multiple sales (Tables IV-04 and IV-06), and production pads are likely to increase from 0 to 8 for a single sale to 0 to 16 for multiple sales (Tables IV-05 and IV-07). Oil pipeline mileage is likely to increase from 95 mi to 295 mi from the first sale to multiple sales (Table IV-29).

Effects from disturbance factors and habitat alteration or loss for each development are likely to be short term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially is lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oil-field facilities associated with multiple sales were grouped in high resource interest areas. If these were located in high-bird-concentration areas--as appears likely in the vicinity of Dease Inlet--greater numbers of individuals are expected to be displaced and more species would be involved than with a single sale. Such effects could alter bird populations of these local areas substantially. For species with narrower habitat preferences, limited tolerance to disturbance factors, or small and/or declining populations (e.g., red-throated loon, yellow-billed loon, king eider, common eider, Sabine's gull, gyrfalcon, peregrine falcon, snowy owl) effects could extend to regional populations and involve long-term changes in distribution. Effects for these and other vulnerable species could be elevated to a moderate level if multiple developments were to be concentrated in a limited region.

The estimated number of large oil spills of 500 or 900 bbl for the first sale or multiple sales (Table IV-19) is expected to stay constant (0 for the $18/bbl, no development scenario, and 1 for the $30/bbl, development scenario). Also, the number/volume of small crude-oil and refined-oil spills--estimated at 130/323 under the first sale (average size 3/0.7 bbl; 127/29.4 gal.)--is expected to remain constant if multiple sales occur (Table IV-20).

These small, chronic spills generally are contained and cleaned up on pads and roads. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is likely to persist for several years but is expected to result in negligible effects for most species and potentially minor effects for sensitive species. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

f. Conclusion--Multiple Sales

Under Alternative A, displacement of birds from disturbance and habitat alteration or loss would be expected to increase substantially if development and production facilities were located in a limited region of higher resource potential (i.e., northern Planning Area). This could occur in several portions of the Planning Area if multiple sales are held and development occurs in areas where higher densities of several species overlap. Such developments potentially could alter local populations in these areas. For species that appear more vulnerable to habitat changes or disturbance (e.g., loons, eiders, raptors) effects could extend to regional populations and involve long-term changes in distribution. Although most effects that are likely to occur throughout the Planning Area are expected to be short term and negligible to minor, moderate effects could occur if concentrations of several particularly vulnerable species--declining and/or with small or sensitive populations--were to be involved. The likely increase in numbers of small crude-oil and refined-oil spills would be expected to elevate losses of birds somewhat during the period of oil development resulting from multiple sales. In any scenario losses and subsequent recovery of cumulative lost productivity and recruitment may not be detectable above the natural population fluctuations given the survey methods/data currently available. However, effects of oil and gas developments resulting from lease sales following the first sale are expected to be additive to those of the first, and may range from a slight increase to a doubling or tripling of effect. This would depend on whether the later developments were concentrated or scattered through areas of low or high density and distributional overlap of species that vary in their vulnerability to development activities (i.e., low: increasing/stable population and/or less sensitive species, versus high: declining population and/or sensitive species).

10. Mammals

a. Terrestrial Mammals

(1) Effects of Non-Oil and Gas Activities

Under Alternative A, the entire Planning Area would be designated as open to recreational off-highway vehicle (OHV) use and there would be no restrictions on the use of airboats. Over the short term, these designations would have no practical affect on terrestrial mammals as virtually no recreational OHV use occurs and the current level of airboat use is extremely low.

Air traffic, excavation, and the presence of resource inventory survey camps are expected to increase somewhat under Alternative A as compared to the No Action Alternative. The type of impacts would be similar to those under the No Action Alternative but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from the camps and along aerial survey routes. The disturbance reactions of caribou and other terrestrial mammals are expected to be brief, lasting for a few minutes to less than 1 hour. Some terrestrial mammals may avoid inventory survey camps during the 6 to 12 weeks of activities, while bears and foxes may be attracted to the camps by food odors. Impacts from recreation and overland moves would be the same as the No Action Alternative. Current management practices and stipulations attached to land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities to terrestrial mammals as discussed under the No Action Alternative.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

1) Seismic

Three seismic operations would occur in the Planning Area each winter. Impacts to terrestrial mammals would be similar in type to those discussed under the Seismic Option of the No Action Alternative but would be greater in extent and frequency. A greater number of individual animals would be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from seismic camps. The disturbance reactions of caribou and other terrestrial mammals are generally expected to be brief, lasting for a few minutes to less than 1 hour. Larger and more mobile mammals such as caribou are likely to be displaced from the general area of seismic work for several days. Some terrestrial mammals may avoid seismic camps while bears and foxes may be attracted to the camps by food odors. These animals also may habituate to human activities. The potential for disturbance of hibernating bears would be greater due to the increased level of seismic activity occurring in the Planning Area and the fact that more seismic activity would likely occur in the southern part of the Planning Area, which is better bear habitat. The potential for temporary disturbance of moose would also be greater if seismic activity is located in the southeastern part of the Planning Area. A greater number of lemmings and voles may be killed or disturbed by surface vehicles. Impacts to terrestrial mammals from seismic activities are not expected to be significant at the population level.

2) Exploratory Drilling

Under the first sale, 6 to 16 exploration wells and 2 to 24 delineation wells are projected to be drilled. Impacts to terrestrial mammals would be similar to those caused by seismic activity, though lesser in spatial terms and greater in temporal terms. Habitat impacts would be minimal, as exploratory drilling would occur during the winter on frozen tundra, packed snow roads, and ice roads. Potential causes of disturbance to terrestrial mammals from exploratory drilling include surface vehicular traffic, humans on foot, and fixed-wing aircraft traffic. In most cases, these activities are expected to cause short-term (few minutes to < 1 hour) displacements and/or disturbance of terrestrial mammals. Camps at drill sites may result in localized disturbance and/or displacement of terrestrial mammals for several weeks to months. Exploratory drilling operations and ice roads would traverse Teshekpuk Lake herd (TLH) and Western Arctic herd (WAH) caribou wintering areas. Any caribou in the immediate vicinity of the activity would be disturbed, possibly having a negative effect on their energy balance. Few wintering Western Arctic herd animals would be affected because the vast majority of the herd winters outside of the Planning Area. Because these animals are mobile and the operation is temporary, it is not expected that there would be any long lasting effects on caribou. Muskoxen and moose winter distribution is such that exploratory drilling activities would be unlikely to have any impacts on these species unless located in the eastern or southeastern portions of the Planning Area (Map 55). In that case, impacts would include short-term displacement or disturbance. Unlike caribou, muskoxen are not able to easily travel and dig through snow. In the winter, they search out sites with shallow snow, and greatly reduce movements and activity to conserve energy (USDOI, Fish and Wildlife Service, 1999). Muskoxen survive the winter by using stored body fat and reducing movement to compensate for low forage intake (Dau, 2001). Because of this strategy, muskoxen may be more susceptible to disturbances during the winter. Repeated disturbances of the same animals during winter could result in increased energetic costs that may affect mortality rates. Impacts to arctic foxes, grizzly bears and wolverines would be similar to impacts from seismic activities as discussed under the seismic option of the No Action Alternative, but would be more frequent or longer in duration. There would be a higher potential for bears and foxes to be attracted or habituated as camps associated with drill sites would be in place for several months vs. a week or less. Small rodents (such as lemmings and voles) may be locally affected due to direct mortality and minor loss of habitat from snow compaction or ice road construction. However, these losses are expected to be insignificant at the population level.

3) Oil and Gas Development

The entire Planning Area would be made available for leasing under Alternative A (Map 15). Under this alternative, up to 5 oil fields could be discovered and developed on lands leased in the first sale (Table IV-04). Primary effects on terrestrial mammals would come from construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; from aircraft traffic; from crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou is through disruption of the movement of mosquito-harassed TLH caribou from insect-relief habitat to foraging areas.

a) Caribou

Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities to caribou range. Caribou may be disturbed by traffic, humans on foot, and low-flying aircraft (Calef, DeBock, and Lortie, 1976; Horejsi, 1981; Shideler, 1986; Tyler, 1991). The response of caribou to potential disturbance is highly variable from no reaction to violent escape reactions depending on: their distance from human activity; speed of the approaching disturbance source; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Caribou cow and calf groups appear to be the most sensitive to traffic, especially in early summer during and immediately after calving, while bulls appear to be least sensitive all year.

Tolerance to aircraft, ground vehicle traffic, and other human activities has been reported in several studies of caribou and other hoofed-mammal populations in North America (Davis, Valkenburg, and Reynolds, 1980; Johnson and Todd, 1977). The variability and unpredictability of the arctic environment dictate that caribou have the ability to adapt their behavior (such as changing the time and route of migration) to some environmental changes. Some groups of caribou that winter in the vicinity of Prudhoe Bay and have been frequently exposed to disturbance apparently have become somewhat accustomed to human activities. Such habituation has been observed in the Prudhoe Bay area (Cronin et al., 1994). It appears that caribou can habituate to structures, noise and odors but habituate slowly or not at all to humans on foot or large moving objects such as vehicles (Murphy and Lawhead, 2000). Most of the caribou in the Planning Area are from the TLH and WAH herds, have had less exposure to human activities, and are less likely to be tolerant of disturbances than animals habituated to Prudhoe Bay.

Some displacement of the Central Arctic herd (CAH) from a portion of the calving range near the Prudhoe Bay and Milne Point facilities is well documented (Cameron, Whitten, and Smith, 1981, 1983; Cameron et al., 1992). In the Kuparuk-Milne Point area, the relative distribution of calving has shifted away from development facilities (Lawhead et al., 1997; Wolf, 2000). Cameron et al. (2002) evaluated changes in distribution of calving CAH caribou associated with the Kuparuk-Milne Point area. Before construction of a road system to Milne Point, caribou were found in a single, more or less continuous concentration, roughly centered where the road was later built. After construction of the road, a bimodal distribution--with separate concentrations of animals east and west of the road--was clearly apparent, indicating that calving caribou are avoiding the infrastructure area. Ground observations of caribou within the Kuparuk area from 1978-1990 indicated that caribou increasingly avoided zones of intense activity, especially during the calving period (Smith et. al. 1994). Data analyzed by Cameron et. al. (2002) suggest that having roads too closely spaced would depress calving activity within the oil field complex. Other studies (Roby, 1978; Cameron et. al., 1981, 1983; Cameron et al., 1992; Pollard and Ballard, 1993) and literature reviews (Cronin et al.,1994, 1998) indicate some seasonal avoidance of habitats within 1.86 to 2.48 mi (3 to 4 km) of existing Prudhoe Bay area facilities by cows and calves during calving and early post-calving periods (May through June). An analysis of the distribution of radio-collared female CAH caribou from 1980-1993 suggests that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970's (Cameron et al., 2002). Recent information on the body weight of CAH caribou calving in the oil fields compared to CAH caribou calving east of the Sagavanirktok River suggests that displacement-disturbance of cow caribou on the oil fields may be affecting caribou productivity (Cameron, 1994). Several data sets examined by Cameron et al. (2002) indicate reduced nutritional status and fecundity of female CAH caribou exposed to oil development west of the Sagavanirktok River compared to those in undeveloped areas to the east. Body-weight estimates, over-summer weight gain, the incidence of pregnancy in two successive years, and perinatal calf survival all tended to be lower for female caribou west of the Sagavanirktok River.

The TLH, WAH, and CAH core calving ranges lie outside of the Planning Area. Development would not result in the loss of any core calving habitat. Thus, on-site development is expected to have no effect on caribou movements within the calving range, and no calving activity would be displaced unless access to calving grounds is disrupted. In some years, 5 to 10 percent of the WAH may winter on the North Slope. Depending upon the location of oil development infrastructure, movement of both WAH and TLH caribou from winter range to calving grounds could be disrupted by oil and gas development. The level of effect would depend upon the level of development. An aboveground pipeline with no associated road would have little effect on movement between winter habitat and calving grounds. A road and associated traffic would have a greater impact. Pregnant caribou may be delayed in reaching the calving grounds because of delays in crossing roads or attempts to detour around roads or oil fields. Calving in route to calving grounds may result in reduced calf survival.

One issue arising from oil field development is the ability of caribou to move freely through the oil fields during insect seasons. Caribou under extreme insect harassment initially move rapidly to insect-relief habitat. For the TLH, this is often coastal areas from west of Barrow to Smith Bay (Map 49 and Map 50). After reaching these habitats, they often continue to move rapidly and may cover long distances. Caribou are generally insensitive to disturbance when under extreme insect harassment. When insect harassment abates, caribou drift inland to better foraging areas. At this time, they are more sensitive to disturbance, and infrastructure and activities in oil fields or roads between oil fields could delay or deflect movements of caribou from coastal insect-relief areas to foraging habitat further inland. Impaired movements between insect-relief habitat and inland foraging areas could depress energy balance (Smith, 1996) and rates of weight gain. The probability of producing a calf is directly related to body weight and/or fat content of females during the previous autumn (Cameron et al., 2000). Since reproductive success of caribou is highly correlated with nutritional status (Cameron et al., 2002), there could be reproductive consequences from extensive disruption of caribou during the insect season.

Cameron et al. (1995) noted that reports of insect-harassed caribou aggregations along the Beaufort Sea Coast and completely traversing the Prudhoe Bay complex as reported in the 1970's had become rare. An analysis of the distribution of radio-collared female CAH caribou from 1980-1993 suggests that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970's (Cameron et al., 2002). However, the Prudhoe Bay field was not designed to facilitate caribou movement. It is complex and has many older pipelines that are less than 1.5 m above ground. Movement of insect-harassed caribou through the Kuparuk Oil Field has been examined in several studies (Johnson and Lawhead 1989; Lawhead, Johnson, and Byrne, 1994; Smith, Cameron, and Reed, 1994). In the Kuparuk Field where all pipelines are elevated a minimum of 1.5 m above ground, mosquito-harassed caribou were able to pass through the field on their way to and from insect-relief habitat, although they typically detoured around drill pads and were often delayed up to several hours at road crossings. Smith, Cameron, and Reed (1994) monitored caribou movement in relation to roads and increasing development in the Kuparuk Area from 1978-1990. They found that groups of mosquito-harassed caribou were deterred from crossing roads with higher levels of vehicular traffic. Over the 12 years of the study, a change in access to the oil field area by insect-harassed caribou occurred. During the early years of construction, large insect-harassed groups of caribou approached the road from the middle section. By the end of the study, most large groups were observed at the extremes of the road transect, indicating that caribou might be avoiding the core areas of industrial activity. Designing oil fields to facilitate movement of caribou reduces but does not eliminate impacts.

Development in the TLH insect-relief habitat is a likely development scenario given the high potential for oil and gas in the area. In this case, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) could be located within important TLH insect-relief habitat from Smith Bay to the west side of Dease Inlet (Map 50) and in coastal areas west of Barrow (Map 49). Movements of the TLH caribou from coastal insect-relief areas to foraging areas farther inland during the insect season (late June to early August) would be adversely affected by pipelines and roads with vehicle traffic located between the Ikpikpuk River and Dease Inlet. There may be increased energetic costs to caribou and possible decreased weight gain. Summer is the season when female caribou need sufficient forage to meet the demands of lactation and gain sufficient weight to enable conception in the fall (Cameron et.al. 1993). Reproductive pauses may occur if necessary weight gain is not achieved during summer (Cameron 1994). There could be reproductive consequences to the TLH if extensive disruption of caribou occurs during the insect season. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. There may be a similar distruption of some WAH caribou if an oil field or fields were developed in the southern part of the Planning Area. In most years, this would affect only a portion of the herd since the majority of the herd uses insect-relief habitat that is south and west of the Planning Area. About 10 percent of the herd could use the Planning Area during the insect season and thus be exposed to development structures during the peak insect season.

When mosquitoes decline and oestrid fly harassment increases in mid-July, the large aggregations of caribou generally disperse into smaller groups of animals seeking relief habitats. These insect-relief habitats include a variety of unvegetated and elevated sites. Coastal areas apparently provide little relief from fly harassment (Ballard, Cronin, and Whitlaw, 2000). Gravel pads and roads are sometimes used as fly-relief habitat by caribou (Johnson and Lawhead, 1989; Pollard et al., 1996b). Oestrid flies are less common in shade than in sunlit areas (Pollard et al., 1996a) and caribou sometimes use the shade of elevated pipelines and buildings to escape from flies (Murphy and Lawhead 2000). Caribou are still more aggregated at this time than during the fall and winter, and may move long distances when insect harassment occurs. At this time, caribou movements may be negatively affected by oil field facilities and roads that temporarily delay movement of animals back to foraging habitats.

Curatolo and Murphy (1986) evaluated the ability of caribou to cross roads and pipelines. They concluded that crossing success was reduced where pipelines were adjacent to heavily traveled roads (> 15 vehicles/hour). Isolated pipelines or roads had lesser effects on crossing success. Groups did eventually cross the roads and move through the oil field, however the energetic costs associated with such delays are unknown. For caribou in the Prudhoe Bay and Kuparuk oil fields and pipeline-road corridors, the greatest human-caused influence on behavior and movement is vehicle traffic (particularly high traffic levels, such as 40 to 60 vehicles/hour, or traffic levels of > 15 vehicles/hour) within the pipeline-road corridors (Murphy and Curatolo, 1984; Lawhead and Flint, 1993). Caribou are hesitant to cross the Dalton Highway and other roads on the oil fields because of the traffic (Leonard Lampe, as cited in USDOI, BLM, 1997a). A decline in the frequency at which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline and may be delayed in crossing a pipeline and road for several minutes or hours during periods of heavy road traffic; however, successful crossings do occur. Caribou have returned to areas of previous disturbance after construction was complete in other development areas (Hill, 1984; Northcott, 1984 as cited in USDOI, BLM and MMS, 1998).

A pipeline from the oil field(s) in the northern part of the Planning Area would connect to the TAPS through facilities at the Kuparuk fields (Map 108). The pipeline would be constructed during winter using ice roads and no permanent road would be built. During construction, air traffic would include several flights per day, which could temporarily disturb some caribou within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou are expected to be short term, interference with their movements would be temporary (a few minutes to less than a few days), and they eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction is complete. The mere physical presence of a pipeline would probably have minimal effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall may prevent some animals from crossing under or over the pipeline. During the winter, caribou movements can be blocked or interrupted along the elevated (5 ft) pipelines, when snow drifts under the pipeline (Issac Nukapigak, as cited in USDOI, BLM, 1997a). However, such an effect is expected to be temporary and local, with the caribou moving across the corridors at locations where the snow is shallower or has melted during the spring. Construction of additional pipelines through Northeast NPR-A to the Kuparuk area would add to the cumulative effect of development on

TLH and CAH caribou. Construction of a pump station in NPR-A would result in the loss of up to 40 acres of tundra habitat and temporary displacement or disturbance of caribou during construction.

Development of an oil field or fields could result in impacts to wintering TLH (Map 54) and WAH caribou. Depending upon the location of the development, some TLH migration movements may be temporarily disrupted or diverted by air and surface traffic along pipelines and roads within the oil field. Wintering animals may be temporarily disturbed or avoid the development area. Repeated disturbance of the same animals during the winter could have negative impacts on individual animals' energy balance. Most of the WAH animals winter south of the Brooks Range (Map 47) and would not be affected. Impacts to wintering groups of TLH and WAH animals would not be significant on a population level.

Development of oil fields would require large amounts of gravel (up to 5 million cubic yards). Gravel is a scarce resource in NPR-A and if local sources of gravel are not available, alternative strategies may be used, including: barging construction materials to coastal staging areas for later transit over ice roads; processing bedrock for construction materials; using year-round ice pads; or reusing gravel from previous Husky drill sites. Gravel extraction (outside of the Planning Area), hauling of the gravel on ice roads (into the Planning Area), and deposition of gravel in the lease areas would result in local disturbance-displacement of small numbers of individual animals but would not affect the overall distribution and abundance of caribou. The loss of relatively small areas of tundra habitat to gravel pads, roads, and other alterations generally has not had significant effects on the CAH caribou and would likely have minimal impact on the TLH and WAH.

If a system to transport North Slope natural gas to southern markets were developed, a natural gas pipeline would be constructed from oil fields in the Planning Area to Prudhoe Bay. The pipeline would be buried and thus would not affect caribou movements. Wintering caribou could be temporarily disturbed or displaced during construction. A relatively small amount of habitat both within (45 to 90 acres) and outside (305 to 610 acres) of the Planning Area would be disturbed by trenching.

b) Moose

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter (Map 55). Unless an oil field were to be developed in the southeastern portion of the Planning Area, such as the headwaters of the Ikpikpuk or near the Colville River, development would be unlikely to impact moose. A number of studies show that the TAPS has no significant effect on moose movements and habitat use near the pipeline (Sopuck and Vernam, 1984, 1986; Eide, Miller, and Chihuly, 1986). In one study, 94 percent of the moose successfully crossed the pipeline corridor, and moose distribution was independent of distance from the pipeline (Sopuck and Vernam, 1986). However, moose preferred to cross pipelines elevated above 5 ft (Sopuck and Vernam, 1984). Under Alternative A, a crude oil pipeline (elevated 5 ft) connecting with the TAPS is not expected to affect moose habitat use and movements regardless of the location of the field(s). Depending upon the location, construction of a pump station would result in the loss of up to 40 acres of moose habitat. Given the amount of habitat available in NPR-A, the impacts would be negligible. Moose could be temporarily disturbed or displaced during construction if the pump station were located in winter moose range.

If gravel is mined from riverbeds in the Planning Area, there is a potential for temporary displacement and disturbance of moose. From 20 to 50 acres of moose habitat could be destroyed or degraded by borrow pit operations. Construction of a natural gas pipeline would have minimal impact on moose. The pipeline would be constructed during the winter, north of winter moose habitat in the Planning Area. Outside of the Planning Area, moose in the Colville River may be temporarily displaced or disturbed during pipeline construction. Minimal habitat disturbance would occur at river crossings.

c) Muskoxen

Potential effects of oil and gas development activities include displacement and disturbance of individual animals, direct habitat loss from gravel mining in river floodplains and at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities (Clough et al., 1987, as cited by Winters and Shideler, 1990; Garner and Reynolds, 1986). Muskoxen may be more exposed to oil exploration and development than caribou, because they tend to remain year round in the same habitat area (Jingfors, 1982); conversely, muskoxen may be more likely to habituate because of this year-round exposure. Muskoxen have been exposed to the TAPS and the Dalton Highway with the expansion of their range west from the ANWR and the Kavik River. Muskoxen are still uncommon in the Planning Area. Initial oil and gas development activities are unlikely to impact muskoxen. However, as populations continue to expend west into the Planning Area, they may move into areas of development. Immigration into specific areas could be slowed by development. Construction of oil and gas pipelines to Prudhoe Bay may result in temporary disturbance of mixed-sex groups of muskoxen in the Colville and Fish river areas. Repeated disturbance of the same group during the winter could negatively affect energy balance of individual animals and potentially contribute to winter mortality.

d) Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil or gas pipelines, pump stations, gravel mining, and drilling operations. These activities may disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence also pose potentially serious disturbances to denning bears. In one study, seismic activities within 1.15 mi (1.8 km) of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds, Reynolds, and Follmann, 1986). The investigators suggest that seismic testing activities within about 600 ft of the den may cause abandonment of the den. A similar effect could occur from construction activities within 600 ft of dens. In a study of maternal denning of polar bears and their cubs (a comparable species), disturbances from capture, marking, and radio tracking did not affect litter sizes or the stature of cubs produced. This tolerance by bears and the fact that maternal investment in the denning effort increases through the winter indicate that spatial and temporal restrictions on development activities could prevent abandonment of the dens (Amstrup, 1993).

Human scent and other noises also may disturb the bears. When grizzly bears first encounter humans on foot, their initial response is to flee; responses to ground-based human activities are stronger than responses to aircraft, especially when encounters occur in open areas such as the Arctic Slope (McLellan and Shackleton, 1989). Both the increase in human presence and resulting encounters with grizzly bears associated with recreation and tourism are temporary in nature. However, the establishment of permanent settlements (oil fields, mines, etc.) usually leads to human-bear encounters on a regular basis--and to conflict, particularly if bears learn to associate humans with food (Schallenberger, 1980; Harding and Nagy, 1980; Miller and Chihuly, 1987; McLellan, 1990). Grizzly bears initially avoid human settlements because of the noise and disturbance (Harding and Nagy, 1980), but if the area includes an important food source (such as a fish stream), some bears are likely to habituate to the noise and human presence, leading to an increase in encounters. People often don't believe the risk of bear attacks, and these encounters too often lead to the loss of bears (Archibald, Ellis, and Hamilton, 1987). Individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some will continue to avoid areas when humans are present (Olson and Gilbert, 1994). Although studies show that cub survival is higher in bears using anthropogenic food sources in the oil field region (Prudhoe and Kuparuk), this effect is countered by the fact that these bears have a lower than normal survival rate after becoming subadults (Shideler and Hechtel, 2000).

The attraction of grizzly bears to garbage and/or food odors at oil and gas-related facilities has led to encounters in which the need to protect workers results in the loss of bears (Schallenberger, 1980). Once bears become conditioned to the availability of human sources of food, measures to reduce this availability by improved garbage handling are not always effective (McCarthy and Seavoy, 1994). The bears will make an extra effort to get to the food sources that they are conditioned to having.

Oil exploration and development under Alternative A are expected to attract some grizzly bears to oil field facilities and may result in the loss of some bears due to interactions with humans. The level of impacts to bears would be dependant upon the location of the oil fields. Bears are much less common in the coastal plain than in the foothills and mountains of the southern part of the Planning Area. Oil development in the area with the highest potential for oil reserves (the north) would initially have fewer impacts on bears than development in the middle to southern portion of the Planning Area. However, if bears are attracted to development, impacts may increase over time. Shideler and Hechtel (2000) estimated bear densities in the oil field region (Prudhoe and Kuparuk) to be 4 bears/1,000 km^2 more than twice the highest density estimate for the coastal plain. This higher density could not be attributed to anthropogenic food sources and the authors speculated that the oil field region was higher quality habitat than other parts of the coastal plain.

Gravel mining in riparian corridors along major rivers could result in disturbance and loss of 20 to 50 acres (per material site) of bear habitat. Shideler and Hechtel (2000) found that bears often used riparian habitats on the North Slope. An average of 51 percent of the observations of radio-collared bears were in riparian corridors along major rivers and streams.

Construction of a natural gas pipeline would have minor impacts on bears. The pipeline would be constructed during the winter, when bears are generally hibernating. If construction were to occur within 600 ft of an occupied bear den, hibernating bears could be disturbed by noise and could abandon the den. Minimal habitat disturbance would occur at river crossings.

e) Wolves

Potential effects on wolves include short-term disturbance from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence that may be associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be adversely affected. Wolves are generally not abundant in the Planning Area and the highest populations are located in the southern and eastern portions of the area. Oil and gas development in the high potential area would have minimal impact on wolves.

f) Wolverines

Potential effects on wolverines from oil and gas development could include disturbance from air and surface vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they may be sensitive to oil exploration and development activities and abandon habitat areas near oil development. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake caused the displacement of a wolverine from its den (Harry Brower, Jr., as cited in USDOI, BLM, 1997c). If caribou abundance were adversely affected by oil development, wolverines could be affected in return. Decline in distribution and abundance of wolverines in Canada was attributed to increased harvest and decline in caribou populations (Van Zyll de Jong, 1975). Alteration of riparian habitats through gravel excavation or gas pipeline construction could adversely affect wolverines, especially during the winter, when theses habitats provide cover and important hunting areas. Some wolverines may be displaced near (within a few miles) oil field facilities under Alternative A.

g) Foxes

Oil and gas development activities can affect the arctic fox by increasing the availability of food and shelter. Oil field facilities provide additional food sources for foxes at dumpster sites near the galley and dining halls and at dump sites (Eberhardt et al., 1982; Rodrigues, Pollard, and Skoog, 1994). Crawlspaces under housing, culverts, and pipes provide foxes with shelter for resting and, in some cases, artificial dens (Eberhardt et al., 1982; Burgess and Banyas, 1993). Localized oil development activities do not appear to have any dramatic, deleterious effect on arctic fox populations (Eberhardt et al., 1982). A study of den sites and fox productivity near Prudhoe Bay indicates that adult fox densities and pup production are higher in the oil fields than in surrounding undeveloped areas (Burgess et al., 1993). An increase in the fox population associated with oil development may adversely affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself (Burgess et al., 1993). If development occurs in the arctic foothills or mountains similar impacts to red foxes could occur.

h) Other Mammals

Small rodents and their predators would be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along pipelines, gravel pads, and other facilities. Arctic ground squirrels sometimes den in gravel fill in the oil fields (Shideler and Hechtel, 2000). The availability of suitable burrowing habitat may increase local densities of ground squirrels. These effects are expected to be insignificant to populations on the Arctic Slope of Alaska.

(b) Effects of Spills

Under Alternative A, an estimated 130 small crude-oil spills (averaging 3 bbl in size) and 323 small, refined-oil spills (averaging 29 gal) are assumed to occur over the production life of the Planning Area (Table IV-20). A maximum of 1 large spill (500 or 900 bbl) is projected (Table IV-19). The likelihood of a large spill is low. Typical refined products that are spilled on the Alaska North Slope include aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The extent of environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The following effects would more likely result from a large spill. Many small spills would be contained on the gravel pad and would have no impact on terrestrial mammals or their habitat.

Caribou and other terrestrial mammals could become oiled or ingest contaminated vegetation. Adult caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermal insulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermal insulation, leading to their death (USDOI, BLM, 1998). Oiled caribou, moose, and muskoxen hair would be shed during the summer before the winter fur is grown. If caribou were oiled in the winter after shedding their summer coats, oiling would not be expected to affect thermal insulation, because the outer guard hairs of caribou are hollow. No documented caribou deaths have been attributed to the numerous spills associated with TAPS. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects. Exposure of livestock (horses and cattle) utilizing grazing lands that support oil extraction have resulted in mortality and morbidity (Edwards 1985). Exposure may involve heavy metals, salt water, caustic chemicals, crude oil and condensates. In cattle, this exposure may result in a wide variety of symptoms including effects on the central nervous system, cardio-pulminory abnormalities, gastrointestinal disorders, inhalation pneumonia, and sudden death (Edwards 1985). Caribou, moose, and muskoxen that become oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic hydrocarbon inhalation and absorption through the skin.

Spill response would result in disturbance impacts to terrestrial mammals. The extent of the disturbance would depend upon a variety of factors including spill size and location, response actions, and season of year. Terrestrial mammals present in the vicinity of the spill would be temporarily disturbed by aircraft or overland vehicles. Disturbance response may last from a few minutes to a few hours. Larger and more mobile terrestrial mammals would be temporarily displaced by human activity around the clean up site. Displacement may last for a few days to a few weeks. Cow caribou with calves may be displaced by up to 2.5 miles (4 km). Small mammals such as lemmings and voles may be killed during clean up activities. These disturbance impacts are not expected to have population level effects on any terrestrial mammals.

If a release from a pipeline, or a spill large enough to escape from a gravel facility pad were to occur, some tundra vegetation would become contaminated. Caribou, moose, and muskoxen probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant, 1980). For most spills, control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskoxen away from the spill and prevent the possibility of these animals grazing on the oiled vegetation. In most cases, onshore oil spills are not expected to affect caribou, moose, and muskoxen through ingestion of oiled vegetation. For large spills that are not immediately or successfully cleaned up, the potential for contamination would persist for a longer time and there would be a greater likelihood of animals being exposed to the oil. Cleanup success may vary depending upon the environment. Over time, any remaining oil would gradually degrade. Although oiling of animals would likely not remain a threat after cleanup efforts, some toxic products could remain for some time. Depending upon the spill environment, part of the oil could persist for 5 years (USDOI, BLM, 1998).

Oil spills on wet tundra kill the moss layers and aboveground parts of vascular plants and sometimes kill all macroflora at the site (McKendrick and Mitchell, 1978). Damage to oil-sensitive mosses may persist for several years, if the site is not rehabilitated (McKendrick and Mitchell, 1978). The length of time a spill persists is dependant upon soil moisture, and concentration of the product spilled. McKendrick (2000) reported that complete vegetation recovery occurred within 20 years on a wet sedge meadow without any cleanup. A dry habitat exposed to the same application supported less than 5 percent vegetative cover after 24 years. For the most part, onshore oil spills would be very local (< 1 acre) in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen habitat. However, some local contamination of tundra vegetation is expected to occur near production wells and processing facilities. Spills that occur within or near streams and lakes may affect foraging habitat along these waterbodies.

Grizzly bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching fish and finding carrion. If an oil spill were to contaminate beaches and tidal flats along the Beaufort Sea coast, some grizzly bears would be likely to ingest contaminated food, such as oiled birds, seals, or other carrion (USDOI, BLM, 1998). Such ingestion could result in the loss of a few bears. An oiling experiment on captive polar bears indicated that if a bear's fur becomes oiled and the bear ingests a considerable amount of oil while grooming, kidney failure and other complications could lead to the bear's death (Oritsland et al., 1981). Brown bears on the Shelikof Strait coast of Katmai National Park (an area contacted by the *Exxon Valdez* oil spill) were observed with oil on their fur and were consuming oiled carcasses (Lewis and Sellers, 1991). A study of the exposure of Katmai National Park (Katmai Bay area) brown bears to the *Exxon Valdez* oil spill through analysis of fecal samples indicated that some bears had consumed oil or were exposed to oil; one young bear that died had high concentrations of aromatic hydrocarbons in its bile and might have died from oil ingestion (Lewis and Sellers, 1991). Anecdotal accounts of polar bears deliberately ingesting hydraulic and motor oil, and foreign objects from human garbage sites suggest that both bear species are vulnerable to ingesting oil directly, especially from oiled carrion and other contaminated food sources (Derocher and Stirling, 1991). Skin damage and temporary loss of hair can result from oiling of bears, with adverse effects on thermal insulation (Derocher and Stirling, 1991). Spills estimated to occur under Alternative A could result in the loss of small numbers of grizzly bears through ingestion of contaminated prey or carrion.

Small mammals and furbearers may be affected by spills due to oiling or ingestion of contaminated forage or prey items. These impacts would be localized around the spill area and would not have population level impacts.

If seawater were used for enhancement of oil production, a saltwater spill could occur within the NPR-A. According to McKendrick (2000), brine spills kill plants on contact and increase soil salinity to the point that many species cannot survive. Unlike oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A spill would have adverse effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be small, no more than a few acres. Thus, potential saltwater spills are not likely to affect forage availability for caribou, muskoxen, moose, or other terrestrial mammals in the Planning Area. In cattle, ingestion of saltwater at >10,000 ppm salt can cause sodium-ion toxicity and at lower levels may affect rumen activity (Edwards 1985). In the case of a saltwater spill on tundra habitat the water would likely be adsorbed into the vegetative mat or in wet habitats, diluted with fresh water. Cleanup and rehabilitation activities would likely keep terrestrial wildlife out of the spill area for the short term. Over the long term, mortality of vegetation in the area affected by the spill would make the area undesirable for grazing by terrestrial mammals until the vegetation recovers.

In the event of a natural gas-well blowout or pipeline rupture, there would be a short-term release of gas (< 1 day) which could extend downwind for about 1 km and would quickly dissipate once the blowout or leak was stopped. Terrestrial mammals in the immediate vicinity of the blowout could be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any terrestrial mammal exposed to high concentrations. Given the small area that would be exposed to the plume and the rapid dissipation of the gas, it is not likely that any animals other than individuals present in the immediate vicinity at the time of the blowout would be affected. The likelihood of caribou, moose, muskoxen, wolves, or grizzly bears being exposed to toxic amounts of gas and condensates is very low and--should it occur--would probably only affect a few individuals.

Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings may be affected in larger numbers. However, there would be no population level impacts on these species.

(c) Summary

Among the terrestrial mammal populations that could be affected by management actions under Alternative A are the TLH, WAH, and CAH caribou. Caribou could be temporarily exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction, but such exposure is not expected to have any effects at the population level. The TLH caribou movements within insect-relief areas may be disrupted by oil development activities with unknown levels of effects on the productivity of the herd. The WAH caribou may be exposed to oil development facilities in localized areas. Moose, muskoxen, grizzly bears, wolves, wolverines, foxes, and small mammals may be locally affected by activities associated with oil and gas exploration and development.

(3) Effectiveness of Stipulations

Stipulations A-1 and A-2, and ROP's A-3, A-4, A-6, and A-7: These measures regarding HAZMAT, spills, and proper handling of petroleum and chemical products and waste would be beneficial to all terrestrial wildlife species by reducing the potential of direct mortality due to oiling, ingestion of toxic materials, or contamination of habitat, prey species, and forage species.

Stipulation C-1 and ROP C-1: These measures would put restrictions on the types of heavy equipment used and the seasons of allowable use and would be beneficial to terrestrial mammals by reducing the amount of habitat disturbed during exploration. Use of low-pressure vehicles may also reduce the mortality of small mammals.

Stipulation D-1: This stipulation would prohibit exploratory drilling in lakes, streams, lakebeds, and active floodplains unless impacts to wildlife are minimal, and would reduce the potential for damage to the riparian habitats that are so important to many species of terrestrial mammals, including moose, bear and wolverine. Disturbance impacts to wolverines and moose would also be reduced.

ROP E-1: This ROP would require that all pipelines be designed, constructed and operated under approved Quality Assurance/Quality Control Plans. Quality assurance/quality control would reduce the potential for pipeline spills or blowouts due to manufacturing, maintenance or operation failures. This would reduce the potential for direct mortality of terrestrial mammals due to toxic exposure and the contamination of prey and forage. Less habitat would be damaged, resulting in positive benefits to terrestrial mammals. There would be fewer spills, resulting in less cleanup activity along pipelines and fewer disturbance impacts to wildlife. Less human activity along pipelines would result in fewer crossing delays for caribou. Positive results associated with this ROP would not be significant under the alternatives but would contribute to mitigating impacts in the cumulative case.

ROP E-2: This ROP would require the lessee to minimize the development footprint and would be beneficial to terrestrial wildlife in that it would reduce the amount of habitat lost and decrease disruption of caribou movements. Conversely, it would also reduce the amount of gravel habitats created that can be used to advantage by ground squirrels. Although caribou may also use gravel pads for insect-relief habitat, the negative effects of development outweigh any positive impacts. Overall, the impact of this ROP would be beneficial to most terrestrial wildlife.

ROP E-4 and ROP E-5: These ROP's regarding location and design of permanent oil and gas infrastructure would reduce impacts to caribou from oil development activities. ROP E-5 would require that pipelines and roads be designed to facilitate caribou passage. ROP E-4 would require that permanent oil and gas infrastructure be designed, located, constructed and operated to minimize adverse effects on caribou movements. If fully implemented, these ROP's would reduce (but not eliminate) impacts of oil development on caribou movements. Since caribou are sensitive to humans on foot and moving vehicles, there would be some negative effects on their ability to freely move through the area regardless of how well the field was designed.

ROP E-6: This ROP would require a 500-ft setback of permanent facilities from shallow lakes, streams, lakebeds, estuaries and other active floodplain and would generally be beneficial to terrestrial mammal species that are dependant upon riparian habitats--such as wolverines, moose and grizzly bears--by reducing the potential for habitat loss and disturbance impacts.

ROP E-8: This ROP would require that coastal facilities be designed, sited and constructed to prevent significant changes to oceanographic circulation patterns and water-quality characteristics and to maintain free passage of marine and anadromous fish. It would benefit bears by protecting prey species. The benefit in this case would be minor, as bear densities are very low on the coastal plain.

ROP F-1: This ROP states "All aircraft use shall be conducted in a manner that will minimize impacts to wildlife and birds." Assuming that aircraft operators were cognizant of the potential effects of aircraft on wildlife and took the appropriate actions to minimize those effects, disturbance impacts to terrestrial mammals could be reduced substantially.

ROP I-1: This ROP would require that lessees provide a wildlife orientation program for all employees. Education of employees should reduce the potential for harassment and direct mortality of wildlife.

ROP J-1, ROP A-1, and ROP A-2: These ROP's would reduce impacts on bears and foxes. ROP J-1 would require lessees to prepare and implement bear-interaction plans to minimize conflicts between bears and humans. ROP A-1 and A-2 regarding proper handling of garbage and waste would reduce the potential for bears and foxes to be attracted to both permanent and temporary facilities. These ROP's would benefit bears by reducing both the number of bears killed in defense of life and property (DLP) and the number of bears becoming habituated to anthropogenic food sources. Measures designed to avoid attracting bears to work sites should also reduce the attraction of arctic foxes.

(4) Conclusion--First Sale

Non-oil and gas activities are expected to increase somewhat compared to the No Action Alternative, but the increase is not expected to significantly affect terrestrial mammal populations. The effects of oil and gas activities are expected to be greater under Alternative A than under any other alternative. Projected levels of development would result in increased disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of up to 5 oil fields, an elevated pipeline to Kuparuk, and a buried gas pipeline to Prudhoe Bay. Some TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic and construction. Near the oil fields, surface, air, and foot traffic is expected to increase significantly and to displace some terrestrial mammals. If a field were to be developed in critical TLH insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipeline corridors. This could increase energy costs to caribou. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. Crude-oil and fuel spills are expected to result in the loss of small numbers of terrestrial mammals.

(5) Multiple Sales

If several lease sales occur under Alternative A, considerably more exploration activity is expected to occur in the habitat of the TLH and WAH caribou, with twice as many exploration wells being drilled. Twice as many oil fields would be developed and the number of staging areas and pipeline miles would increase. An oil field or fields could be developed in the southern portion of the Planning Area within the summer range for WAH (Map 47).

For many years,the WAH has exhibited a consistent pattern of movement during the summer (ADF&G comments on Draft IAP/EIS). After calving in the Utukok Uplands, the herd moves west into the Lisburn Hills (west of the Planning Area). During the height of the insect season (early July), 80 to 90 percent of the herd form into large aggregations in the western DeLong Mountains and western North Slope (south of the Planning Area). During late July through early August, they move rapidly back east toward Howard and Anaktuvuk Pass (south of the Planning Area) and then disperse north and west onto the North Slope and the Planning Area during late August and early September. Since most of the WAH animals are outside of the Planning Area during most of the insect season, there would be minimal impacts on movement of insect-harassed WAH animals. Within the Planning Area, insect-harassed groups of WAH caribou may have to detour around oil fields. Impacts would be limited to short-term disruption or displacement.

An elevated pipeline would likely be constructed from the oil field east to Pump Station 2 of TAPS. This would cross the north-south route used by the CAH to migrate between their winter habitat in the Brooks Range and calving grounds along the Arctic Ocean (Map 47). Short-term impacts during construction would be the same as those discussed above for construction of a new pipeline to the Kuparuk Area. Over the long term, the new pipeline could temporarily delay north-south caribou movement. No road would be associated with the new pipeline and the mere physical presence of the pipeline would probably have minimal effect on the behavior, movement, or distribution of caribou, except perhaps during periods of heavy snowfall or intensive human activity (e.g., during major pipeline repairs or spill cleanup).

Human activities associated with transportation routes can affect the behavior and distribution of caribou. Frequent disturbance can have adverse effects on caribou energy levels. In the cumulative case, an additional manmade feature would be introduced into the range of the CAH--a caribou population that has already been affected by development at Prudhoe Bay and Kuparuk--in the form of a second gas pipeline from the southern part of the Planning Area to Prudhoe Bay.

The increase in the number or miles of roads and pipelines that would accompany development under multiple sales is expected to further impede movements of TLH caribou from insect-relief areas along the coast to inland foraging areas. This effect is expected to persist over the productive life of the oil fields and may reduce productivity of the TLH.

Impacts to moose, wolverines, wolves, and bears would be similar to those discussed under the single sale scenario. However, if the oil field facilities were to be located in the southern part of the Planning Area, a greater number of animals could be exposed to oil exploration and development, as densities of these species are greater in the foothills and mountains than on the coastal plain. Moose could be temporarily disturbed during construction of a southern pipeline and second gas pipeline.

Spills under the multiple sale scenario are expected to have about the same type and level of effects on terrestrial mammals and their habitats as under the single sale scenario but with a higher likelihood of impacts to WAH and CAH caribou, grizzly bear, moose, wolverine, and wolf. Impacts to these populations and species are expected to be higher because more exploration and development would occur in the southern part of the Planning Area, and a southern pipeline would be constructed.

(6) Conclusion--Multiple Sales

Multiple sales under Alternative A are expected to increase disruption of TLH caribou movements within insect-relief areas along the coast and cause some disruption of CAH and WAH caribou. Impacts to grizzly bears, moose, wolves, and wolverines would be greater as development would be located in higher density habitats for these species.

b. Marine Mammals

Under Alternative A, the northern coast of the Northwest NPR-A Planning Area, which extends from Smith Bay-Dease Inlet to west of Barrow, would be open to leasing. Seven species of non-endangered marine mammals-- ringed, spotted, and bearded seals; walruses; polar bears; and beluga and gray whales--commonly occur year round or seasonally in coastal habitats adjacent to the Planning Area. Under Alternative A, some individual members of these species may be exposed to effects from oil and gas exploration and development and other activities.

(1) Effects of Non-Oil and Gas Activities

The primary potential causes of disturbance of marine mammals would be helicopter traffic (1 to 2 round trips per day for 3 to 6 weeks per survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. Overland moves and seismic operations would occur during the winter on stable sea ice or frozen tundra. The other activities would take place in summer and early fall (June-September). These activities, if they were to occur along the coast of the Planning Area, may cause short-term (less than 1 hour) displacements or harassment of hauled-out seals and polar bears.

It is assumed that geophysical surveys would use 60 persons, would collect 5 to 10 line-miles of 3-D seismic data per day, and would be conducted entirely in winter (early December-mid-April) using ice roads. Under Alternative A, seismic surveys conducted near the coast could expose a few denning polar bears to seismic activity noise and associated disturbances. This activity could result in the displacement of a few maternal polar bears and their cubs, leading to the abandonment of the den site and possible loss of a small number of cubs. Few polar bears are expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the Planning Area (Map 51). Seismic surveys would be prohibited near known polar bear den sites in the Planning Area.

Onshore seismic activity is not expected to have any effects on other marine mammals. Ringed seals den during the winter; however, denning ringed seals would not be expected to be exposed to the noise and activity associated with onshore seismic operations, because their denning habitat is located in the floating-fast ice zone (Map 56) generally some distance offshore.

The overland moves that occur each winter travel from Prudhoe Bay or Oliktok Point to Barrow, follow a route offshore over stable sea ice, and include 20 to 100 trains of 1 to 6 vehicles and attached sleds. These moves could be a disturbance to denning ringed seals, if the routes cross floating-fast ice areas, and may temporarily displace seals within a short distance of the traffic route. Polar bears also may be temporarily disturbed within about 1 mi of this traffic.

Recreational camps may attract bears in some cases, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population, but would contribute to cumulative adverse effects.

Very small fuel spills (less than 1 bbl) are expected to occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction, hydrocarbon fuels that would evaporate and disperse rapidly. Under current BLM stipulations, fuel spills are required to be cleaned up immediately, if possible. Such events are not expected to have any significant effects on marine mammals in the Planning Area.

The effects on marine mammals (seals, polar bears, and whales) of activities other than oil and gas exploration and development under Alternative A would be local and short-term, with no significant adverse effects to the populations.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

Some potential noise and disturbance of marine mammals from aircraft traffic and seismic activities could occur along the coast, primarily in the Dease Inlet/Admiralty Bay area, and these effects are expected to be local and short term (generally < 1 year).

The primary source of noise and disturbance would come from air traffic along the coast of the Planning Area, specifically from helicopters associated with the projected oil exploration and production activities. Aircraft traffic--several helicopter round trips/day during exploration and development, originating from Deadhorse-Prudhoe Bay and traveling to and from exploration and production facilities in the Northwest NPR-A--is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches along the coast and to polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed and spotted seals hauled out on the ice or along the coast, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing hauled-out seals. In the Dease Inlet/Admiralty Bay area, the number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of large groups of hauled-out seals in the Planning Area could result in possible injury or death to young spotted seal pups if they are trampled by other seals during the disturbance or are abandoned by their mothers. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of adult seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent.

Exploratory drilling is projected to occur during the winter (December to mid-April) over about 9 years using 1-4 drill rigs (Table IV-05). If exploratory drilling activities were to occur near the coast, polar bears could be attracted to the camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears, although consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. In any event, the number of bears lost as a result of such encounters is expected to be very low.

Under Alternative A, seals and polar bears could be affected by possible oil exploration offshore drilling from an ice island and subsequent oil development on the coast of the Dease Inlet/Admiralty Bay area (Map 51). Construction activities associated with development are projected to occur over a 7-year period with production to occur over the assumed 20-year life of an oil field (Table IV-03) using up to 6 production rigs and as much as 230 mi of pipelines (Tables IV-05 and IV-29). Most of the exploration and development activities are expected to occur onshore, with pipelines routed across the NPR-A and connecting to TAPS (Map 108). Gas production is expected to follow similar onshore pipeline routes. These onshore activities would affect local tundra habitats and are not likely to affect individual marine mammals or populations.

(b) Effects of Spills

For a discussion of the effects of oil on marine mammals that commonly occur in offshore habitats adjacent to the Planning Area, see USDOI, MMS (2002). For detailed discussions of the various possible direct and indirect effects of oil on marine mammals, see OCS Reports MMS 85-0031 and MMS 92-0012 (Hansen, 1985; 1992).

1) Effects from a Possible Large Spill in Marine Waters

There is an estimated 0 to 38 percent chance of a possible 500- or 900-bbl pipeline spill occurring under the Alternative A (Table IV-19). Assuming this spill occurred in Dease Inlet within the marine environment, some spotted seals (perhaps as many as a few hundred) could be exposed to the spill if it occurred during the open-water season. It could affect ringed seals if it occurred during melt-out in the spring.

Assuming the spill occurred during the summer open-water period, 17 to 22 km^2 of coastline could be contaminated in the Dease Inlet/Admiralty Bay area and the spill could sweep over 103 to 140 km^2 during open water or sweep over 134 to 181 km^2 if it occurred during melt-out. Several hundred spotted seals that congregate in Dease Inlet/Admiralty Bay near the mouths of streams flowing into the inlet could be exposed to the spill. Small aggregations of ringed seals could also be present in the area. Such an event could result in the contamination and possible loss of some spotted seals. Perhaps 10 to 50 seals out of a population of about 1,000 animals could suffer lethal effects. The population would be likely to replace this loss within one year. The number of ringed seals that might be affected if the spill occurred during melt-out could potentially be as many as 86 to 116 seals, assuming a density of 0.64 ringed seals/km^2 times the area swept by the spill--134 to 181 km^2 --during melt-out. The ringed seal resident population of about 40,000 would be likely to replace such a loss within one year.

The 500- or 900-bbl pipeline spill would not be likely to affect many bearded seals, walruses, beluga and gray whales because these species tend to occur offshore of Dease Inlet/Admiralty Bay and the 500- or 900-bbl spill would be expected to disperse before reaching migration routes and offshore habitats where these species could be exposed. Because few, if any, bearded seals, walruses, beluga whales, or gray whales would be likely to be exposed to the spill and suffer sublethal or lethal effects, these species populations would not be affected by this spill.

Because of the small fraction of the pipeline spill that might be expected to reach feeding areas, little or no significant contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would occur. A small fraction of the spill (1 to 5%) is expected to be widely dispersed in the water column and to be weathered and degraded by bacteria (USDOI, MMS, 1997, *Spilled Oil Fate and Behavior in Marine Waters*). The amount of benthic prey killed or contaminated by the spill is likely to be very small and represent an insignificant proportion of the prey and benthic habitat available to walruses, bearded seals, and gray whales, so that the 500- or 900-bbl spill is not likely to have any food-chain effects on marine mammals.

Polar bears would be most vulnerable to the spill if it were to reach the barrier islands of Elson Lagoon to Point Barrow (Map 51). However, the number of bears likely to be contaminated--or to be indirectly affected by a local contamination of seals--probably would be small. Even in a severe situation in which a concentration of perhaps 10 bears (such as at a whale carcass site) were to be contaminated by the 500- or 900-bbl pipeline spill and all the bears died (a type of worst case), such a one-time loss is not expected to significantly affect the polar bear population of 2,272 to 2,500 bears (USDOI, FWS, 2002).

2) Effects from Small Onshore Spills

Estimated onshore spills under Alternative A are 0 to 130 crude-oil spills of < 1 bbl and 0 to 34 crude-oil spills of > 1 bbl and < 500 bbl, with total volume of 0 to 393 bbl, as well as a total of 0 to 323 small, refined-oil spills with an average size of 29 gal (about half a barrel) (Table IV-20 and Table App 9-07). These small onshore spills are expected to have little effect on seals, walruses, and polar bears. However, if some of these spills were to occur in or contaminate streams in the Dease Inlet area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated if any of these spills were to reach the marine environment during early winter, resulting in the death of some pups (perhaps 10 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). If any of the spills were to reach Dease Inlet during the summer open-water season, some spotted seals that frequent the inlet could be exposed to the oil and suffer sublethal and possibly lethal effects. Perhaps as many as a few hundred seals could be exposed to the contamination, with heavily oiled individuals suffering lethal effects (perhaps 10 to 30 animals). Smaller numbers of polar bears would be expected to be exposed to and affected by these small spills. The loss of small numbers of seals, and possibly a few polar bears is not expected to affect the seal and polar bear populations. These spills are not likely to affect walruses and beluga whales offshore of Dease Inlet.

(3) Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, and A-3 on fuel spill prevention, handling, disposal, and cleanup would reduce potential marine pollution and effects on marine mammals in the Dease Inlet/Admiralty Bay area where oil exploration and development could occur under Alternative A. ROP A-1 on garbage/waste handling and food and ROP J-1 on polar bear/human interaction plans would prevent the attraction of polar bears to campsites that could result in the taking of polar bears in human/bear interactions. Under Overland Moves Stipulation C-1, BLM/operators planning winter activities (including seismic operations) within 25 mi of the coast would consult with FWS to prevent disturbance of denning polar bears. Activities would be prohibited within 1 mi of known bear dens. This consultation would prevent most disturbances of denning polar bears under Alternative A. ROP F-1, requiring aircraft traffic to be conducted in a manner that will minimize impacts to wildlife, would reduce the number of disturbances of marine mammals and other wildlife.

Under the Marine Mammal Protection Act (MMPA), harassment or "taking" of marine mammals is prohibited unless the lessees have a Letter of Authorization (LOA) that would allow them to unintentionally harass marine mammals during their operations. To limit and avoid excessive harassment or taking of non-endangered marine mammals the MMPA requires lessees to have an LOA to conduct activities that may harass or take marine mammals. This requirement is expected to limit any disturbance of marine mammals associated with seismic activities and other oil and gas activities in the Northwest NPR-A Planning Area.

(4) Conclusion--First Sale

For Alternative A, activities other than oil and gas that are expected to affect marine mammals--particularly polar bears and spotted seals along the coast of the Planning Area--are expected to be local, within about 1 mi of resource inventory survey activities, survey and recreational camps, and overland moves. The effects of oil and gas activities are expected to result in a small increase in potential noise and disturbance along the coast, primarily in the Dease Inlet-Elson Lagoon Area, and these effects are expected to be local and short term (generally < 1 year). Under Alternative A, seals and polar bears could be affected by possible oil exploration offshore of an ice island and subsequent oil development on the coast of the NPR-A in the Dease Inlet Area (Map 15). Effects of these activities would be local and are not likely to affect marine mammal populations.

A small number of seals and no more than a few polar bears might be adversely affected or killed by a 500-900-bbl crude-oil spill occurring in and contacting Dease Inlet, but these losses would not be significant to marine mammal populations. The effects of Alternative A are expected to be short term, with no significant adverse effects on marine mammal populations.

(5) Multiple Sales

If several lease sales occur under Alternative A, more exploration activity is expected to occur in the southern and central part of the Planning Area, with the number of exploration wells drilled increasing to 18 ($18/bbl) to 48 ($30/bbl) for multiple sales from the 6 ($18/bbl) to 16 ($30/bbl) wells for a single sale. The amount of development also is expected to increase. The number of oil fields could increase to 10 for full economic potential under multiple sales from the 5 oil fields projected for a single sale, and total pipeline miles would increase to 740 mi for multiple sales from the 230 mi for a single sale (Tables IV-04, IV-06, and Table IV-29). The number of small crude-oil and refined-oil spills is estimated to be about the same as under Alternative A for the first sale (Table IV-19 and Table IV-20). A small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Dease Inlet-Barrow area, and these effects are expected to be local and short term (generally < 1 year).

(6) Conclusion--Multiple Sales

The effect of oil and gas activities under Alternative A with multiple sales is expected to be about the same as for the single sale, but the duration and extent of activities would occur over a longer period of time, as would potential disturbance effects.

11. Endangered and Threatened Species

The U.S. Department of the Interior (USDOI), Bureau of Land Management (BLM) initiated the process for the Northwest National Petroleum Reserve-Alaska (Northwest NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) to fulfill BLM's responsibility for managing lands in the Northwest NPR-A Planning Area (the Planning Area). The IAP/EIS includes various management activities that may affect endangered and threatened species, such as aircraft use, hazardous- and solid-material removal and remediation, overland moves, seismic activities, and oil and gas exploration and development. Such activities--particularly oil and gas exploration and development/production activities and aircraft traffic associated with wildlife studies and other surveys--may result in noise and disturbance, altered habitat, and spilled oil or other contaminants that could adversely affect the behavior, distribution, and abundance of individuals or populations occurring in or adjacent to the Planning Area.

If a sale were to be held in the Northwest NPR-A, it would be the seventh sale in the NPR-A since January 1982. The first two oil and gas lease sales were held in January and May 1982. Two subsequent sales followed in 1983 and 1984, and a fifth lease sale was canceled. Sales in the Northeast NPR-A were held in 1999 and 2001. A total of approximately 129 wells have been drilled in the NPR-A (including shallow core test wells, those on Arctic Slope Regional Corporation lands, and wells outside the current NPR-A boundary). Twenty-four exploration wells have been drilled in the Northwest NPR-A Planning Area since 1944, and 13 have been drilled from 2000 to 2002. Of 688 leases issued in various Federal offshore Beaufort Sea sales, 52 are still active, and a total of 30 exploration wells have been drilled, plugged and abandoned. Nine offshore wells were considered producible but uneconomic for development and production at current oil prices, and one offshore production well (Northstar) is in operation.

This section discusses potentially adverse effects of management actions, including proposed oil and gas leasing, exploration, and development, on endangered and threatened species within the Northwest NPR-A Planning Area under Alternative A, and potential mitigating measures to reduce adverse effects on listed species. Because the purpose of this document is to provide information for a phased consultation on Northwest NPR-A sale leasing and exploration phases, the most detailed information on these phases is provided. Because of their uncertainty at this time, this section provides less detail on development and production activities. Sufficient information on development and production is included to provide an adequate basis for an opinion regarding the reasonable likelihood of this action violating Section 7(a)(2) of the Endangered Species Act (ESA), as amended. Should commercially producible quantities of oil be discovered and development and production be proposed, consultation would be reinitiated regarding these activities. The need for further consultation would also be considered if: 1) additional species were listed; 2) critical habitat were designated; 3) the proposed action were substantially modified; or 4) significant new effects-related information were developed. A detailed description of the endangered and threatened species within the Planning Area and an analysis of the effects of similar proposed actions are found in the Northeast NPR-A Final IAP/EIS (August 1998) and the related Biological Opinion. Details concerning the consultation process are included below and in Appendix 10.

A description of the threatened and endangered species in or near the Planning Area is provided in Section III.B.6 of this document, the Biological Opinion in Appendix 10, the Biological Opinions for the Northeast NPR-A Final IAP/EIS (USDOI, BLM and MMS, 1998; USDOC, NOAA, NMFS, 1998) and Beaufort Sea Planning Area Oil and Gas Lease Sales FEIS (USDOI, MMS, 2003), and the Arctic Region Biological Opinion (USDOC, NOAA, NMFS, 2001). No critical habitat in or near the Planning Area has been identified for these species.

Primary effects on bowhead whales would result from disturbance during their semiannual migration past the Planning Area. Primary effects on spectacled eider and Steller's eider exposed to such activities would be: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, staging, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by crude- and refined-oil products, wastewater, and solid/liquid wastes of various toxicity. This analysis assumes the stipulations and ROP's in Table II-02 are in place.

a. Consultation Assumptions

In accordance with the ESA Section 7 regulations governing interagency cooperation, the early consultation process was initiated when BLM requested notification from the U.S. Fish and Wildlife Service (FWS) (memorandum dated June 10, 2002) and the NOAA Fisheries (National Marine Fisheries Service) (letter dated June 10, 2002) of the listed and proposed species and critical habitat to be referenced in the memorandum and letter to follow requesting initiation of formal consultation for this project. The FWS responded (memorandum, dated July 24, 2002), specifying the threatened spectacled and Steller's eiders as the species to be included in the IAP/EIS for the Planning Area; and NOAA Fisheries responded (letter, dated July 26, 2002), specifying the endangered bowhead whale as the species to be included. These letters are reproduced in Appendix 10. No critical habitat is located within the Northwest NPR-A Planning Area.

The endangered bowhead whale may occur seasonally adjacent to or in the Planning Area, and the threatened spectacled and Steller's eiders occur seasonally in the Planning Area; each of these species may be exposed to activities associated with the Northwest NPR-A management plan. Sections 4(d) and 9 of the Endangered Species Act (ESA), as amended, prohibit taking of listed species of fish and wildlife without a special exemption. "Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harass" is further defined as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behaviors that include, but are not limited to, breeding, feeding, or sheltering. "Harm" is further defined as an act that may include significant habitat modification or degradation to the point at which it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NOAA Fisheries agreed that the proposed project was unlikely to adversely affect the bowhead whale and found that formal consultation was not required, as noted in their July 26, 2002 letter (Appendix 10). Section 7 consultation with FWS was reinitiated in September 2003 to address the BLM's Preferred Alternative developed for the Final IAP/EIS. Additional and updated information and analysis on the potential impacts of selected factors on spectacled and Steller's eiders can be in the *Biological Assessment for Threatened and Endangered Species with Respect to the Proposed Northwest National Petroleum Reserve-Alaska Integrated Activity Plan* (USDOI, BLM, 2003) prepared for the reinitiation of the Section 7 consultation with FWS.

b. Effects of Non-Oil and Gas Activities

Under Alternative A, effects of management actions within the Planning Area on bowhead whales potentially could include minimal changes in nearshore behavior and/or distribution. For spectacled and Steller's eiders, such actions may include altered distribution, abundance, and/or behavior resulting from disturbance. Such changes may be associated with aerial surveys (including wildlife surveys), human presence and activities such as summer camps and hazardous- and solid-material removal and remediation during breeding, staging, or migration periods, and alteration and pollution of eider habitats. Effects of non-oil and gas activities on eiders may be greater than those discussed under the No Action Alternative, Section IV.B.11.a. This is because several categories of anticipated non-oil and gas activities, including aircraft use and duration of camp occupation, are increased under Alternative A (Table IV-28). The additional risks from oil and gas exploration and development activities are discussed below. The two alternatives are similar in that neither proposes new protective land designations, and anticipated numbers of overland trips and Colville River float trips are the same.

(1) Effects on Bowhead Whale

Bowhead whales may be present in the Beaufort Sea offshore of the northern Planning Area primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea. They may be present in the Chukchi Sea off the western Planning Area in April to early June during their northward spring migration. Under Alternative A, only under exceptional circumstances--when whales migrate near the coast coincident with the presence of barge traffic, or possibly air traffic to supply a shoreline camp or aerial surveys along barrier islands or offshore areas--is it likely bowheads would be disturbed by activities associated with the management plan. For example, in 2000, when median distance of migrating whales offshore was just 11.0 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance from underwater or airborne noise would have existed. Effects from such exposure are likely to be negligible.

(2) Effects on Spectacled and Steller's Eiders

Spectacled eiders are widely distributed near lakes or coastal margins throughout much of the Planning Area in summer (Larned et al., 2001; Ritchie and King, 2002), and are essentially absent from the area from October to May. Highest densities occur in several areas from Dease Inlet west to the Chukchi coast and west of the village of Atqasuk to Peard Bay and Kuk River/Wainwright Inlet (Map 62). Females with broods typically are found offshore later in summer. Steller's eiders are sparsely distributed in the Planning Area, particularly in the northwest portion between Dease Inlet/Admiralty Bay and the Chukchi coast, and nest attempts apparently are relatively infrequent. They are absent from the area from late October to May. Effects of management actions on spectacled and Steller's eiders are likely to be similar to those discussed for other rare and/or declining waterfowl species in Section IV.B.11.a but their ESA listed status is assumed to lend greater significance to a given level of effect.

(a) Effects of Ground Activities

Most ground transport activities occur in winter and thus would not disturb eiders or affect their habitats. However, during the summer breeding season, noise and visual presence of personnel resulting from various activities may disturb eiders. Eiders are likely to be displaced from within 700 ft to 0.6 mi of large summer encampments, causing a local decline in nest attempts and success. Under Alternative A, occupation of large camps is anticipated to be 12 weeks rather than 6 weeks as under the No Action Alternative (Table IV-28). However, this difference is not likely to alter the disturbance effects on birds significantly because--in the context of the short arctic breeding season--those that are displaced when the camp is first occupied probably would not return to the area to renest after 6 weeks any more than 12 weeks because of insufficient time remaining in either scenario to raise a brood. Lack of mate availability at the end of these periods also would limit success. Those individuals that are tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks. Local eider populations may experience minor declines in breeding success from disturbance in summers when camps are occupied, although this may not be as relevant to Steller's eiders with their scattered distribution. Habitat loss in Northwest NPR-A, though somewhat greater under Alternative A than the No Action Alternative, is expected to be negligible. Predators attracted to camps may decrease breeding success of local eiders. Effects of small, frequently moved camps are likely to be negligible; those in place for 6 to 12 weeks may cause minor local loss of nest success and productivity.

Hazardous material, fuel spill, and solid-material removal and remediation may disturb local nesting birds for varying periods, resulting in lowered nest success or failure for those at the site. Because these activities may be conducted during summer months, they could disturb or displace eiders that are brood rearing in the area; nesting eiders probably would abandon the nest. Assessment of the nature and extent of contamination of the site and cleanup may involve the use of drill rigs, hydropunches, or backhoes. Removal and remediation activities may continue for as long as 3 to 4 weeks. Females with broods would move out of the area immediately, as would those not yet sitting on eggs. Spills of refined-oil products are likely to be contained and cleaned up before contacting eiders. If contact occurs, effects probably would be similar to those described for an oil spill below.

Small groups of travelers at the frequency anticipated on the Colville River and other rivers are expected to cause minimal disturbance of eiders.

(b) Effects of aircraft

Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment into summer field camps and to fly aerial surveys. Helicopter traffic in particular potentially could cause substantial disturbance of eiders, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 ft often caused spectacled eiders to flush while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. Also, behavioral reactions of pre-nesting birds to aircraft overflights may not be representative of behavior of incubating or brood-rearing birds. It is possible that some eiders may be disturbed by these activities and experience temporary, nonlethal effects lasting less than an hour. Effects of routine aircraft flights into large camps may range from causing avoidance of certain areas by eiders to abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights may pass over areas where eiders occur at higher density. There is a potential for displacement of some nesting eiders near routinely used aircraft landing sites as a result of numerous overflights, landings and takeoffs. However, although the reaction of eiders to aircraft overflights is unpredictable, there is a potential for habituation to routine air traffic by spectacled eiders. In the Prudhoe Bay area, nests are regularly located in wetlands within 1 km of the Deadhorse Airport (TERA, 1995b), including one less than 250 m from the runway (Martin, 1997), suggesting that some individuals are tolerant of aircraft activity in the vicinity of nests.

Aerial survey flights for monitoring bird or caribou populations also have considerable potential for disturbance of eiders because they are flown at low altitude. However, in most areas they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects are likely to be minimal. In the northeastern portion of the Planning Area, wildlife survey activity may be more frequent during a three-week period in June and July--thus disturbing larger areas--than elsewhere. Also, eiders may be disturbed by helicopters used in studies in which caribou are captured for attachment of radio collars. Other aerial surveys and point-to-point transport air traffic are likely to cover a small percentage of the Planning Area. Also, relatively few nest sites are expected to be affected because eider nest sites generally are scattered at relatively low density over much of the northern half of the Planning Area and even lower density in the remainder. For these reasons(and with the possible exception of the northeastern Planning Area), the increase from 2 weeks under the No Action Alternative to 3 weeks under Alternative A that wildlife surveys would be flown--or increase of other surveys from occasional to several--is not likely to increase disturbance in any given area significantly (Table IV-28). In isolated areas, aircraft effects are likely to be negligible; though potentially minor effects could occur in the vicinity of large camps. Areas suspected of containing hazardous material may be surveyed initially from aircraft, with the potential for disturbance to eiders as noted above. Quantitative effects resulting from most factors are likely to be difficult to separate from natural variation in population numbers.

c. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Oil and gas leasing, exploration, and development/production would be allowed throughout the Planning Area under Alternative A (Map 15). Alternative A would result in greater oil and gas activities and effects than the No Action Alternative since the Planning Areas would not be open to leasing under the latter. Exploration and development/production activity for the first sale under Alternative A could vary substantially (also for 1 or more of the other alternatives) depending on the per-barrel price of oil (Table IV-05). Thus, the projected activities for the first sale are presented as ranges. The number of exploration/delineation wells for the first sale ranges from 6/2 to 16/24, exploration/delineation rigs from 1 to 4, production pads from 0 to 8, staging bases from 1 to 2, and 95 new pipeline-miles (Table IV-05 and Table IV-29). If only exploration were to occur, activities would be expected to take place over a period of 8 years. If development were to follow exploration, it is projected to require 10 years, plus 4 years for additional production well drilling. Production is estimated to last 22 years. It is projected that any development in the Planning Area would involve relatively small, interconnected gravel structures.

(a) Effects of Exploration

Oil and gas exploration may result in noise and disturbance and altered habitat effects on behavior, distribution, and abundance of individuals or populations occurring in or adjacent to the Planning Area. The discussion of potential effects in this section is based on activities projected to occur under Alternative A. Contaminants such as drilling muds and cuttings would not be released during exploration activities, and no adverse effects should result to individuals either through direct contact or indirectly as a result of effects on prey populations or important habitats. Based on industry's record, the probability of crude-oil release during exploration is assumed to be zero. Seismic activity and exploration drilling would be conducted entirely during the winter months. Information on drilling operations and logistical support for them is found in Section IV.A.1.

1) Effects on Bowhead Whale

Bowhead whales move through the Beaufort Sea offshore of the NPR-A during their fall migration to wintering areas in the Bering Sea. No drilling activities would occur in OCS waters under this IAP/EIS, and potential offshore exploration effects would be limited to noise-producing activities. Noise-producing aircraft and marine vessel traffic are the activities most likely to affect bowhead whales during exploration. Other noise-producing activities, including seismic surveys and drilling activities, would take place in winter (early December to mid-April) when most bowheads are absent from the area. A detailed description of these activities and their potential effects on bowhead whales in the Beaufort Sea OCS and the NPR-A can be found in the *Beaufort Sea Sale 144 Final EIS* (USDOI, MMS, 1996a:Sec. IV.B.6), the *Biological Evaluation for Beaufort Sea Sale 170* (USDOI, MMS, 1998), the *Arctic Region Biological Opinion* (USDOC, NMFS, 2001), and in the *Beaufort Sea Planning Area Lease Sales Final EIS* (USDOI, MMS, 2003:Sec. IV.C.5).

a) Seismic Activity and Exploratory Drilling

Seismic and drilling activities would be far removed from the typical bowhead migratory corridor and occur in winter using all-terrain vehicles supported by light aircraft when few or no whales are likely to be present. Thus these activities are not likely to expose whales to underwater noise or cause any disturbance effects.

b) Vessel and Aircraft Activity

Only under exceptional circumstances--when whales migrate near the coast coincident with the presence of barge traffic to supply a shoreline staging area--is it likely bowheads would be disturbed by these exploration activities. For example, in 2000, when median distance of migrating whales offshore was just 11.0 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance of those individuals from underwater or airborne noise or visual presence would have existed. This proximity of bowheads to the Northwest NPR-A Planning Area has been observed in just 6 of the 20 years that MMS has carried out the bowhead whale aerial survey program (Treacy, 2002b). There may be some barge transport of heavy equipment during the summer open water season (mid-July to early October) to staging areas along the coast where it would be stockpiled for operations at inland sites during the winter months. Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. Most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 0.62 to 2.5 mi (1 to 4 km) away. A few whales may react at distances from 3 to 8 mi (4.8 to 12.8 km), and a few whales may not react until the vessel is < 0.62 mi (1 km) away. Received noise levels as low as 84 dB re 1 µPa or 6 dB above ambient noise may elicit strong avoidance of an approaching vessel at a distance of 2.5 mi (4 km) (Richardson and Malme, 1993, as cited in USDOI, MMS, 1996a). Fleeing from a vessel generally stops within minutes after the vessel passes, but scattering may persist for a longer period. In some instances, bowheads return to their original locations. Bowhead whales could encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration through the Alaskan Beaufort Sea, although most of the vessel activity would be in shallow nearshore waters, probably shoreward of the main, fall whale migration route. Vessel traffic generally would be limited to routes between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas along the coastline in the Planning Area. Effect of vessel traffic on bowheads is likely to be temporary and negligible.

Aircraft flying at low altitude (below 300 m [984 ft]) often cause hasty dives by bowheads, but they generally are not affected by overflights above this altitude. Flights supporting oil and gas operations in the Planning Area are not likely to occur over marine waters beyond the nearshore zone, and then only when approaching a shoreline staging base, well outside the typical whale migration corridor. Effect on bowhead behavior from any aircraft or vessel exposure is likely to be temporary and negligible.

2) Effects on Eiders

Spectacled eiders are widely distributed throughout the coastal plain portion of the Planning Area and are essentially absent from the area from late October to May. Manmade noise and activities, as well as human presence, may result in disturbance of some eiders in the Planning Area. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect spectacled and Steller's eiders. Due to the relatively low density of eiders in the Planning Area during the summer breeding season, substantial disturbance is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

a) Seismic Activity and Exploratory Drilling

Seismic surveys and drilling activities occur during winter months (December-April) when eiders are absent from the region. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early-arriving eiders could occur, causing negligible increases in energy use.

b) Vessel and Aircraft Activity

There could be some transportation of equipment and supplies through the marine environment during the summer open-water season (mid-July to early October). Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline and materials transported and stockpiled during the summer months (mid-July-early October) for operations at inland sites during the winter months. Vessel traffic generally would be limited to routes in shallow nearshore waters between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas along the coastline in the Planning Area (e.g., Cape Simpson). Spectacled and Steller's eiders that are accompanying young or are staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) and that encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration are expected to experience negligible disruption of foraging because of the low probability of disturbance by vessel activities.

Aircraft likely would be used to support winter oil and gas exploration activities in the Planning Area. Mostly fixed-wing aircraft would be used, with helicopters used only in emergencies. Wintertime aircraft flights associated with seismic surveys and drilling operations during exploration should have no effects on spectacled or Steller's eiders. Aircraft activity over the marine environment during the open water season as a result of exploration operations in the Planning Area is likely to be minimal. Spectacled or Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability that these areas would be overflown by support aircraft. Because spectacled eider nest sites are scattered at relatively low density over the northern half of the Planning Area, substantial disturbance of nesting or brood-rearing females and young is not expected to occur. Some eiders may experience temporary, nonlethal effects, probably lasting less than an hour. Also, because it is unlikely that the primary Alaskan nesting area for Steller's eiders--located south and southeast of Barrow--would be overflown by aircraft associated with oil and gas activities, substantial disturbance of nesting or brood-rearing Steller's eiders is not expected to occur.

(b) Effects of Development and Production

Activities during development and production may result in disturbance and altered habitat effects on behavior, distribution, and abundance of individuals and local or regional populations in or adjacent to the Planning Area. Potentially disturbing factors can be categorized as 1) causing injury or death, 2) causing increased energy expenditures that affect physiological condition and rate of survival or reproduction, or 3) causing long-term changes in behavior, including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect from oil and gas development and production in Northwest NPR-A, though careful planning and scheduling could avoid most serious effects. Effects on bowhead whales could result from vessel traffic and aircraft overflights. Depending on location and season, oil and gas activities in areas where eiders occur potentially could cause increased disturbance from routine aircraft or vessel operations, construction activities, presence of gravel mines, pads, and roads, facilities, associated vehicle and foot traffic, and drilling activities. Although regular seismic surveys would not disturb either bowheads or eiders (because they are conducted in winter when these species are not present), a commercial discovery could result in seismic surveys being carried out when these species are present in or near the Planning Area, possibly causing disturbance.

Initial developments are likely to occur in the extreme northern portion of the Planning Area, generally surrounding the Dease Inlet/Admiralty Bay area to Smith Bay, and possibly westward to the Chukchi coast. Substantial numbers of spectacled eiders (Map 62) could be affected to some extent by potentially disturbing, isolated events (e.g., passage of aircraft), though most incidents are expected to result in minor effects from which individuals would recover within hours to 1 day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially may adversely affect physiological condition, molt, nest success, and survival of individuals. Ultimately this could result in population-level effects, though these usually are difficult to separate from natural variation in population numbers. The presence of facilities and construction of gravel structures that result in displacement from favored habitats--and the associated energy costs--could result in short-term negative effects during breeding, brood rearing, or migration; however, the footprint of such structures is small enough that effects are not likely to be evident at the regional population level. Information on development and production activities is found in Section IV.A.1.

Crude oil released during development or production could cause adverse effects on individuals, either through direct contact or indirectly as a result of effects on prey populations or important habitats. Drilling operations in marine environments during development are restricted in broken ice seasons (spring, fall); otherwise, drilling may occur year-round, including when these species are present. Oil prices of $30/bbl are likely to stimulate development and production sufficient to result in one large (500 or 900 bbl) crude oil spill (38% chance of 1 or more occurring) over the production life of Northwest NPR-A Planning Area (Table IV-19). At $18/bbl no spills are likely. Small crude or refined oil spills could number 130 crude (average size = 3 bbl) and 323 refined (average size = 0.7 bbl) if the price of oil is at $30/bbl (Table IV-20). Approximately 65 to 80 percent of all crude oil spills occur on a pad and have no little or no effect on the environment. Approximately 20 to 35 percent occur on or reach the surrounding environment. These spills generally remain on a limited area of tundra unless they reach a river, stream, or waterbody. Off-pad spills generally cover a small area ($\leq$ 500 ft² [46.5 m²]). Larger contamination areas may occur as a result of wind blowing a fine oil mist over a larger area.

1) Effects on Bowhead Whale

The bowhead whale migration route typically is well offshore (median 32.2 km) of where any oil and gas development is likely to occur (Treacy, 2002). Noise-producing aircraft and marine vessel traffic are the activities most likely to affect bowhead whales during development and production. Only under exceptional circumstances-when whales migrate near the coast coincident with the presence of barge traffic or air traffic to supply a shoreline staging area--is it likely bowheads would be disturbed by these activities (see discussion under exploration, above). Thus it is unlikely whales would experience intense or frequent disturbance from noise originating from Northwest NPR-A activities that would modify normal behavior beyond a negligible extent. If a commercial discovery were made, transport of equipment and supplies by barge to the Planning Area would increase, although still would happen shoreward of the bowhead migration route.

Seismic activity would likely occur entirely during winter months when most whales are absent from the vicinity of the Planning Area. Most development and production drilling activity is likely to occur on shore and thus would not affect bowhead whales. Likewise, most construction of pipelines and other structures would occur in winter and/or away from marine waters.

An oil spill or substantial discharge of other contaminants is not likely to occur in the marine environment, or to reach typical bowhead migration habitat from onshore locations at concentrations that would cause adverse effects. Regardless of whether some bowhead whales migrate in nearshore waters in exceptional years, it would be a rare random event for such an occurrence to be coincident with a substantial oil spill (which may have some probability of reaching marine waters) whose probability of occurrence is very low (mathematical number of large spills = less than 1, Table App 9-05). Onshore small spills are not likely to reach marine habitats, and thus have a low probability of affecting bowheads. Short-term exposure to spilled oil is likely to have negligible effects on bowheads (St. Aubin, Stinson, and Geraci, 1984). Spill cleanup activity under these circumstances is likely to have a negligible effect. A detailed discussion of potential effects of oil on whales can be found in Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a), the Biological Evaluation for Beaufort Sea Sale 170 (USDOI, MMS, 1998), the Arctic Region Biological Opinion (USDOC, NMFS, 2001), and the Beaufort Sea Planning Area Lease Sales Final EIS (USDOI, MMS, 2003:Sec. IV.C.5).

Regardless of whether some bowhead whales migrate in nearshore waters in exceptional years, it would be a rare random event for such an occurrence to be coincident with a substantial oil spill (which may have some probability of reaching marine waters) whose probability of occurrence is very low (mathematical number of large spills = less than 1, Table App 9-05).

2) Effects on Eiders

Most nesting occurs west from the Sagavanirktok River. The highest densities of nesting spectacled eiders in the Planning Area occur in areas south of Barrow and in the west-central Planning Area (Map 62). Females are present in the breeding area from May to September, males from May to late June. Steller's eiders are relatively sparsely distributed, primarily west of the Colville River. Females with broods are present in the breeding area from early June to late August or early September.

Manmade noise and activities, as well as human presence, may result in disturbance of some spectacled eiders in the Planning Area. Noise-producing activities, including aircraft traffic and marine vessel traffic, are the activities most likely to affect spectacled and Steller's eiders. Seismic surveys would be conducted in winter so would not affect eiders except under exceptional timing circumstances as noted for exploration above.

Disturbance effects may be particularly serious in areas where higher densities of spectacled eiders occur. Such areas are west of Dease Inlet; south of Barrow; the southwest-central portion of the Planning Area; and the western Planning Area south of Peard Bay, east of Wainwright, and east of the Kuk River (Map 62). Steller's eiders usually are sparsely scattered across the northern Planning Area (Map 63), with a somewhat greater concentration south of Barrow.

a) Air Traffic and Vessel Effects

Air traffic is likely to be the most important source of disturbance associated with oil and gas development; helicopters are the most disturbing type. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992), few comparable studies of effects on other species at other phases of the annual cycle - or long-term effects on populations - have been done. Also, it is not clear whether eiders and brant are at all comparable in this regard.

Aircraft routinely flying over the areas of higher density in the Planning Area noted above are likely to cause minor effects in the local eider populations. For example, disturbance associated with development in the northern area where the first development is likely to occur could adversely affect higher concentration areas of both eiders south of Barrow. Aircraft support of winter seismic operations would not affect eiders since they are absent from the area during this season. It is likely there would be minimal aircraft flights over the marine environment during the open water season as a result of oil and gas activities in the Planning Area. In the event of a commercial discovery, drilling operations and other activities may continue through the summer months and would be supported by aircraft. Pipelines are likely to be constructed aboveground, and aircraft likely would be used to look for leaks in the pipeline. Although Balogh (1997) indicated that fixed-wing aircraft flying at an altitude of 150 ft (45.7 m) often cause spectacled eiders to flush, few nest sites are expected to be affected, because nest sites occur at relatively low density in most of the Planning Area and females with their broods are scattered. Some displacement of Steller''s eiders in the vicinity of pipeline corridors could occur as a result of aircraft overflights. Relatively few nest sites are expected to be affected, because--as with the spectacled eider--nest sites are scattered at relatively low density over much of the Planning Area.

There may be some transportation of equipment and supplies through the marine environment during the summer open water season (mid-July to early October). Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline and materials transported and stockpiled during the summer months (mid-July-early October) for operations at inland sites during the winter months. Vessel traffic generally would be limited to routes in shallow nearshore waters between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas along the coastline in the Planning Area (e.g., Cape Simpson). Spectacled and Steller's eiders that are accompanying young, or are staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) and that encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration are expected to experience negligible disruption of foraging because of the low probability of disturbance by vessel activities.

b) Gravel

Gravel within the Planning Area is likely to be obtained from river drainages and be transported to a site on ice roads during winter. The resulting habitat burial would displace any nesting individuals from the local area (up to 50 acres) to undisturbed habitats, with potential for lowered productivity. Depending on location and extent of each material site, overall effects could range from negligible to minor in cases in which mining eliminates breeding habitat of the spectacled eider, whose coastal plain population is declining at a non-significant rate.

The presence of pads and short connecting roads is expected to displace local breeding individuals from the affected sites, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat as suggested by studies at Prudhoe Bay (Troy and Carpenter, 1990). Such displacements are not expected to cause long-term effects on population productivity given the relatively small areas likely to be involved at a given site (TERA, 1993; Troy and Carpenter, 1990), but could constitute a local long-term or permanent result. Overall effect, particularly at the regional level, is likely to be negligible. Permanent roads connecting to infrastructure to the east may be considered.

c) Structures, Facilities and Drilling Operations

The presence of facilities (including pipelines) and drilling operations is expected to displace local breeding individuals from affected sites, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat. Such displacements are not expected to cause long-term effects on population productivity given the relatively small areas likely to be involved at a given site, but could constitute a local long-term or permanent result. If a commercial discovery is made, drilling activity during the summer is likely to increase, and a small number of nesting or brood-rearing individuals could be affected. Disturbance from a drilling operation is likely to be limited to within a kilometer of the activity; a few eiders may experience temporary, non-lethal effects which may continue through the summer. Affected eiders may respond to drilling disturbance or other activities by relocating before or during the nesting phase, abandoning a nest, or relocating the brood at a more distant area once hatching is completed. Overall effect of these factors, particularly at the regional level, is likely to be negligible. The presence of an aboveground pipeline is not likely to represent a significant collision hazard since migrating eiders generally fly at greater elevation than pipelines are constructed, and much movement during the breeding season is by swimming. Disturbance from onshore construction and maintenance of pads, facilities, and roads is likely to be minimal beyond a kilometer from the activity.

d) Predation

Potential predator enhancement at the level of development envisioned for NPR-A is not likely to approach that of the Prudhoe Bay area. This is because 1) development sites are likely to be few (10 fields) and relatively small and scattered, 2) practices that have allowed artificially enhanced predator populations in the past are expected to be tightly controlled through adherence to ROP's A-2 and E-9 that would require all feasible precautions to avoid attracting wildlife (i.e., predators) to food and garbage, and 3) utilizing best technology to prevent facilities from providing nesting. denning, or shelter sites for predators. At the Alpine Development, Johnson et al. (2003) found that predator numbers remained stable from pre-construction through construction periods. They also found no clear evidence that predation rates by either foxes or avian predators changed during their study. Thus, predator populations in the vicinity of small footprint developments are not expected to increase significantly. Although neither species of eider nest in colonies, which would make them prone to substantial losses if discovered by predators, the ACP spectacled eider population may be in a nonsignificant declining phase such that any predation represents serious effect. Overall, effects of predators on regional populations of eiders is likely to be minor to negligible.

(c) Effects of Spills

One spill $\geq$ 500 bbl is assumed for Alternative A (Table IV-19), though the most likely number of spills is 0 (Sec. IV.A.2). A crude-oil spill from a pad or pipeline onto tundra and then into local lakes or other interconnected wetlands could cause mortality of small numbers of eiders, especially during the brood-rearing period later in summer. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the water. It is likely the above effects would be negligible to minor with regard to proportion of regional population involved. Because of the oil-absorptive capacity of tundra habitats, only a relatively small proportion of a spill is likely to enter a river, and it is likely that an even smaller proportion would enter the marine environment. Under Alternative A, the entire Northwest NPR-A coastline could be available for oil and gas leasing. If a spill were to reach a delta area or Elson Lagoon, Dease Inlet, Smith Bay, or other coastal waters, individuals staging before fall migration would be at risk, with the possibility of elevating effects to a moderate, potentially significant level. However, it is possible that most spectacled eiders nesting in the western part of the Planning Area migrate overland directly to the Chukchi, thereby avoiding potential spills into the Beaufort from the northern Planning Area. As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of fewer than 20 individuals--a minor effect--but potentially tens of individuals could be killed by cumulative total mortality from many small spills occurring over extended intervals. Such losses could represent a serious liability for species where productivity is low. Onshore spill cleanup involving personnel, equipment, and aircraft could result in displacement of pre-nesting birds, or nest abandonment if it were to occur later in the season. Most spills would be contained on the pads where they occur, and would affect a small area. Due to the relatively small average size of spills, the limited area affected by a spill, and the limited likelihood for a spill to occur near an eider-nesting area, it is likely only a few eiders would be displaced from favored habitats or otherwise be affected by these activities. The effect of such losses may not be detectable above the natural fluctuations of the population.

Physiological effects of oil on individual birds would be the same as described in the *Northeast NPR-A IAP/EIS* (1998). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Oiled individuals may lose the water repellency and insulative capacity of their feathers and subsequently die from hypothermia. Light to moderate exposure could reduce future reproductive success as a result of pathological effects on liver or endocrine systems (Holmes, 1985) that interfere with the reproductive process and that are caused by oil ingested by adults during preening or feeding. Stress from ingested oil can be additive to ordinary environmental stresses such as low temperatures, and metabolic costs of migration. Oiled females could transfer oil to their eggs, which at this stage could cause mortality, reduced hatching success, or possibly deformities in young. Flocks of staging eiders could contact oil in nearshore areas. Food resources could be adversely affected by oil, causing indirect, sublethal effects that decrease survival, future reproduction, and growth of the affected individuals. Because the spectacled eider population has declined 50 percent, even relatively low mortality still is likely to represent a minor to moderate, potentially significant, effect.

d. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate the effects on eiders of three types of problems that may result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, and contamination of waterbodies occupied by eiders. No stipulations specifically apply to bowhead whales.

ROP E-6, by restricting approval of permanent oil and gas facilities within 500 ft of the floodplain of various waterbodies to those that would cause minimal impacts to wildlife, including those from vehicle and aircraft noise and activity on roads and airstrips, could mitigate disturbance of breeding waterfowl and shorebirds in particular.

ROP F-1, by requiring that aircraft use be conducted so as to minimize impacts to birds, could mitigate aircraft disturbance of birds.

ROP E-6, by restricting approval for location of permanent oil and gas facilities within 500 ft of the floodplains of various wetlands to those projects that are likely to cause minimal impacts to wildlife, could reduce the loss (burial) of wetland habitats that are important for breeding eiders.

Stipulation A-2, by requiring storage and fueling to take place in diked and impermeably lined areas at least 500 ft from the active floodplain of fish-bearing and 100 ft from the active floodplain of non-fish-bearing waterbodies, could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die.

Stipulation A-3, by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing and 100 ft of the active floodplain of non-fish-bearing waterbodies may prevent spilled fuel from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die.

ROP C-1, by recommending that refueling of most equipment take place at least 500 feet from the active floodplain of fish-bearing and 100 feet from the active floodplain of other waterbodies, may prevent spilled fuel from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die.

ROP E-6, by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife, may prevent spilled fuel or leaking pipeline oil from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die.

These stipulations and ROP's would minimize disturbance of eiders from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated. In most cases, the stipulations and ROPs are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of an eider species regional population.

e. Conclusion--First Sale

Under Alternative A, only if bowhead whales were to migrate exceptionally near the coast coincident with the presence of vessel or low altitude aircraft traffic is it likely they would be disturbed by activities associated with non-oil and gas transport activities or oil and gas transport and seismic activities discussed in the IAP/EIS. Bowheads may exhibit temporary avoidance behavior in the presence of vessels. Effects from such exposures are likely to be short term and negligible. Spilled oil or other contaminants are not likely to reach typical bowhead migration habitat at concentrations that would cause effects exceeding a negligible level.

Disturbance effects from non-oil and gas survey aircraft operations, small summer camps, waste/fuel spill removal, river transport activity, habitat loss, aerial surveys, and winter ground transport, oil and gas seismic exploration and gravel mining activities on spectacled and Steller's eiders are likely to be short term and localized and result in negligible effects. Aircraft overflight effects on eiders are likely to be temporary and nonlethal, probably lasting less than an hour. Gravel mines, pads, roads, airstrips, and pipelines that would eliminate breeding habitat are likely to result in negligible population effects. Elevated activity and air traffic in the vicinity of large summer camps may result in minor impacts on both local and regional populations of these two species. Routine helicopter traffic to oil and gas development sites in summer, especially over higher density areas, is likely to result in minor impacts. Depending on the nature and duration of behavioral changes caused by disturbance, such effects could be considered a "take" under the ESA.

Effects from crude-oil spills, when confined to terrestrial and freshwater aquatic habitats where mortality of eiders is likely to be relatively low, is expected to be minor. Minor to moderate effects are likely for these eider populations if a spill were to enter a river delta or nearshore marine habitats during a period when occupied by substantial numbers of brood-rearing, staging or migrating individuals. There is a potential for a significant impact as a result of an oil spill in this circumstance. Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations would decrease disturbance from most factors for threatened eiders and help prevent fuel and oil pollution and degradation of important bird habitats.

f. Multiple Sales

If multiple sales were to occur under Alternative A, construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under the multiple-sale scenario, depending on the oil price, up to 3 times the number of exploration and delineation wells could be drilled (24 to 96 for multiple sales versus 8 to 40 for the first sale; Table IV-07 and Table IV-05); the number of production pads is projected to increase from 0 to 8 for the first sale to 0 to 16 for multiple sales (Table IV-07 and Table IV-05). Total pipeline mileage would be likely to increase (driven by the price of oil, which dictates whether any development would occur) from 230 to 740 mi (Table IV-29). Effects from disturbance factors and habitat alteration or loss from each development are likely to be short term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially would be lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oil-field facilities associated with multiple sales are grouped in high resource interest areas. If these are located in higher concentration areas, (as appears to be likely south of Barrow), greater numbers of individuals are expected to be displaced than with a single sale. Multiple sales likely would result in increased vessel traffic over a longer period of years, although the general effects on bowhead whales and eiders are likely to be similar to those described above. Such effects could alter the populations of these local areas substantially, and effects could extend to regional populations and involve long-term changes in distribution. With multiple developments concentrated in a limited region, population effects could be elevated to a moderate level.

The estimated number of onshore oil spills of 500 bbl or greater is expected to stay constant (0 for the $18/bbl no development scenario, 1 for the $30/bbl development scenario) for both first sale and multiple sales (Table IV-19). Also, the number/volume of small crude or refined oil spills, estimated at 130 crude/323 refined under the first sale (average size 3/0.7 bbl; 127/29.4 gal) is expected to remain constant if multiple sales occur (Table IV-20). These small, chronic spills generally are contained and cleaned up on pads and roads. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is likely to persist for several years but is expected to result in negligible to potentially minor effects. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

g. Conclusion--Multiple Sales

Under Alternative A, displacement of eiders by disturbance and habitat alteration or loss is expected to increase substantially if development and production facilities are concentrated in limited regions with higher resource potential (i.e., northern Planning Area). This also could occur in several portions of the Planning Area if multiple sales are held and development occurs in areas where higher density of eiders occurs. Such development potentially could alter local populations in these areas. For Steller's eider, that may be particularly vulnerable to habitat changes or disturbance in the vicinity of the nesting area south of Barrow, effects could extend to regional populations and involve long-term changes in distribution. Although most effects that would be likely to occur throughout the Planning Area are expected to be short term and negligible to minor, moderate effects could occur if eider concentrations were contacted more frequently by the likely increased number of crude- and refined-oil spills under the multiple sale scenario. The likely increase in numbers of small crude-oil and refined-oil spills (over single sale estimates) would be expected to elevate losses of eiders somewhat during the period of development resulting from multiple sales. Although in any scenario of losses and subsequent recovery of cumulative lost productivity and recruitment may not be detectable above the natural population fluctuations given the survey methods/data available, they would be considered significant for these ESA-listed species. Effects of oil and gas developments resulting from lease sales following the first sale are expected to be additive to those of the first, and may range from a slight increase to a doubling or tripling of effect. This would depend on whether the later developments were concentrated or scattered through areas of low or high density of eiders that may through time vary in their vulnerability to development activities. If subsequent developments are more scattered, they may occur by chance in areas of low eider vulnerability and thus add little to the effects of earlier sales.

12. Economy

a. Effects of Non-Oil and Gas Activities

For Alternative A, recreation-field employment would be generated by 30 one-week float-trip parties per year, which is equal to one person working for 8 months each year (Delaney, 2002, pers. comm.).

b. Effects of Oil and Gas Activities

The first Alternative A lease sale would generate economic activity manifested primarily in revenues to 1) government, 2) employment, and 3) personal income. The economic effects would occur in the North Slope Borough (NSB), South Central Alaska, and Fairbanks. The exploration and development projected in Table IV-06 and discussed in Section IV.A.1.b. form the basis for analysis of potential economic effects in this section. The reader should refer to these sections for a description of timing of activities including wells, rigs, production pads, pipelines, and staging bases. The activities and construction and operation of infrastructure described in the exploration and development scenario generate economic activity. As Section IV.A.1.b. indicates, Alternative A is designed to allow oil and gas leasing and development of all lands administered by BLM in the Northwest NPR-A Planning Area.

(1) Revenues

With long-term oil prices at $18 or lower per barrel, (with corresponding gas prices at or below $2.56 per Tcf)--and with the expectation that long-term oil prices will remain at or about $18/bbl--projected revenues could be expected to be similar to those accruing from the 1999 Northeast NPR-A Lease Sale, i.e., the NSB would show a one-year, 10 percent revenue increase, and the State and Federal Governments would show a negligible revenue increase. In the 1999 sale the State of Alaska received $38 million in bonus bids, of which it transferred $28 million to the NSB in grants. The Federal Government also received $38 million in bonus bids. The State and Federal Governments each receive approximately $2 million per year in rentals. See Section III.C.1 for details of the distribution of revenues from the 1999 Northeast NPR-A lease sale. Because the NSB cannot collect property tax on infrastructure or improvements on Federal lands, no property taxes would accrue to the NSB from any oil or gas activity on NPR-A.

The activities projected with $30/bbl oil prices ($4.27/Tcf for gas) would, in the early years of production, generate an increase of 27 percent in revenues from royalties to the NSB above those projected for the no-development scenario. In the latter years of production, royalty revenues would taper to 5 percent above the level they would have been at without development. The assumption for this analysis is that the State would allocate half of its share of royalty revenues to the NSB--$33 million in the first year of production, tapering to $3 million in the latter years. These are percentages of the NSB budget, estimated at $120 million in 2013 (hypothetical first year of production) and $60 million in latter years.

The activities in the early years of production would generate increases in revenues from royalties to the State of Alaska of 3.4 percent above the level they would have been at without development. The increases would taper to less than 0.3 percent above the no-development level in the latter years of production. In this analysis, these numbers represent revenue expressed as a percentage of the State budget ($4.3 billion in 2000) and are assumed to be constant in real dollars for future years. The royalty revenue to the State would be about $67 million in the first year of production, tapering to $7 million in the latter years. This figure is based in turn on the Federal royalty rate of 16.67 percent. According to law, the Federal Government must share 50 percent of the Federal royalty rate with the State; and the State must share a portion of its royalty with the affected local government (see Section III.C.1). The affected local government in this case is assumed to be the NSB. The State can collect severance tax of 12.5 percent for the first 5 years and 15 percent for the following years. The average annual State severance tax is estimated to be $112 million in the early years declining to $11 million in the latter years.

Production activities would generate increases in revenues from royalties to the Federal Government of less than 0.004 percent above the no-development level of the Federal budget--about $67 million in the first year of production, tapering to $7 million in the latter years, based on the Federal royalty rate of 16.67 percent.

Note: These figures represent the Federal Government's 50 percent share of the projected royalty.

(2) Employment and Personal Income (Not Related to Oil Spills)

With long-term oil prices at $18 or lower per barrel (with corresponding gas prices at or below $2.56 per Tcf)--and with the expectation that long-term oil prices will remain at or about $18/bbl--employment and personal income are shown in Table IV-21. The difference would be less than 0.1 percent above the 1999 baseline for the NSB and for the rest of Alaska. Employment and personal income shown in Table IV-21 would be generated during the 6 years of exploration.

For employment and personal income, the potential economic effects of development would occur in three major phases: exploration, development and production. In general, employment and associated personal income are at relatively low levels in exploration, peak during development, and drop to a plateau in production phase. This pattern of economic effect is reflected in the exploration and development scenario described in Table IV-02 and Table IV-03 and in Section IV.A.1.b. All direct workers are assumed to stay in enclaves on the North Slope during their work time and commute to residences elsewhere in their time off. Their places of residence during the time they are not in an enclave are assumed to be in NSB villages or in South Central Alaska or the Fairbanks area as indicated in Table IV-22.

Note: Approximately 30 percent of current North Slope workers in the classification of oil and gas commute to residences outside Alaska (Hadland, pers. comm., 2002; Hadland and Landry, 2002). The workers who commute to residences outside the State would not generate the economic effects of indirect and induced employment-- or expenditure of income in the State--and would have a negligible effect on the economy of the rest of the U.S.

All workers would be present at a new enclave staging base somewhere in the Northwest NPR-A or in associated enclave-support facilities in and near the Prudhoe Bay complex for approximately half of the days in any year.

For activities projected with $30/bbl oil prices, the increase in total employment and personal income is shown in Table IV-22. The difference is less than 1 percent above the 1999 baseline for the NSB and the rest of Alaska (except for NSB personal income during the development phase, which would be 3.4% above baseline).

Note: These activities also generate employment and personal income in the rest of the U.S., but the percent contribution to the overall U.S. economy is so small that it is not analyzed here.

For activities projected with $30/bbl oil prices, exploration phase would occur between 2005 and 2014, development phase would occur between 2011 and 2018, and production phase would occur between 2013 and 2034. To simplify analysis, data for employment and personal income are presented as annual averages for the three main activity phases.

"Direct employment" refers to jobs that are actually in the fields of oil and gas exploration, development, and production. "Indirect employment" refers to jobs that support exploration, development and production activities. For example, jobs involved with providing food to workers while they are working on the North Slope would be "indirect employment." Helicopter pilots and mechanics on the North Slope are another example of indirect workers. Both direct and indirect workers spend a part of their earnings for food, housing, clothing, etc. The aggregate of jobs associated with providing those goods and services is termed "induced employment." Compensation derived from direct, indirect, and induced employment is defined as "personal income" in Table IV-21 and Table IV-22.

As another example, through the development (or the continued use) of facilities that are taxable by the NSB, the NSB would have additional revenues available that most likely would be used for its ongoing operations. This in turn results in NSB government jobs. This is in large part how the indirect and induced jobs are generated in the NSB.

(3) Employment Related to Spills

No employment would be generated from cleanup of small spills of less than 500 bbl, large spills of 500 bbl from a pipeline, or a 900-bbl crude or diesel spill from a facility. On-site workers doing other operations would clean up spills of these sizes.

(4) Subsistence as a Part of the North Slope Borough Economy

The predominately Inupiat residents of the NSB have traditionally relied on subsistence activities. Although not fully part of the cash economy, subsistence hunting is important to the NSB's whole economy and even more important to its culture. For effects on these aspects, see Section IV.C.14 Subsistence-Harvest Patterns and Section IV.C.15 Sociocultural Systems.

c. Effectiveness of Stipulations and Recommended Operating Procedures

Under Alternative A, stipulations and ROP's would not alter the economic effects.

d. Conclusion--First Sale

Alternative A, at $30/bbl, would generate a 27 percent increase in NSB revenue above the no-development level of NSB revenues in the early years, tapering to a 5 percent increase in the latter years. Alternative A in the early years of production would generate increases in revenues to the State of Alaska of 3.4 percent above the no-development level that would taper to less than 0.3 percent in the latter years of production. For the NSB, Southcentral Alaska and Fairbanks, the increase in total employment and personal income during exploration, development and production would be less than 1 percent over the 1999 baseline (except for NSB personal income during development phase, which would be 3.4 percent). Alternative A, at $18/bbl (assuming 6 years of exploration), would generate a one-year (lease year), 10 percent NSB revenue increase and less than 0.1 percent increase in employment and personal income for the NSB, South Central Alaska, and Fairbanks.

e. Multiple Sales

The effect of multiple sales for Alternative A is projected to be approximately two times that of the first sale for this alternative. Subsequent sales would likely heighten the economic effect in any given year, as exploration, development, and production resulting from separate lease sales occur in the same years. Multiple sales would lengthen the period of economic impact, as the lives of new fields would extend beyond the lives of those fields that resulted from the earliest lease sales.

f. Conclusion--Multiple Sales

The effect of multiple sales for Alternative A is projected to be approximately two times that of the first sale.

13. Cultural Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative A, the type of non-oil and gas activities would be the same as those under the No Action Alternative. However, the level of activity and duration could increase by as much as a factor of 3. This means there is a greater likelihood of impacts on cultural resources under this Alternative than under the No Action Alternative, but the impacts would still be minimal.

b. Effects of Oil and Gas Activities

Under Alternative A, the level of seismic activity is expected to increase beyond that projected under the No Action Alternative because unlimited oil and gas exploration would be allowed in the Northwest NPR-A Planning Area. While the types of impacts to cultural resources would remain the same, the increased level of seismic activity would increase the possibility that impacts could occur. However, even with the increased activity level, in most instances (as described in the No Action Alternative), any impacts that do occur are not expected to be significant.

Cultural resources are not ubiquitous in the Planning Area, as are wildlife and vegetation. Although cultural resources--because of their near-surface and surface contexts (as well as other factors)--are more common than paleontological resources, cultural resources tend to be more easily recognized and therefore avoided. As a result, it is quite possible that oil and gas exploration or development activities would have limited impact on cultural resources simply because, in most cases, such oil and gas activities could be conducted so as to avoid the locations where cultural resources occur.

(1) Effects of Disturbances

Under Alternative A, the level of activity in the Planning Area would probably be at its maximum. However, because most of the activity would occur during the winter months, the potential for impact to cultural resources remains relatively low.

The drilling of as many as 16 exploration wells and 24 delineation wells is projected to occur under Alternative A. Because of the limited availability of drill rigs, no more than a few wells are expected to be drilled at one time. If the maximum 40 exploration and delineation wells are drilled, drilling activities would certainly occur over the span of several winter seasons and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no gravel or rock needed, no significant disturbance of the ground would occur and buried as well as most surface cultural resources would not be in jeopardy (see No Action Alternative). The only significant subsurface disturbance that would occur as a result of the actual drilling would be the creation of the drill hole itself. It is possible that drilling the hole could impact a small amount of material if a well bore were to be drilled through a cultural resources site, but the likelihood of that occurrence is minuscule and impacts to the site would probably be minimal.

The effects of disturbance from development--the construction of as many as 8 production pads (connected by roads), one airstrip, one pump station, two staging bases and approximately 230 mi of pipeline--could occur under Alternative A. Surface disturbance resulting from this work would impact approximately 250 acres. It is possible that surface cultural resources could be impacted (buried) as a result of such construction activities, but it could be argued that such an impact would not be adverse. However since most surface cultural resource sites are readily discernable, it is unlikely that this would happen. The primary source of potential impacts to cultural resources would be the excavation of material for construction of the permanent facilities. If the pads/roads/airstrip material source were terrestrial, then extraction of material could impact buried cultural resources.

It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of vertical support members (VSM's). Because of the near-surface and surface contexts of cultural resources sites it is possible that cultural resources could be impacted. Given the limited area of disturbance associated with the drilling and setting of VSM's the resulting impact to a typical cultural site would not be significant in most cases. If buried pipelines were to be used, disturbance and impacts to cultural resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline.

(2) Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions when cleanup is less invasive than in a summertime terrestrial spill. In such a case, a buried cultural resource site would probably not be affected by the spill or subsequent spill cleanup. On the other hand, a surface cultural resources site could be impacted by such a spill and/or the subsequent cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they could occur during the snow-free months. A spill occurring during the summer would have a greater potential of impacting either surface or buried cultural resource sites since the effects of both spill and cleanup would be more intense than if the same spill occurred in a frozen environment.

c. Effectiveness of Stipulations and Required Operating Procedures

There are no stipulations or ROP's that directly address the protection of cultural resources. However, stipulation C-1b and ROP C-1e would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact cultural resources that are near the surface. In addition, stipulations A-1, A-2, and A-3 and ROP's A-6 and E-1 would help to prevent large fuel or crude oil spills, and consequently reduce the already small potential for impacts to cultural resources from spill cleanup. The NHPA requires that an archaeological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities such as the construction of buried pipelines are considered undertakings. If cultural resources are identified during the survey, Federal law requires that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

d. Conclusion--First Sale

Under Alternative A, impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously stated. Impacts would include displacement and/or destruction of resources and are anticipated to be minimal regardless of the level of seismic activity. Under Alternative A, the potential impacts to cultural resources from first sale oil and gas exploration and development would be at their highest level due to the amount of anticipated surface and subsurface disturbance.

e. Multiple Sales

For multiple sales under Alternative A, potential impacts could increase by a factor of two, depending on a suite of variables, including construction techniques and associated oil field infrastructure. The scattered nature of cultural deposits and the fact that the locations of most remain unknown make it somewhat difficult to assess the likelihood and severity of potential impacts except to say that as oil and gas activities increase, the potential for impacts to cultural resources increases.

f. Conclusion--Multiple Sales

For multiple sales under Alternative A, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously described. However, the probability of impacts occurring might increase. The potential impacts to cultural resources from oil and gas exploration and development could increase significantly compared to that of a single sale. This statement is not meant to be an equivocation but simply reflects scattered distribution of cultural locales and the fact that the locations of most remain unknown.

14. Subsistence-Harvest Patterns

This discussion is concerned with subsistence resources and subsistence-harvest patterns of Native communities in and adjacent to the Northwest NPR-A that could be impacted by ground-management actions and oil and gas leasing within the Planning Area. These communities are Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. Under Alternative A, all BLM-administered lands in the Planning Area would be available for leasing. Restrictions on seismic activities, exploratory drilling, and the siting of permanent facilities in the Planning Area would depend on future site-specific analysis. Under Alternative A, no Special Areas, wilderness study areas, or Wild and Scenic Rivers would be proposed. The entire Planning Area would be open to recreational OHV use and there would be no restrictions on the use of airboats. Protective measures would include applying stipulations and identifying Visual Resource Management Areas. Additional protection could be introduced following future NEPA analysis on specific proposed activities. The activities and events most likely to have some effect on subsistence-harvest patterns would be various types of noise and disturbance (vessel traffic, air traffic, seismic surveys, pad construction, drilling, pipeline construction), oil spills, and habitat disturbance.

The primary subsistence resources and aspects of subsistence-harvest patterns covered in this analysis are: 1) a heavy reliance on caribou and fish in the annual average subsistence harvest for all five villages; 2) a heavy reliance on bowhead whales in Wainwright, Barrow, and Nuiqsut and beluga whales in Point Lay); 3) subsistence-harvest areas overlap for many species harvested by these communities; 4) subsistence hunting and fishing are cultural values that are central to the Inupiat lifeway and culture; and 5) the importance of guaranteeing healthy populations of these resources for local subsistence needs.

For the communities mentioned above, most of Barrow's terrestrial subsistence-harvest area, the western edge of Nuiqsut's terrestrial subsistence-harvest area, and most of Atqasuk's and Wainwright's terrestrial subsistence-harvest areas, and the eastern portion of Point Lay's terrestrial subsistence-harvest area are within the Planning Area (see Sec. III.C.3).

a. Effects of Non-Oil and Gas Activities

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from non-oil and gas activities under Alternative A on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in detail in this section under the various resource categories above and are summarized below.

The fall and winter harvest seasons are times when subsistence resources are available well past coastal areas and rivers accessible in the summer. Winter allows access to an expanded harvest area for ungulates and furbearers and can lead to greater potential industry and hunter contact and consequent disruption of harvest activities. Winter also is a time when wildlife are more vulnerable to natural environmental stresses limited forage, severe cold, high winds, and compacted snow cover. The effects on certain subsistence resources and their harvest from stresses produced from seismic activities may actually be more pronounced during winter.

The type of impacts to terrestrial mammals would be similar to those under the No Action Alternative but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Impacts from recreation and overland moves would be the same as the No Action Alternative.

Actions and impacts associated with Alternative A that could cause disturbance to freshwater fish are similar to those described under the No Action Alternative. Non-oil and gas related activities are not likely to have a measurable effect on marine fishes.

Effects on birds from non-oil and gas activities under Alternative A are likely to be somewhat greater than those discussed under the No Action Alternative. Most ground transport activities occur in winter and thus would not disturb most bird species or affect their habitats. Ptarmigan, gyrfalcon, and snowy owl may be displaced temporarily from vehicle routes, a negligible effect. Under Alternative A, occupation of large camps is anticipated to increase from the 6 weeks projected under the No Action Alternative to 12 weeks; this difference is not likely to alter the disturbance effects on birds significantly. Those birds that are displaced when the camp is first occupied probably would not return to the area to renest after 6 weeks any more than after 12 weeks because of insufficient time remaining in the short arctic breeding season to raise a brood. Also, those individuals that are tolerant of camp activity for 6 weeks would probably be tolerant for 12 weeks. Effects of small camps that are frequently moved are likely to be negligible for most activities and species, but could increase to a level representing a minor loss of productivity for some species that are uncommon, decreasing, or recently declined.

Bowhead whales may be present in the Beaufort Sea primarily from August through October and in the Chukchi Sea in April to early June. Only under exceptional circumstances when whales migrate near the coast coincident with the presence of barge traffic or possibly air traffic to supply a shoreline camp, would bowheads be disturbed by non-oil and gas activities under Alternative A. Effects from such exposure are likely to be negligible.

The primary potential causes of disturbance of marine mammals are helicopter traffic, fixed-wing aircraft traffic, and humans on foot. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra; other activities take place in summer and early fall (June-September). These activities, if they occur along the coast of the Planning Area, may cause short-term displacements or harassment of hauled-out seals and polar bears. The effects of activities other than oil and gas exploration and development under the Alternative A on marine mammals (seals, polar bears, and whales) would be local and short term, with no significant adverse effects to the populations.

b. Effects of Oil and Gas Activities

Oil and gas leasing, exploration, and development/production would be allowed throughout the Planning Area under Alternative A. A projected 6 to 16 exploration wells and 2 to 24 delineation wells would be drilled over the life of the oil and gas activities. A projected 5 oil fields may be developed (Table IV-04). Exploration and development activities resulting from the first sale could vary substantially depending on the per-barrel price of oil. Thus, the number of exploration/delineation wells, exploration/delineation rigs, production pads, staging bases, and pipeline miles could vary. If only exploration were to occur, it is expected to take place over a period of 7 years. If development were to occur, it is expected to require 10 years. Production is estimated to last 22 years. It is expected that any development in the Planning Area would involve relatively small, interconnected gravel structures.

(1) Effects of Disturbances

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from oil and gas exploration and development activities under Alternative A on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in this section (Section IV.C) above and are summarized below.

Under Alternative A, impacts on terrestrial mammals from seismic surveys would be similar in type to those discussed under the Seismic Option of the No Action Alternative but would be greater in extent and frequency. A greater number of individual animals would be exposed to human activities. The potential for disturbance of hibernating bears would be greater because of the increased level of seismic activity occurring in the Planning Area, especially in the southern part of the Planning Area, which is better bear habitat. The potential for temporary disturbance of moose would also be greater if seismic activity were to be carried out in the southeastern part of the Planning Area.

Impacts to terrestrial mammals from exploration drilling would be similar to those caused by seismic activity, though lesser in spatial terms and greater in temporal terms. Habitat impacts would be minimal, as drilling would occur during the winter on ice pads, facilitated by packed snow roads and ice roads. Potential causes of disturbance to terrestrial mammals from exploratory drilling include surface vehicular traffic, humans on foot, and fixed-wing aircraft traffic. In most cases, these activities are expected to cause short-term (few minutes to < 1 hour) displacements and/or disturbance of terrestrial mammals.

Camps at drill sites may result in localized disturbance and/or displacement of terrestrial mammals for several weeks to months. Exploratory drilling operations and ice roads would traverse TLH and WAH caribou wintering areas. Any caribou in the immediate vicinity of the activity would be disturbed, possibly having a negative effect on their energy balance. Because these animals are mobile and the operation is temporary, it is not expected that there would be any long-lasting effects on caribou. Muskoxen and moose winter distribution is such that exploratory drilling activities would be unlikely to have any impacts on these species unless located in the eastern or southeastern portions of the Planning Area; impacts would include short-term displacement or disturbance. Impacts to arctic foxes, grizzly bears and wolverines would be similar to impacts from seismic activities as discussed under the No Action Alternative seismic option, but would be more frequent or longer in duration. There would be a higher potential for bears and foxes to become attracted or habituated, as camps associated with drill sites would be in place for several months.

Primary effects of development activities on terrestrial mammals would come from: construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; aircraft traffic; crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou is through disruption of the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas. Infrastructure and activities in oil fields may delay or deflect movements of caribou between coastal insect-relief areas and foraging habitat farther inland. The TLH, WAH, and CAH core calving ranges lie outside of the Planning Area, thus development is expected to have no effect on caribou movements within the calving range, and no calving activity would be displaced. Development activities are not expected to result in the loss of any core calving habitat.

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter. Under Alternative A, moose could be temporarily displaced or disturbed during construction of a southern pipeline route. If gravel is mined from riverbeds in the Planning Area, there is a potential for temporary displacement and disturbance of moose. Minimal habitat disturbance would occur at river crossings.

Muskoxen are uncommon in the Planning Area. Initial development activities are unlikely to impact muskoxen.

Grizzly bears within a few miles of noise sources may be disturbed. Major sources of noise include construction of roads, installation of pipelines, gravel mining, and drilling operations. Oil exploration and development under Alternative A are expected to attract some grizzly bears to oil field facilities and may result in the loss of some bears because of interactions with humans. Minimal habitat disturbance would occur from gravel mining and pipeline construction.

Potential effects on wolves include short-term disturbance from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence that may be associated with oil development. Wolves are generally not abundant in the Planning Area.

Potential effects on wolverines could include disturbance from air and surface-vehicle traffic, increased human presence, and habitat alteration. Some wolverines may be displaced near oil field facilities.

Oil and gas development activities can affect the arctic fox by increasing the availability of food and shelter. An increase in the fox population may adversely affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself. If development occurs in the arctic foothills or mountains, similar impacts to red foxes could occur.

Small rodents and their predators would be affected locally by loss of of habitat of individuals along pipelines, gravel pads, and other facilities. Effects are expected to be insignificant to populations on the Arctic Slope of Alaska.

Seismic surveys under Alternative A are expected to have no measurable effect on arctic fish populations. Construction-related activities that may affect arctic fish include water withdrawal related to the construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling. These winter activities could adversely affect arctic fish depending on the location of the construction and the quantity of freshwater withdrawn. Lake water withdrawal might be expected to kill a small number of individual fish but is expected to have no measurable effect on arctic fish populations in the Planning Area. Activities related to development that could impact fish include excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways, and water withdrawals. One impact related to these structures is the potential to alter flow patterns to--and within--waterbodies. Potential loss of migratory capacity could stress or kill fish if they were unable to migrate to food rich habitat in the summer, reach spawning areas, or move into overwintering habitat. Pipeline construction associated with Alternative A is expected to have no measurable effect on arctic fish populations in the Planning Area.

Marine fishes could be affected by marine seismic surveys, marine construction, and marine oil or fuel spills. No measurable effect on marine fish populations would be expected. While there is no stipulation that precludes seismic surveys above overwintering areas, the likelihood of them occurring in such areas is considered very low.

Winter seismic operations may displace small numbers of ptarmigan, gyrfalcons, and snowy owls temporarily from within 700 ft to 0.6 mi of the activity. The duration of disturbance incidents is likely to be brief and infrequent and not result in a substantial adverse effect. The overall population effect from this activity is likely to be negligible.

Oil and gas activities in areas where waterfowl and other species occur potentially could cause increased disturbance from routine aircraft operations, gravel-mining operations, presence of gravel pads and facilities, and associated vehicle and foot traffic. Most incidents are expected to result in minor effects from which individuals would recover within hours to 1 day. The presence of facilities and construction of gravel structures would result in displacement from favored habitats and associated energy costs, which could result in short-term negative effects during breeding, brood rearing, or migration; however, the footprint of such structures is quite small, so effects are not likely to be evident at the regional population level.

Air traffic is likely to be the most important source of disturbance associated with oil and gas development; helicopters are the most disturbing type of air traffic. Disturbance effects may be particularly serious in areas of higher densities of several species that are especially sensitive to disturbance or whose populations have declined or are declining. Species at particular risk from disturbance effects in the Dease Inlet/Admiralty Bay area include red-throated loon, tundra swan, brant, long-tailed duck, king eider, and Sabine's gull; in the vicinity of Smith Bay, yellow-billed loon, tundra swan, and Sabine's gull; in the south-central area, yellow-billed and red-throated loons, king eider, and Sabine's gull; and in the western area, red-throated loon, long-tailed duck, and king eider.

The presence of pads, short connecting roads, facilities, and drilling operations would displace all but the most tolerant individuals of bird species breeding locally from the affected site, and probably also from the immediate area. Such displacements are not expected to cause long-term effects on population productivity, but there would be a long-term or permanent local result. The overall effect is likely to be negligible. Gravel mining activities would displace any nesting species to undisturbed habitats from the local area (up to 50 acres), with potential for lowered productivity, and could cause local disturbance and temporary displacement of the resident. Overall effects could range from negligible for species with abundant, stable or increasing populations, to minor where mining eliminates breeding habitat of declining species.

The bowhead whale migration route typically is well offshore, so it is unlikely whales would experience intense or frequent disturbance from noise originating from activities in the Northwest NPR-A. Seismic surveys occur during winter months (December-April) when bowhead whales are absent from the region. Some potential noise and disturbance from aircraft traffic and seismic activities could occur along the coast and disturb beluga whale or other marine mammals. Effects are expected to be local and short term (generally < 1 year).

Air traffic would be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches along the coast and to polar bears using coastal habitats. Aircraft disturbance of hauled-out seals in the Planning Area could result in injury or death to young ringed seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of any adult seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent. Seals and polar bears could be affected by possible oil exploration offshore drilling from an ice island and subsequent oil development on the coast of the Dease Inlet/Admiralty Bay area. Onshore activities are not likely to affect individual marine mammals or populations.

(2) Effects of Spills

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of spills on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in this section Section IV.C above and are summarized below.

Under Alternative A, 130 small, crude-oil spills (averaging 3 bbl in size) and 323 small, refined-oil spills (averaging 29 gal) are estimated to occur over the production life of the Planning Area. A maximum of 1 large spill (500 or 900 bbl for this scenario) and no very large spills (> 120,000 bbl) of crude are projected. An estimated 65 to 80 percent of the crude-oil spills associated with NPR-A oil production would occur on drilling pads and be contained. Typical refined products that are spilled on the Alaska North Slope include aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The extent of environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and the effectiveness of the response.

Adult caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermal insulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermal insulation, leading to death. Oiled caribou, moose, and muskoxen hair would be shed during the summer before the winter fur is grown. Because the outer guard hairs of caribou are hollow, if caribou were to become oiled in the winter after shedding their summer coats, oiling would not be expected to affect thermal insulation. No documented caribou deaths have been caused by the numerous spills associated with the TAPS. For the most part, onshore oil spills would be very local (< 1 acre) in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen habitat. Caribou, moose and muskoxen probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume. For most spills, control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskoxen away from the spill and prevent the possibility of these animals grazing on the oiled vegetation. Some local contamination of tundra vegetation is expected to occur. Spills that occur within or near streams and lakes could affect foraging habitat along these streams. Caribou, moose, and muskoxen oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic hydrocarbon inhalation and absorption through the skin.

Grizzly bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching fish and finding carrion. If an oil spill contaminates beaches and tidal flats along the Beaufort Sea coast, some grizzly bears are likely to ingest contaminated food, which could result in the loss of a few bears. Direct contact with oil can cause skin damage and temporary loss of hair to bears, with adverse effects on thermal insulation.

Small mammals and furbearers could be affected by spills from oiling or ingestion of contaminated forage or prey items. These impacts would be localized around the spill area and would not have population level impacts.

Given the small size of the fuel spills anticipated and the fact that they would most likely happen on pads, fuel spills associated with Alternative A are not expected to have a measurable effect on arctic fish populations. Fuel spills occurring in a small body of water containing fish with restricted water exchange might be expected to kill a small number of individual fish but are expected to have no measurable effect on arctic fish populations.

Fuel and oil spills associated with Alternative A are not expected to have a measurable effect on marine fish populations. Some marine fish in the immediate area of an offshore oil or diesel spill could be lethally or sublethally affected, particularly if the spill were to occur when marine fish were migrating and feeding nearshore (summer), or in overwintering areas during winter (an estimated 3-year recovery). Sublethal effects may include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movement to feeding, overwintering, or spawning areas, localized reduction in food resources, and consumption of contaminated prey.

A 500- or 900-bbl crude-oil spill from a pad or pipeline onto tundra would be likely to cause mortality of small numbers of shorebirds and passerines; if it enters local lakes or other interconnected wetlands, small numbers of waterfowl--and potentially additional shorebirds--could be contacted. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the water. If the spill were to enter a local river, a variety of waterfowl and several shorebird species could be present. If gyrfalcons, peregrine falcons, or rough-legged hawks were breeding in the vicinity, they could become secondarily oiled by preying on oiled birds. It is likely the above effects would be minor with regard to the proportion of the regional populations involved. If a spill moved into a delta area or into Elson Lagoon, Dease Inlet, or other coastal waters, additional waterfowl species that breed, stage, or stop there before or during migration would be at risk. A spill entering a river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate before occupying nesting areas. Either of these scenarios involving king or common eiders, black guillemots, or Ross' gulls potentially could elevate effects to moderate.

An offshore spill during August or September when ice cover is less than 50 percent, or an onshore spill near the coast from a pad, or fuel oil from a tank that reaches the marine environment could contact loons and flocks of brant, long-tailed duck, and eiders staging before or stopping during migration in protected coastal habitats, as well as black guillemots year round or Ross' gulls in fall (e.g., Elson Lagoon, Dease Inlet, Smith Bay, near barrier islands). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interfere with the reproductive process. Some brood-rearing, molting, or staging loons, brant, long-tailed ducks, or other waterfowl could contact oil in coastal habitats. Mortality of molting long-tailed ducks from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because of natural population fluctuations.

Flocks of staging eiders could contact oil in nearshore or offshore areas. King eider population and common eiders nesting on barrier islands and along the coast have has declined so substantial mortality could be significant.

Onshore spills would not be expected to impact migrating bowhead whales, whose migration route typically is well offshore of onshore locations where oil and gas development is likely to occur. A spill occurring in Dease Inlet would be expected to disperse before it reaches migration routes and offshore habitats where bowheads could potentially be exposed to the spill.

Some seals could be exposed to oil if a spill were to occur within the marine environment of Dease Inlet during the open-water season. Such an event could result in the loss of perhaps 10 to 50 spotted seals. The population would be likely to replace this loss within one year. As many as 86 to 116 ringed seals could be affected if the spill occurred during spring melt-out. The population of about 40,000 would be likely to replace this loss within one year. A hypothetical 500- or 900-bbl pipeline spill would not be likely to affect many bearded seals, walruses, beluga or gray whales because these species tend to occur offshore of Dease Inlet/Admiralty Bay and such a spill would be expected to disperse before it reached the migration routes and offshore habitats where these species could be exposed. Such a spill would not be likely to have any food chain effects on marine mammals.

Polar bears would be most vulnerable to the spill if oil were to reach the barrier islands from Elson Lagoon to Point Barrow. The number of bears likely to be contaminated or to be indirectly affected by a local contamination of seals probably would be small. Even in a severe situation where a concentration of perhaps 10 bears (such as at a whale-carcass site) were to be contaminated by the assumed 500- or 900-bbl pipeline spill and all the bears died (a worst case situation), this one-time loss would not be expected to significantly affect the regional polar bear population.

Small, onshore spills are expected to have little effect on seals, walruses, and polar bears. If spills were to occur in or contaminate streams in the Dease Inlet area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by any spills that reach the marine environment during early winter, resulting in the death of some pups (perhaps 10 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). If some of the spills reach Dease Inlet during the summer open-water season some spotted seals that frequent the inlet could be exposed to the oil and suffer sublethal and possibly lethal effects. Perhaps as many as a few hundred seals could be exposed to the contamination, with heavily oiled individuals suffering lethal effects (perhaps 10 to 30 animals). Smaller numbers of polar bears are expected to be exposed to and affected by these small spills. The losses of small numbers of seals, and possibly a few polar bears are not expected to affect the seal and polar bear populations. These spills are not likely to affect walruses and beluga whales that occur offshore of Dease Inlet.

If seawater were used for enhancement of oil production, a saltwater spill could occur within the NPR-A. Brine kills plants on contact and increases soil salinity to the point that many species cannot survive. Unlike oil, salts are not biodegradable and natural recovery occurs only after salts have leached from the soil. A spill would have adverse effects on salt-intolerant vegetation but the amount of tundra habitat affected would be small, no more than a few acres. Thus, saltwater spills are not likely to affect forage availability for caribou, muskoxen, moose, or other terrestrial mammals in the Planning Area. The effects of a seawater spill on freshwater fish populations would depend on the specific location, size, and timing of the spill. Because of the small size of the seawater spills anticipated, and the low diversity and abundance of freshwater fish in most of the Planning Area, seawater spills are not expected to have a measurable effect on arctic fish populations in the Planning Area.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations that protect and mitigate impacts to subsistence resources would also mitigate potential impacts to subsistence-harvest patterns. Stipulation H-1 specifies that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP-H-1 would direct the lessee to develop and implement a plan, in consultation with the affected susbsistence communities and the SAP, to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area; specifically the program is designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel will be working with the intent of reducing any potential conflicts with subsistence.

d. Conclusion--First Sale

(1) Effects on Subsistence Species

The effects of oil and gas activities are expected to be greater under Alternative A than under any other alternative. The activities and events most likely to have some effect on subsistence-harvest patterns would be various types of noise and disturbance (overland moves, vessel traffic, air traffic, seismic surveys, pad construction, drilling, pipeline construction), oil spills, and habitat disturbance. Effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally < 1 year), and to have no regional population effects.

If a field were to be developed in critical Teshekpuk Lake caribou herd (TLH) insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect-relief areas could be disrupted, with possibly significant levels of effects on the productivity of the herd. Effects from crude-oil spills on birds could range from minor--when confined to terrestrial and freshwater aquatic habitats where the mortality of few waterfowl, shorebirds, raptors, and passerines is likely to be relatively low--to moderate if a spill were to enter a river delta or nearshore marine habitats occupied by loons, large numbers of sea ducks whose populations have declined, black guillemots, or Ross' gulls.

(2) Effects on Subsistence-Harvest Patterns

Effects to subsistence-harvest patterns result from effects on subsistence resources and from potential displacement of subsistence hunters from traditional hunting areas because of access impediments. The overall impacts of activities under Alternative A on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in this section (Section IV.C) above.

Subsistence-harvest pattern effects are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of the Teshekpuk Lake herd (TLH) if development were to take place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would be elevated from low to moderate or high effects, because one or more important subsistence resource would then have become unavailable, undesirable for use, or less available for a period greater than 2 years.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

(3) Effects on Communities

(a) Point Lay

Effects on subsistence-harvest patterns are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If caribou populations become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects over the long-term.

Community Traditional Knowledge of Effects on Resources and Harvests

Beluga whales are a prized subsistence resource, and for this reason Point Lay residents object to nearshore or offshore disturbances. Wille Tukrook gave this testimony at a Point Lay public hearing in 1987 for MMS's Chukchi Sea Lease Sale 109:

> I'd like to see this lease sale postponed or cancelled due to the fact that not enough noise pollution study has been done on the belugas...we have no idea how the noise will affect them. It might change their migratory routes...it might be too much activity around if the lease sale goes through, and it might chase belugas away...I've seen the same thing happening in Kotzebue. The belugas hardly go into Kotzebue Sound anymore where they used to be numerous. It might be due to activity or noise pollution. But I think some kind of study should be made...Like some of the people say...these land resources should be exhausted before we try to do anything in the ocean. That's it. (USDOI, MMS, 1987)

This same concern about disturbance to belugas was echoed by former Point Lay Village Coordinator Josh Tucker during a public teleconference held in Barrow in 1996 for testimony for MMS's Outer Continental Shelf Oil and Gas Leasing Program for 2002-2007. Tucker related:

> I'm a Village Coordinator here and a resident of Point Lay. And I used to work on tugboats out of Kotzebue and Nome, and I know it affects the animals down there. There's no more belugas going into Kotzebue Sound anymore because of all of the heavy boating traffic down there. And it's even getting same way in Eschscholtz Bay for the Buckland people on beluga. And I was wondering, [are] we going to take those

> [things] into consideration when the animals start migrating either up this way or back down to where they come from, or where they winter. And it's going to affect our village because we have to compensate [depend?] a lot on beluga. (USDOI, MMS, 1996)

A hunter interviewed in 1995 related changes in local beluga whale migration to a local fuel spill at the whale gathering area at Omalik Lagoon south of Point Lay. During the winter of 1992-1993, there was a 10,000 gallon fuel tank leak there and since then the whales come up the coast earlier, rather than waiting at Omalik Lagoon for the ice to go out like they used to. This hunter believes that this could be due to belugas avoiding the spill area. He believes it is important to find out if belugas still use the Lagoon (Huntington and Mymrin, 1996).

There is also concern among whalers of a potential coal mine development near Omalik Lagoon. The projected marine terminal (an island or a causeway) would be in the middle of a critical beluga gathering and feeding area and would also be in the path of their migration. Hunters believe such development would disturb migrating whales and make them impossible to hunt or adversely affect their population (Huntington and Mymrin, 1996).

Point Lay resident Frederika Stalker expressed concern about the overall health of caribou, beluga whales, polar bears, brown bears, wolves, and wolverines in the area:

> My name is Frederica Stalker. I was originally born in Kotzebue, but lived in Point Lay since the 80's. I've learned a lot about hunting since moving to Point Lay. I hunt year round, and I've noticed more and more caribou are sick. We don't know why there are illnesses. We don't get caribou around Point Lay often now. Sometimes we don't have meat the whole year. It took a while for the store to catch up on their groceries. It's getting harder and harder for Point Lay people to find the caribou. Sometimes we need to go almost up to Wainwright and they're getting further and further away. We used to see them in the villages. They used to come down this way, but now they don't. We have to travel farther and farther away to find caribou....but it's really hard to find caribou. They have puss, they have tumors, they are skinny, and it's hard for us to find a caribou that is not sick. We love to eat this stuff....In the belugas, we see puss in them, but we don't know why. It is getting scarier and scarier to eat the game we like to eat. I wish we could find out what's making this game sick and skinny. There are hardly any youngsters going out hunting nowadays. I wish they would go out.... The polar bears are coming in skinny, hungry, to where they got one of my brother-in-laws a few years back. There are more and more bears that are skinny. We have to have bear patrols. It's getting scary because we have to watch our kids. We sure would like to know why these animals are coming in skinny. Not just polar bears, but also brown bears, wolves, and wolverines. I noticed they haven't been fat lately. We never had to worry about this stuff - we used to be able to walk around the villages and out of the village - now we have to worry. (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, Sept. 1998 [University of Alaska, Anchorage, Institute of Social and Economic Research, No date]).

Another Point Lay resident and hunter, Charlie Tuckfield, observed similar problems with caribou and believed the problems stemmed from contaminants:

> We all know that these animals have been ill in the rivers and on the land. These dumpsites are all over and there are all these animals that hang around them. In my younger days there wasn't anything like them, but nowadays they're all over. These containers they were using have deteriorated and the contents have drained - leached out. I know that some caribou are always skinny and some are always ill. It's always been like that. (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, Sept. 1998 [University of Alaska, Anchorage, Institute of Social and Economic Research, No date]).

Dorcas Neakok, interviewed in 1988 and 1989, reflected on her difficult interactions with Point Lay DEW-Line and oil exploration workers:

Well, those new DEW-line people opened our ice cellar that was here on this side [of the barrier island at the old town site], while we were in Wainwright. We had filled it with caribou meat so if the kids came back [from boarding school] they could have some. That was when there were no Natives working the DEW-line. We stayed away almost one year. We went to Wainwright with a snowmachine in the springtime and came back the next spring the same way. We sent all our things back with the airplane. That was the longest we stayed away from here.

We knew we were coming back. That's why we wanted to be ready with all that caribou in the ice cellar. We made sure it was all covered before we left so it wouldn't melt during the summer. But somebody took everything off to see what was inside and then left it open. It just melted-full of caribou.

I guess those new people didn't know what it was. They thought that was where we dumped trash or something. Oh boy, everything was ruined. The ice cellar just filled up with water. There was nothing we could do. Then when winter came, it all turned to ice. People told me to sue them but I didn't want to. We didn't even know who did it.

It was good that we had another ice cellar across the lagoon. And it was good they left that one alone. Sometimes I had a board over there that said 'Leave Alone. Neakok.' That's because I knew DEW-line people sometimes took things from over there.

One time they used a helicopter to pick things up from the Old Site. People took things left behind in the old houses and warehouses. Warren [Neakok, her husband] saw that helicopter going back and forth from the Old Village back to the garage at DEW-line. These people with the helicopter weren't DEW-line workers. They were oil drillers or exploration-I don't know what they were doing. There were too many things going on with people coming in and out. I couldn't keep track of them all.

Maybe I shouldn't talk about these things. But they are not stories. Those are the things I went through. I saw it. And I was telling you about that helicopter going back and forth from the Old Village. Since my husband worked over there at DEW-line, he looked in the garage and saw all the winter clothes and skins. He recognized our stuff in the garage.

Warren came home to tell me what was happening. I got a piece of paper and started writing. "Bring all the junks you pick up from Old Village and bring them to me here. Right now." Warren took that over to them. Those people had to load everything into trucks and bring them to my house.

Eskimos don't take things when they go to a new town, not unless they are told to take it. And when I go to Anchorage, they don't give me anything. All they want is my money. That's how it is. These newcomers visit the village once in awhile and they think Eskimo stuff is priceless. But they have no right to take things from between the houses and what's stored inside. Even if no one is staying at the house, that's still their house. They come back sometimes.

> When those guys brought our stuff over with the trucks, they were full of all kinds of things. And the other stuff, I knew who they belonged to. There were all my old parkies that I never used, old mukluks and hip boots. Some of them had holes in the bottom or the caribou hair coming out. That's why I didn't use them. But they were nice and dry. Some of the people wanted to buy them. I picked out what we still used and sold the others one by one. There, we were happy. I told them not to do it again.

> Some of those companies looking for oil came around here. They unloaded about five hundred barrels of diesel and jet fuel over by where Cully Camp is now for when the company came in with their Cat-train. The Cat-train was all their equipment for drilling to see what was around here. You know they even drilled in front of my door! We were away for two weeks and when we came home, there was no house around here except one hut. That was the quonset hut we lived in. I said, 'How come they dumped sand in front of my steps?' I thought they brought sand from DEW-line. Here they drilled in front of our house and brought up sand. I didn't even know they drilled! (Impact Assessment, Inc., 1989)

(b) Wainwright

Effects on subsistence-harvest patterns are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If caribou populations become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years, effects subsistence-harvest patterns would elevate from low effects to moderate or high effects over the long-term.

Community Traditional Knowledge of Effects on Resources and Harvests

Lydia Agnasagga, testifying at a community public hearing in 1986 for MMS' Beaufort Sea Oil and Gas Lease Sale 97, reflected on the ongoing issue of impact assistance to local communities from oil activity impacts:

> My objection to the Chukchi Sea area and it come to my mind that if oil development ever comes, you know, occurs, I'd like to see the money in the North Slope Villages because right now...everybody knows in the villages that the money is exhausted, and we have so much to do in our villages yet. We've been trying here for the road to be worked on. We need a lot of things yet. I'd like to see that money come into the villages that are going to be impacted on. That's one thing I'd like to see. (USDOI, MMS, 1986)

Wainwright residents object to nearshore or offshore disturbances of any kind because of the displacement of game they have already observed. Jim Allen Aveoganna, Wainwright resident and hunter, gave this testimony at a local public hearing in 1987 for MMS' Chukchi Sea Lease Sale 109:

> ...Since there's a lot of activities coming through our area, like tug boats coming through here, there's a lot of difference already. The animals that we used to know...I know exactly when, the day, the month, and what time of year to go [to get] what I need to hunt for family needs...but nowadays there are no more on account of the activities that's coming through [tugboats]...So when they start drilling out there...that's going to be bad for us... (USDOI, MMS, 1987c)

Florence Ahmaogak, at the same MMS Sale 109 hearing, observed a pervasive attitude concerning Native testimony on public development projects:

> If we keep saying that we don't want holes to be drilled, what will happen? Nobody's going to listen." She continued to comment about bearded seal: "And this [the ocean] is where we get our oil, like this man over here who hunts all his life...How come those ugruks are getting lean? We're losing a lot of seal oil that's good for our diet." She concluded her testimony with fears of potential contamination from oil: "There's something down there already from spillage. There's contamination from somewhere out there. I've read about it. There's going to be more after this lease sale, and who is going to feed us? Nobody will be waiting to feed us. We're working so much now, but it doesn't buy much food. Our ocean and our areas out there, the hunting grounds, that's where we eat from. I hope somebody will learn what the true meaning of subsistence is. That's how we live. We're attached to it. Do you have any questions? (USDOI, MMS, 1987c)

At the same hearing in 1987, Luke Kagak summed up fears about oil-spill cleanup capabilities: "...I don't think there's a lot of people that wouldn't be hurt from the oilfield like if there was an oil spill. If there was a great oil spill, how could it be picked up on the ice and the water? Can you answer that?" (USDOI, MMS, 1987c)

Similar concerns were voiced by former Wainwright Mayor Eluk Oktullik during a public teleconference held in Barrow in 1996 for testimony for MMS's 5-Year OCS Leasing Program. Mayor Oktullik stated: "I think for my case I would have to oppose oil and lease sale in this area because it affects our migration routes for sea mammals and sea birds. And it would pretty well impact those type of resources that we utilize to keep ourselves in health and strength." (USDOI, MMS, 1996)

In public hearing in 1998 for BLM's NW Area NPR-A IAP/EIS, then-Mayor Rossman Peetook voiced his apprehensions about potential contamination in NPR-A. A local translator related Mayor Peetook's statement made in Inupiaq like this:

> That area [NPR-A] is being used for subsistence area uses and will probably be polluted if the industry takes over the land. He's very concerned about that because he wanted to use the example that the DEW line sites [that] have been left vacant. There's pollution there that's never been cleaned up, and he feels that that same thing will probably be there if the industry or the seismic people use the area for oil and gas. (USDOI, BLM, 1998)

At the same NPR-A hearing, Marjorie Angashuk talked about contamination and the changes that have occurred to wildlife:

> ...When I was a little girl, I used to live with my dad and everything - everything was okay on the land. Before he died, he used to ask me the land's going to change; people nowadays finally believe what he told me. But now it's changed so much, I just don't know why. December, I walked down the creek; I find a dead animal, a walrus. When I take a little walk up north, I find a dead animal, a bird... (USDOI, BLM, 1998)

Another abiding concern of local subsistence hunters is that BLM, in its planning protocol for NPR-A, will designate certain areas off limits to subsistence. Mayor Peetook, speaking through an interpreter expressed his concerns this way:

> ...Whether it be wilderness and scenic things, [if these] designations should come about, that he really supports the position of 'no designation' policy of the North Slope Borough. He's concerned that these [designations] will perhaps interfere with subsistence hunting by people who are primarily there for purposes of sports or recreation. (USDOI, BLM, 1998)

Wainwright resident, Dorcas Tagarook, commented on waste sites, contamination, and local ocean conditions:

> ...I came from Wainwright to attend this meeting. My ancestors came from Pt. Hope and my father came from Pt. Hope and my mother came from Wainwright. My grandparents came from Wainwright. I welcome each and every one of you and greet each and every one of you. We are learning from each other and listening to people's comments so they can be of some help about how we have lived and about the way we live and about the work that has been done on our land. I would also like to talk about people leaving areas as dumpsites without even cleaning them up even though they were told to clean up after each work project--they just left everything where it was. Now I want to go forward as to how to keep these people from just dumping trash in the areas that they work on. Now we know that the dumpsites have brought a lot of contamination and damage to our body systems and we also have learned that it has affected our health. They have learned that it has affected the health in our bodies and also we have seen green skins in the bodies of the animals that they have hunted. Some of the animals were contaminated and some of the ducks that they have hunted have been carefully looked at and they have known that some of them have been contaminated and are thin because of the contamination that is going on. We all have to work together and see how it can be of some help to us and also to the animals around us and to the foods that we eat, the fish that we eat and the fish that are in the lakes and ponds. We have to know about this--about the heavy waves the ocean sometimes has if we're going to be traveling by boat--we have to be really careful in our way of travel because of heavy waves. The ocean has animals that we love to eat and we would like to learn more. Sometimes the way we think is good and sometimes it's good for us to think. Working together is very helpful and very good. (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, Sept. 1998 [University of Alaska, Anchorage, Institute of Social and Economic Research, No date]).

Gregg Tagarook, hunter and elder, talked about certain kinds of birds no longer available to hunt, DEW Line site and radiation contamination, and fish, caribou, and polar bear behavior:

> I am glad to be here - to be present to say my piece. I am glad that our Lord has provided for me until I am 79 years old. I'm glad to be Inupiat and when you're Inupiat you do a lot of hunting. My uncle had made me a bow and arrow when I was a young boy. The bow and arrow was taller than I was. The bow and arrow was strong enough for me to handle. I used it when I was growing up. There was a bird called Ocra--several kinds of birds we used to hunt. Ever since I was growing up, we used to hunt and live on several types of small birds. I'm wondering where those birds are? Kenneth is right, there used to be thousands of them but you hardly see any anymore. Another species called Kavashoop is not present any more. I'm glad that I am a pastor and that the Lord God prepared this world for us to have enough to feed on with the animals that God provided on this earth. A priority that I have is for us to clean Mother Earth, our home. I'm really concerned about the earth and cleansing the earth. There are some species that we find dead on the beach - species that eat each other are just cleansing. At times us occupants of the earth get careless.
>
> I really want to say this about the DEW line. I had worked for them. I worked at Wainwright and Barter Island and a lot of contaminants have been thrown away. I know at Wainwright DEW line, we would take the drums to the dump and the people running the airport at the time - white folks - had ruptured those drums and buried them. The contents would drain into the ground and into ponds, and I have observed this. There is another location above Wainwright - there's a lot - they had an attempt to clean up but they didn't take it all out.

> When I was a young man, Inupiat always fed ourselves from the land, and my wife and I always traveled from Point Lay to Pt. Hope and other places. There were healthy fish at the time. From the catch, I told my wife to make some boiled grayling. On the Meade River, fish taste a lot better than the next river. As I go further south, the fish taste better still. The food of the fish--they are what they eat. In different locations the fish all taste different. There is smelt at Wainwright and comparing smelt from Wainwright to the smelt of Kotzebue, the fish had a different taste in Kotzebue. At Pt. Hope the caribou were starving. Years ago the reindeer had disappeared. Presently the caribou herd is more like a half-breed and they taste different than they did when I grew up as a young man. The caribou herd at Wainwright hardly moves anywhere. When the caribou herd would eat, it would feed at the outskirts of town and they would come to the town - too many of them. I am aware of radiation - I've been around it. It alters things and I understand how strong and potent it is. Where I used to work, we had to put on some protective suits. Anytime that anyone would come out - there was a screen between each entrance so that the radiation contaminants would not be carried out. There was a person with a Geiger counter. There are some places in our land that are known hot spots like that. It became a part of us. That has altered our land here. There were people that worked it and it was their job. I'm glad that you guys are here to listen to our concerns.

> The numbers of polar bears have increased. They are even getting very dangerous and they can come very near a person. A long time ago when we were growing up, polar bears would never get near a person or a community. Now they get closer because these polar bears are trying to get close to the houses and people. My uncle once said that they had a house, a sod house. When he went to that area during the wintertime, a bear had damaged the sod house. He said that he would have gotten the grizzly bear - if he had met up with that grizzly bear he would have killed it and eaten it carefully. We know that in our camping areas they damage anything that can be found. They damage anything that is within reach within our hunting areas. (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, Sept. 1998 [University of Alaska, Anchorage, Institute of Social and Economic Research, No date]).

The ongoing "Human and Chemical Ecology of Arctic Pathways by Marine Pollutants" collaborative project between the Wainwright Traditional Council and University of Calgary researchers that produced the report entitled "*Passing on the Knowledge: Mapping Human Ecology in Wainwright, Alaska*" revealed a number of observations by local hunters concerning changes in subsistence resource behaviors and populations. Community members noted changes in the skin color of beluga whales "from the normal white to a yellowish tinge." Changes in ice conditions have produced major changes to polar bear behavior. In recent years, the late formation of sea ice "has left many bears trapped on the land." Because they are not able to reach the ice and hunt for seals, many polar bears appear to be starving. Caribou migration corridors have changed, as well. In the last 50 years, local hunters report that more caribou are staying closer to the community rather than following the herd on its migration. Shorter, thinner fur on small furbearers has been reported, especially wolverine. Villagers attribute this change to unusually warm fall and winter seasons. Hunters have reported that "birds harvested in the fall have enlarged livers and gizzards and white (rather than yellow) fat." A number of changes to fish have been observed. A greater number of salmon and a greater number of salmon types have been reported. Fewer fish are reported when boats travel the rivers, and more fish have been found with open sores. Finally, mature grayling seem to be smaller than in the past (Kassam and the Wainwright Traditional Council, 2000).

(c) Atqasuk

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Community Traditional Knowledge of Effects on Resources and Harvests

Luke Kagak, president of Atqasuk Search and Rescue, expressed concern for areas critical to calving caribou and nesting waterfowl, suggesting that special management zones be established for these populations. He believes oil development has affected animal migrations and duck populations near Prudhoe Bay. He contends that development should not occur any closer than 15 to 20 mi to these habitats. Kagak adds that the oil industry should be responsible for funding studies that survey these population effects that have already occurred to wildlife near Prudhoe Bay. It is up to industry to prove developments not Native subsistence hunters:

> The question is, industry, oil and gas developers in particular, have made life rather difficult for us. We have had to go so far as to make accommodations and pay for scientists...to document what we've known so that we can continue a way of life that we've had for centuries or forever. Why not have industry themselves try to find out...what happened to those species whose populations we have seen decline over the years because of impacts that they have done? (USDOI, BLM, 1997a; Adams, 1997:1, 2)

Arnold Brower, Sr., interviewed in the early 1980's, remembers returning from World War II and noticing the extensive environmental damage left by the Navy. He believed that damage done by the Navy near Imagruaq Lake damaged the tundra to such an extent that a drainage ditch was created that lowered the lake's water level and ruined fishing there. After the War, Navy exploration continued and Thomas Brower, Sr., remembers having to negotiate with the Navy so their planes wouldn't buzz his reindeer herd (Arundale and Schneider, 1987).

After World War II, seismic exploration was a problem to the reindeer in other ways, and Brower remembers the seismic wire catching in the hooves of the reindeer and making them lame (Arundale and Schneider, 1987). Fifty years later, seismic activity still is a problem. Karen Burnell, NSB Planning Director, indicated at the March 1997 Atqasuk Northeast NPR-A Scoping Meeting that inspection of seismic crews is necessary to keep their activities in line with permitting guidelines:

> We have found a couple of instances where spills had occurred, small spills, but we didn't think they were adequately cleaned up, so we required the company to go back and do a better job. Or there's been debris left behind; we've made them go back and pick it up and since we've started doing that they know that we're going to be following them around; they've changed drastically in the last couple of weeks. (USDOI, BLM, 1997a)

Access issues are viewed as critical in view of the areas near Prudhoe now off limits to subsistence. Arnold Brower, Jr., NSB NE Area NPR-A Coordinator, said that similar firearm restrictions at oil-development sites would create problematic detours for subsistence hunters. Atqasuk subsistence hunter Dave Summond added: "I have an allotment out there at Ikpikpuk. I have land there and it won't be right if I'm not able to take my guns with me for purposes of hunting. (USDOI, BLM, 1997a)

Past drilling activity in the NPR-A has left its mark. Thomas Brower, Jr., notes:

> I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed...after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl dying from contaminants being

> left after having conducted drilling activity. I don't want to see that kind of thing. (USDOI, BLM, 1997a)

Considering the overall impact of NPR-A oil development near Atqasuk, Luke Kagak explained: "We need to be thinking of our future and what we leave for our children as we go through this process" (USDOI, BLM, 1997a). Atqasuk elder Ella Sakeagak, interviewed in the early 1980's, summed up the local attitude (that is still current today) about oil development in the vicinity of the village: "We lived at Suqlak [just west of Teshekpuk Lake]; our little house is up there. It's standing. There's lots of fish, all kinds of animals, and I desperately wish that the people working for oil would not disturb that hunting area." (Arundale and Schneider, 1987)

(d) Barrow

Effects to subsistence-harvest patterns are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If caribou populations become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years, effects subsistence-harvest patterns would elevate from low effects to moderate or high effects over the long-term.

Community Traditional Knowledge of Effects on Resources and Harvests

Barrow resident Charles Brower stated in 1986 that subsistence access could be adversely affected if a pipeline were built; additional hunting restrictions would occur, requiring a permit (USDOI, MMS, 1986). And the fact remains that pipelines built in the past have created access problems. Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, has made it clear that any NPR-A IAP/EIS must identify stipulations to protect subsistence-hunting sites, traditional fish camps, and access routes from development impacts. (USDOI, BLM, 1997a)

Oil-industry impacts were described by Barrow elder Jonah Leavitt testifying in court in a class-action suit filed against the U.S. Government in 1980 to gain allotments and protect traditional hunting and fishing areas from industry development within the NPR-A:

> My grandfather, William J.L. Inuguak, moved on to the land in the fall of 1844. At first he lived in someone else's sod house; then he built his own house. My grandfather lived there because the fishing was so good. Other people would stop at that place and fish when they were on their way to trap foxes up inland. The lake nearby had very good fishing up until 1961. Then a vehicle broke down the side bank of the lake and the water drained out. Now we cannot fish in the lake. Baxter Adams, a resident of Barrow, saw the tracks, and he told me that they were made by an LVT (land vehicle transport) vehicle. (*Arctic Coastal Zone Management Newsletter*, 1980)

Noah Itta described past impacts from older seismic techniques, where fish disappeared for three years due to seismic disturbance. "I'm told that techniques have improved and they don't have to resort to those techniques anymore that have such devastating impacts on fish populations" (USDOI, BLM, 1997a). More recent seismic activity still has considerable effects to wildlife, even when conducted in winter. Harry Brower, Jr., whaling captain and subsistence analyst for the NSB Department of Wildlife Management, had this to say of his recent observations traveling NPR-A:

> I just wanted to mention what some of my personal observations with what's happening with that seismic out there and that seismic displacing the animals. I just wanted to pass this on for your information, and I didn't see any furbearers except for the foxes, the red foxes and the different faces anyway. I didn't see no wolves out there, no tracks or anything like that. I was on my way back home just this Saturday and met up with my cousin and he just said, yeah I just ran into a set of wolverine tracks and followed them 26 miles one direction, and he didn't take a close look at the tracks and he started following the trail and it had just been scared away from where the activity was occurring, which was up on the tops against that southeast side of Teshekpuk up in this Piks dunes out there and he found the den and the rig had just gone by. I just happened to be there when he was following the trail and coming back, he said he just followed the trail 26 miles one direction and the wolverine had just made a bee line from where the seismic activity was going on. It had been scared away from its den. It was just moving out. And there was no caribou in the area. Well you know, I'd seen that. I made these trips up to my cabin. It's up on the Ikpikpuk River and I've observed the displacement of the wildlife over the winter. I've been going back and forth since December to just last week and I've seen the different areas where they've been over the winter, and I just wanted to bring that out, of my personal observations. (USDOI, BLM, 1997a)

At the Barrow NE Area NPR-A Scoping Meeting, Johnny Aiken spoke about oil-development impacts on a variety of species:

> We go to Taqulik Lake where we go fishing. Every now and then in that particular lake we hardly get any fish. It's a surprising time. Two years ago we hardly got any grayling from that spot, that's our main grayling fish getter and we hardly got any a couple of years ago; that was surprising. And then in our river Kuparuk...we hardly get any more fish there...and I want to say too that I grew up hunting ugruks and...I don't hardly see those ugruks out there no more. And those eiders, the colored ones, me and my papa used to hunt them. We don't see those no more, hardly ever see them...(USDOI, BLM, 1997a)

(e) Nuiqsut

Effects on subsistence-harvest patterns are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If caribou populations become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years, effects subsistence-harvest patterns would elevate from low effects to moderate or high effects over the long-term.

Community Traditional Knowledge of Effects on Resources and Harvests

Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Fourteen years later, this same concern was still being expressed by Nuiqsut officials Leonard Lampe and Thomas Napageak, who recounted how designed caribou crossings of pipelines did not seem to work (USDOI, BLM, 1997a).

Elder Bessie Ericklook from Nuiqsut maintained that since the oil fields have been established [at Prudhoe Bay], the foxes have been dirty and discolored in [the] area of Oliktok [Point] (USDOI, MMS, 1979a). Leonard Lampe, present Mayor of Nuiqsut, recently expressed further concern for air-pollution and habitat problems, asserting that Nuiqsut has been experiencing these effects for some time: "A lot of air pollution, asthma, bronchitis-a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way. Tundra damage around the village" (Lavrakas, 1996:1, 5). At the Northeast Area NPR-A Scoping Meetings in the village, Lampe reaffirmed his concern for air quality degradation; Rosemary Ahtuangaruak noted that: "The atmosphere has eroded and the fear of ozone depletion is upon us. What will be done to combat this?" (USDOI, BLM, 1997a). A Nuiqsut hunter commented in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 that white fox couldn't be trapped at Prudhoe Bay anymore because of yellow skin (Brower and Opie, 1997). In this same survey, another hunter observed that gas from Deadhorse was poisoning the animals; he was very concerned about gasses from Prudhoe (Brower and Opie, 1997).

Noting problems with seismic activity, Lampe continued, "I swear they seismiced the entire North Slope. It's dangerous with snowmachines to run into deep seismic trails. There's wire cables all over the place" (Lavrakas, 1996:1, 5). At the Nuiqsut village scoping meeting for the NE NPR-A, Lampe again related village conflicts with seismic activity, explaining that seismic work in the vicinity of the village threatened traditional sites and might somehow have affected the caribou food chain as well. He suggested that increased traffic on the Dalton Highway might be interfering with migrations by spooking the animals. "Caribou have always been our primary source of subsistence... this has got to be evaluated very carefully" (USDOI, BLM, 1997a; Adams, 1997:5, 9). At an NE Area NPR-A symposium held in Anchorage in April 1997 after the village scoping meeting, Thomas Napageak, elder, Nuiqsut Native Village President, and AEWC Chairman, noted recent problems with seismic activity:

> Down by the village two years ago, seismic exploration was moving rapidly right over two graveyards. Of course, the markers were driftwood and had fallen off. But the graveyards were still visible. However, you can't see everything from a Rolligon or exploration vehicle when the snow is drifting. The graveyards were being run over. When I die I would like to rest peacefully under the ground without any seismic activity running over me. (USDOI, BLM and MMS, 1997)

Ruth Nukapigak recounted that seismic activity has repeatedly trespassed onto her allotment on the Itkillik River, and that she has been trying unsuccessfully to get compensation since 1974 (USDOI, BLM, 1997a). Oil-exploration crews have been a constant problem to villagers. A cultural plan (Nuiqsut Paisanitch: A Cultural Plan) drafted by the village in 1979 noted these objections to field crews by a Nuiqsut resident: "Those oil exploration crews wreck our camps. They tore up our ice cellars at Oliktok and left meat and fish around to rot. They must not know we use those camps." (City of Nuiqsut, 1995)

Nuiqsut fish harvesters have noted that the number of arctic cisco have been down, coinciding with the [operation of] the Endicott water-treatment plant (Dames and Moore, 1996b). A Nuiqsut subsistence fisherman wondered in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 why whitefish were so small that year when they used to be big the year before (Brower and Opie, 1997). At the April 1997 NE Area NPR-A scoping meeting in Nuiqsut, Rosemary Ahtuangaruak elaborated on development impacts to fish and the associated impact to village life: "The oil companies made causeways for the benefit of oil development. It took the fish away. The people suffered immensely without this natural resource. The community could not meet the needs for survival and the atmosphere was black. We had an increase in all the bad things: domestic violence, suicide, family demise." (USDOI, BLM, 1997a)

In 1979, Nannie Woods, the late Nuiqsut elder, talked about fish and caribou being abundant at the Sagavanirktok River, but now the river isn't as abundant since the development at Prudhoe Bay. She explained that the tributaries off the river don't have as many fish either, and that there are fewer caribou than there used to be in the summer (USDOI, MMS, 1979a).

Concerns about access restrictions have been voiced by local residents. Sarah Kunaknana, talking about local subsistence hunters, observed that others have stated that they don't hunt near Prudhoe Bay anymore because of oil development (S. Kunaknana, in Shapiro, Metzner, and Toovak, 1979). Nuiqsut's present Vice Mayor Mark Ahmakak, when asked in 1982 if people had been turned back from hunting and fishing areas, answered: "Oh, yes. I have experienced that myself in going out towards Nuiktuk [?] over toward DEW Line station. We have been told by oil company officials that we can't hunt near development area" (Kruse et al., 1983). Access problems were expressed by Nelson Ahvakana from Nuiqsut. He was concerned that areas that are supposed to be left open for subsistence hunting effectively will be closed because of increased security associated with the new drill sites, and that access to subsistence resources will be restricted (USDOI, MMS, 1990d). This concern takes on even more substance as the Northstar Project and development at the Alpine field become realities. During the 1996 Northstar Project Nuiqsut community meeting, two Nuiqsut men described being denied access to fishing and hunting areas around Prudhoe operations, even though they have traditional rights to be there. They do not want to be restricted or denied access by new projects (Dames and Moore, 1996c). In Northeast Area NPR-A scoping meetings in the village, Thomas Napageak elaborated on the issue of lost access noting that oil development at Prudhoe Bay and Kuparuk had already cut off Nuiqsut residents from nearly one-third of their traditional subsistence harvest areas. At the same meeting, Leonard Lampe, Jr., recounted how he has not been able to hunt or fish in the Kuparuk/Prudhoe Bay area once visited by village elders and that he fears the same loss of critical subsistence access to important lands in the NPR-A to future generations (USDOI, BLM, 1997a).

A major issue with the NE Area NPR-A is the velocity of the environmental assessment process and the way it has taxed the resources of the Native community. Nuiqsut residents believe it precludes a thorough compilation of the vast cultural knowledge the Inupiat have gained over millennia. Leonard Lampe, Jr., present Mayor of Nuiqsut and Kuukpik Village Corporation officer, commented that 11,000 years of cultural and traditional knowledge could not be compiled and communicated in 8 days (USDOI, BLM, 1997a; Adams, 1997:5, 9). At the same meeting, Rosemary Ahtuangaruak vocalized this problem more simply when she said: "What we have to say will be documented but not integrated. We are being pushed and pulled in all directions at the same time with all the various agencies affecting our ability to thoroughly evaluate and document all issues." Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, did not believe the schedule set by BLM would allow for sufficient time for the proper analysis of recent wildlife and subsistence harvest data (USDOI, BLM, 1997a).

Oil spills also are an identified threat. Thomas Napageak stated in his testimony at the Nuiqsut NE Area NPR-A scoping meeting that: "The oil industry still does not have adequate technology for oil spill clean up in the Arctic, particularly in rivers, lakes, and the Beaufort Sea. Adequate spill response must be part of any development." (USDOI, BLM, 1997a)

Thomas Napageak expresses the larger issue of oil development and its potential effect on the subsistence lifeway:

> ...improvements in our physical comforts and services should not blind us to the threats that oil development on the wrong terms poses to our very identity and culture. Our land and our subsistence practices are our history, our identity, and our future. If we lose the land or can no longer maintain our subsistence culture, we lose ourselves and the future of our children." Rosemary Ahtuangaruak further elaborated Inupiat cultural conflicts with oil development when she asserted: "We need to live as our ancestors have shown us. We have this passion to our families for their survival.... NPR-A has been set aside and should be left alone. It has given the sustenance for countless animals that migrate throughout the world. They come back to us every year unless development prevents it. (USDOI, BLM, 1997a)

(f) Other Subsistence Communities

Because overall impacts to migratory birds in the Northwest NPR-A Planning Area, except eiders, are expected to be minor and these birds in general disperse over large migration and wintering areas, effects on stakeholders (including subsistence hunters) are also expected to be minor. Some mortality to subsistence waterfowl species is in the Northwest NPR-A would be expected, but the mortality rates are expected to be low. There is no realistic way to translate this potential impact in the Northwest NPR-A Planning Area into a level of measurable effect on the distant subsistence users.

e. Multiple Sales

If several lease sales were to occur under Alternative A, considerably more exploration activity would be expected to occur in the habitat of the TLH and WAH caribou. These activities would impede movements of TLH caribou to insect-relief areas along the coast. A southern pipeline route could cause some disruption of CAH caribou during migration. These effects would persist over the life of the fields and could reduce productivity of the TLH.

Water withdrawals would increase in proportion to the increased activity level for multiple sales. Given the large quantity of lakes in the area likely to be developed, increased water use is not expected to impact fish more severely than under a single sale. However, if there were not enough time between activities to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated here.

Activities associated with multiple sales in Alternative A are expected to have the same overall effect on marine fish as discussed for the first sale. If several lease sales occur under Alternative A, considerably more exploration activity is expected to occur in the southern and central part of the Planning Area. However, if there were not enough time between activities to allow for full recovery, or if the level of activity were to be significantly greater than that of the first sale, the effect of each additional sale on marine fish populations is likely to be greater than estimated here.

Effects from disturbance factors and habitat alteration or loss associated with each oil and gas development site would likely be short-term and negligible to minor over most of the Planning Area. Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially is lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oil field facilities associated with multiple sales are grouped in high resource interest areas; if these were to be located in high bird concentration areas, as appears to be likely in the vicinity of Dease Inlet, greater numbers of individuals would be expected to be displaced and more species involved than with a single sale. Such effects could alter bird populations of these local areas substantially, and for species with more limited habitat preferences, less tolerance to disturbance factors, or small and/or declining populations (e.g., red-throated loon, yellow-billed loon, king eider, common eider, Sabine's gull, gyrfalcon, peregrine falcon, snowy owl) effects could extend to regional populations and involve long-term changes in distribution. Effects for these and other vulnerable species could be elevated to a moderate level with multiple developments concentrated in a limited region.

Effects to bowhead whales are not expected to increase under the multiple sale scenario.

If several lease sales occur under Alternative A, a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Dease Inlet-Barrow Area, and these effects are expected to be local and short term (generally < 1 year).

f. Conclusion--Multiple Sales

For the multiple sales under Alternative A, most resources would see increases in effects due to increases in development activity, although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally less than 1 year) and to have no regional population effects--essentially the same effects levels expected for a single sale. Some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under multiple sales.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. If development were to take place in critical insect-relief areas of the TLH, or additional development with a potential southern pipeline route to TAPS Pump Station 2 were to take place, some disruption of TLH and CAH caribou during migration would be expected. An increase in the number or miles of pipelines with development under multiple sales is expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect is expected to persist over the life of the oil fields and may reduce productivity of the TLH. This level of effect on caribou would elevate expected effects on community subsistence-harvest patterns to high or very high effects, defined as one or more important subsistence resource becoming unavailable or undesirable for use, or experiencing population reductions for a period up to 5 years or longer.

15. Sociocultural Systems

This discussion is concerned with those communities that potentially could be affected by activity generated by the Northwest NPR-A multiple sales. These include the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. The primary aspects of the sociocultural systems covered in this analysis are 1) social organization, 2) cultural values, and 3) social health as described in Section III.C.4. It is assumed that effects on social organization and cultural values could be brought about at the community level by increased population, by increased employment, and by effects on subsistence-harvest patterns--predominantly from oil and gas leasing and exploration, development, and production associated with the Northwest NPR-A Planning Area. Potential effects are evaluated relative to the tendency of introduced social forces to support or disrupt existing systems of organization, how rapidly they occur, and their duration (see Langdon, 1996). Effects on the sociocultural systems of local communities could come from disturbance from small changes in population and employment, periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup, and stress due to fears of a potential spill and the disruptions it would cause.

North Slope Inupiat continue to express concern about the differences in how they and the dominant culture relate to the land and waters. Rex Okakok from Barrow expressed the problem when he said "Our land and sea are still considered and thought by outsiders to be the source of wealth, a military arena, a scientific laboratory, or a source of wilderness to be preserved, rather than as a homeland of our Inupiat" (USDOI, MMS, 1987c). Considering such use of Inupiat territory, Robert Edwardson from Barrow said that he would like to see revenues paid to the Inupiat for mineral rights (USDOI, MMS, 1995a).

Any analysis of possible effects on sociocultural systems and social organization must first examine how people are divided into social groups and networks. Social groups generally are based on kinship and marriage systems and on nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, community, and trade. Both kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society.

Social organization could be affected by an influx of new population that causes growth in the community and change in the organization of social groups and networks.

Disruption of the subsistence cycle also could change the way these groups are organized. The sharing of subsistence foods is profoundly important to the maintenance of family ties, kinship networks, and a sense of community well being. In rural Alaska Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations: the individuals one cooperates with help define kin ties, and the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, and others. Disruption of these task groups can damage social bonds that hold a community together. Any serious disruption of sharing networks can appear as a threat to the established way of life in a community and can trigger an array of negative emotions--fear, anger, and frustration--in addition to a sense of loss and helplessness. Because of the psychological importance of subsistence in these sharing networks, perceived threats to subsistence activities from oil development are a major cause for anxiety.

An Alaska Department of Fish and Game social-effects survey administered by the Division of Subsistence Management in 1994 in Nuiqsut included questions on effects from OCS development. One question asked was: "How do you think the offshore development of oil and gas in this area would affect the following resources available for harvest; would the resource decrease, not change, or increase?" About 85 percent of Nuiqsut respondents answered that fish resources would decrease, 87 percent said marine mammals would decrease, 43 percent said land mammals would decrease, and 55 percent said that birds would decrease; 67 percent were not in favor of the search for oil, and 42 percent believed the search for oil would have an adverse impact on subsistence; 68 percent were not in favor of the development and production of oil, and 52 percent believed that oil development and production would have an adverse impact on subsistence (Fall and Utermohle, 1995).

An analysis of cultural values shows those values that are shared by most members of a social group. Generally, these values reflect what is desirable and represent what is accepted, explicitly or implicitly, by members of a social group. Forces powerful enough to change the basic values of an entire society would include a seriously disturbing change in the physical conditions of life--a fundamental cultural change imposed or induced by external forces. One example would be an incoming group that demands that residents accept their culture. Another would be a basic series of technological inventions that change physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959).

Disturbance from oil development could bring about dramatic changes to cultural values on the North Slope, values like strong ties to Native foods, to the land and its wildlife, to the family, to the virtues of sharing the proceeds of the hunt, and to independence from institutional and political forces outside the North Slope (see Section III.C.3 and Section III.C.4).

No disruptions are expected to the five communities' social institutions as a result of increases in temporary or permanent population growth, but the construction of winter ice roads near and a new hotel within Nuiqsut could cause some disruptions to Nuiqsut social organization because of an increase of social interaction between residents and oil industry workers. Traffic restrictions near exploration infrastructure along the Nuiqsut/Prudhoe Bay ice road already have created some friction in Nuiqsut, where considerable dependence has developed within the village on this road for winter access to Prudhoe Bay and south to Fairbanks. Locally, Nuiqsut residents have articulated these conflicts, as seismic and drilling activity have recently increased dramatically for offshore projects such as the Northstar and Liberty developments, and the onshore Alpine field, and potential NPR-A development.

Interaction would increase if many local residents were employed in oil industry jobs, though historically the number of local Native hires is quite small. Some of the interactions of oil workers with the local Inupiat population are likely to be unpleasant and could lead to a growth in racial tension. Nuiqsut already has been exposed to oil workers because of 1) its proximity to Prudhoe Bay; 2) village travel to Prudhoe on the winter ice road that is maintained between the two communities; 3) increased seismic activity in the vicinity of the village;

and 4) a recent influx of personnel working on development of the Alpine field. It appears that the number of oil workers associating with local residents has increased. Social interaction of oil industry workers with Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are likely to cause some disruption to sociocultural systems, though not displacement of existing institutions.

There may be some degree of development-induced local employment, but these changes, particularly as they translate into Native employment, historically have been and are expected to continue to be insignificant. Even though Native employment in oil-related jobs on the North Slope is low, Native leaders continue to push for programs and processes that encourage more Native hire. The NSB has attempted to facilitate Native employment in the oil industry at Prudhoe Bay and is concerned that the industry has not done enough to accommodate training of unskilled laborers or to accommodate their cultural need to participate in subsistence hunting. The NSB also is concerned that--even though recruitment efforts are made and training programs are available--industry recruits workers using methods more common to Western industry practices, and would like to see the oil industry make a more concerted and Inupiat-appropriate effort to hire NSB residents.

Many of the contractors hired by the oil industry in the Oil Patch are either North Slope Native corporations (Arctic Slope Regional Corporation et al.), subsidiaries of such corporations, or otherwise affiliated with such corporations through joint ventures and other relationships. This situation provides significant local economic benefit. One North Slope operator, BPXA, has instituted its Itqanaiyagvik hiring and training program, designed to put more Inupiat into the oil field workforce. It is a joint venture with the Arctic Slope Regional Corporation and its oil-field subsidiaries and is coordinated with the NSB and the North Slope Borough School District. Other initiatives are an adult "job-shadowing" program, and an effort called Alliances of Learning and Vision for Under Represented Americans, developed with the University of Alaska to prepare candidates for degree programs in technical and engineering professions. Most graduates of the adult job-shadowing program already are working in oil field jobs (BP Exploration (Alaska), Inc., 1998d).

ConocoPhillips has partnered with the Arctic Slope Regional Corporation to offer training programs for North Slope residents interested in careers in oil-field and heavy equipment maintenance. During the summer of 2002, twenty North Slope residents were training and working under this program. ConocoPhillips also sponsors the Alpine Career Quest Internship Program, and its employees are volunteer mentors for Nuiqsut high school students who participate. In 2002 seven students from the Trapper School completed the intern program at the Alpine field facility and twelve more students were involved in another summer program based in Nuiqsut. ConocoPhillips expects to continue these programs in 2003 (USDOI, BLM, 2003 [Nuiqsut Public Hearing, March 3, 2003]).

A serious disruption of subsistence-harvest patterns could alter these cultural values. For the system of sharing to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods; it is obviously more difficult for a household to produce a surplus than to simply satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, often is more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers. Thus, when oil-development disturbance occurs, it may disrupt a community's culture, even though it does not cause "biologically significant" harm to a subsistence species' overall population.

Subsistence is a cyclical activity, and harvests vary from year to year, sometimes substantially. Numerous species are hunted to compensate for a reduced harvest of a particular resource in any one year, but there is no satisfactory replacement for bowhead whales or caribou. Multiyear disruptions to even one resource, particularly one as important as the caribou or the bowhead whale could disrupt sharing networks and subsistence-task groups. Other tensions perceived as a threat to subsistence resources could be caused by NPR-A oil and gas activities, especially if oil-industry activities are visibly evident, and North Slope residents in the Northeast NPR-A Planning Area do not perceive development as a benefit to the Inupiat people.

Speaking at a 1983 hearing for an MMS sand and gravel lease sale, Nuiqsut resident Mark Ahmakak stated: "I think that if you are going to go ahead with this sale that you should utilize Natives in...the areas affected by this lease sale; then utilize some of these Natives as monitors on some of your projects" (USDOI, MMS, 1983). The general consensus is the desire for some benefit or employment opportunity to the community from nearby oil activities. Nuiqsut resident Joseph Ericklook expressed the community desire to see employment opportunities for local people result from development (USDOI, MMS, 1990d). Arnold Brower, Jr. noted that he would like to see residual rights to old abandoned wells in the NPR-A pass to the local communities because the local communities could benefit from local oil and gas resource development even when they were not economic for industry to develop (USDOI, BLM, 1997a;Sec. IV.C.13., Subsistence).

a. Effects of Non-Oil and Gas Activities

Ground-impacting management actions within the Planning Area that may affect sociocultural systems by way of affecting subsistence-harvest patterns under Alternative A include aerial surveys (including those inventorying terrestrial mammals and birds) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps, and overland moves, all of which occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned exploration drill sites. Effects from ground-impacting activities, small oil spills, and seismic surveys on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to short term and local, and to have no regional population effects. Little net change is expected in disturbance effects to subsistence resources and the communities within or adjacent to the Planning Area, therefore, little net change is expected to traditional community activities and to traditional practices for harvesting, sharing, and processing of these resources and sociocultural systems.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Because staging would not take place near existing subsistence communities, social systems in the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut would experience little direct disturbance from the staging of people and aircraft transportation for exploration and development for the Northwest NPR-A Planning Area. These activities are expected to have little effect on sociocultural systems. Oil workers likely would not directly interact with local community residents, and there would be no expected displacement of social systems. Also, changes in population and employment are not likely to disrupt sociocultural systems.

Stress would occur if a village were not successful in the bowhead whale harvest, with potential disruption of sharing networks and task groups. This stress could disrupt the community's social organization but likely would not displace the long-term social processes of whaling and sharing. Other, more successful villages would share with a village having an unsuccessful whaling season. More recently, there have been no unsuccessful whaling seasons for Nuiqsut since 1994 and Kaktovik since 1991 (Braund, Marquette, and Bockstoce, 1988; Alaska Eskimo Whaling Commission, 1987-1995). Negotiated conflict resolution agreements between the Alaska Eskimo Whaling Commission, subsistence whaling communities, and the oil industry have successfully served as a means to coordinate whaling activities and potential disturbance to whaling from industry activities.

Any effects on social health would have ramifications on social organization. The NSB Native communities have proven quite resilient to such effects with the Borough continuing to support Inupiat cultural values and its strong commitment to health, social service, and other assistance programs. Health and social service programs have attempted to meet the needs of alcohol- and drug-related problems by providing treatment programs and shelters for wives and families of abusive spouses and by placing greater emphasis on recreational programs and services. However, in comments before the Department of the Interior's OCS Policy Committee's May 2000 meeting, NSB Mayor George Ahmaogak stated that Borough residents are extremely concerned that a lack of adequate financing for local NSB city governments has hampered the development of these programs, and declining revenues from the State of Alaska have seriously impaired the overall function of these city governments. Partnering together, Tribal governments, city governments, and the NSB government have been able to provide some programs, services, and benefits to local residents. For several years, all communities in the Borough have banned the sale of alcohol, although alcohol possession is not banned in Barrow, and many communities are continually under pressure to bring the issue up in local referendums (North Slope Borough, 1998).

Ongoing effects on social health in Nuiqsut would have direct consequences on sociocultural systems but would not tend toward the displacement of existing systems above the displacement that has already occurred with the current level of development. Effects in Point Lay, Wainwright, Barrow, and Atqasuk would be periodic and would not displace existing sociocultural systems.

At hearings in 1982, Mark Ahmakak from Nuiqsut stated that there should be economic benefits to Nuiqsut, such as cheaper diesel (Ahmakak, 1982, as cited in USDOI, MMS, 1982). The consensus has always been that some benefit should come to the community from nearby oil activities. In a 1996 public meeting for the Northstar Project, a Nuiqsut elder stated that she wanted potential human health issues that could result from the project looked into beforehand. Answers could be found in information from other projects. She specifically expressed concern about cancers, health problems related to air pollution, and shortened lifespans (Dames and Moore, 1996e). There are concerns about protecting traditional sites from development. Nannie Woods expressed her opposition to leasing in the Colville River Delta because of her concern that her husband's burial site might be disturbed by development (Woods, 1982, as cited in USDOI, MMS, 1982b). Recently, a Nuiqsut elder had her "home place" at Prudhoe Bay desecrated by an oil company. Her house was looted and built over. She emphasized that graves of family members are in the area and that she has been denied access there (Dames and Moore, 1996e). At a November 1999 MMS Liberty Project Information Update Meeting in Nuiqsut, Elders told MMS to be aware of gravesites on the shoreline of Foggy Island Bay.

Considering such use of Inupiat territory, Robert Edwardson from Barrow said that he would like to see revenues paid to the Inupiat for mineral rights (Edwardson, 1995, as cited in USDOI, MMS, 1995b). All three communities believe that some form of impact assistance should be forthcoming to compensate them for absorbing the social impacts from oil development that have occurred and that are to come.

(2) Effects of Spills

Effects on the sociocultural systems of local communities could come from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup, and stress due to fears of a potential spill and the disruptions it would cause. Traditional practices for harvesting, sharing, and processing subsistence resources could be seriously curtailed in the short term if there are concerns over the tainting of bowhead whales from an oil spill, but overall effects from these sources are not expected to displace ongoing sociocultural systems. Oil-spill employment (response and cleanup) could disrupt subsistence-harvest activities for at least an entire season and disrupt some sociocultural systems, but most likely, it would not displace these systems. The sudden employment increase could have sudden and abnormally high effects, including inflation and displacement of Native residents from their normal subsistence-harvest activities by employing them as spill workers. Cleanup employment of local Inupiat also could alter normal subsistence practices and put stresses on local village infrastructures by drawing local workers away from village service jobs. Oil spills producing disruption of this magnitude are not expected from Northwest NPR-A activities.

The likelihood of a large oil spill from Northwest NPR-A activities is low. However, if one occurred, oil-spill employment (response and cleanup) could disrupt subsistence-harvest activities for at least an entire season and disrupt some sociocultural systems. Most likely, it would not displace these systems. If a large spill contacted and extensively oiled coastal habitats, the presence of hundreds of humans, boats, and aircraft would displace subsistence species and alter or reduce access to these species by subsistence hunters. Employment generated to clean up an oil spill of 1,500 or 4,600 bbl could call for 60 or 190 cleanup workers. This rapid employment increase could have sudden and abnormally high effects, including inflation and displacement of Native residents from their normal subsistence-harvest activities by employing them as spill workers. Cleanup is unlikely to add population to the communities, because administrators and workers would live in separate enclaves. Cleanup employment of local Inupiat could alter normal subsistence practices and put stresses on local village infrastructures by drawing local workers away from village service jobs. Any decline in the certainty about the safety of subsistence foods, potential displacement of subsistence resources and hunters, and changes in sharing and visiting could lead to a loss of community solidarity. Oil-spill cleanup of this magnitude is not expected from spills from Northwest NPR-A activities. Industry oil-discharge prevention and cleanup-contingency plans would include scenarios for cleaning up oil spills.

c. Effectiveness of Stipulations and Recommended Operating Procedures

Specifically for subsistence--and consequent sociocultural benefits--Stipulation H-1 specifies that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP H-1 would direct the lessee to develop and implement a plan, in consultation with the subsistence communities and the SAP, to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area; specifically the program is designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel would be working with the intent of reducing any potential conflicts with subsistence.

d. Conclusions--First Sale

As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, effects on subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. If development took place in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years.

Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and development activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Altogether, subsistence effects periodically could disrupt--but not displace--ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

e. Multiple Sales

For the multiple sales under Alternative A, most resources would see increases in effects due to increases in development activity, although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. But with increased effects anticipated on TLF caribou, elevated effects would be expected on these communities because this important subsistence resource would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer.

f. Conclusion--Multiple Sales

Anticipated subsistence effects could cause chronic disruption of sociocultural systems for a number of years and although traditional practices for the harvesting, sharing, and processing of subsistence resources could be disrupted, subsistence impacts would not be expected to displace existing institutions or ongoing social systems.

16. Environmental Justice

a. Introduction

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by activities in the Northwest NPR-A Planning Area under Alternative A. Because of their reliance on subsistence foods, there could be effects on Inupiat Natives and their subsistence resources and harvest practices. Potential effects from noise, disturbance, and oil spills on subsistence resources and practices and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. For further discussion of Environmental Justice effects, see the discussion on subsistence-harvest patterns and sociocultural systems in Sections IV.F.8.n and IV.F.8.o for Cumulative Effects.

As described in Section III.C.3 subsistence activities in the Planning Area are important to providing food to North Slope residents. As a consequence, impacts to subsistence resources and access to those resources have a direct relationship to the analysis of which alternatives may have a disproportionately adverse effect on the minority and low-income populations. Those alternatives identified in the ANILCA 810 analysis Appendix 5 as having a potentially significant impact on subsistence, also would have a significant impact on minorities and low-income populations and communities. Those stipulations and other protective measures that help to mitigate impacts on these groups of people for each alternative are the same as identified in the subsistence and the sociocultural analyses Sections IV.C.14 and IV.C.15.

b. Demographics

(1) Race

In 1993, the NSB conducted the North Slope Borough Census of Population and Economy. It found that of the

6,538 Borough residents, 4,941 identified themselves as Native and 1,597 identified themselves as non-Native. Of the Native population, 97.71 percent or 4,828 were Inupiat Eskimo. The 1998 census conducted by the NSB identified 7,555 Borough residents, with 5,485 reporting as Native and 2,096 as non-Native. Of the 1998 Native population, 96.83 percent, or 5,285, were Inupiat Eskimo. For the NSB as a whole in 1993, the population was 74 percent Inupiat and 26.1 percent non-Inupiat; in 1998, the population was 72.24 percent Inupiat and 27.76 percent non-Inupiat (North Slope Borough, 1995, 1999). The 2000 Census counted 7,385 residents in the NSB; 5,050 identified themselves as American Indian and Alaska Native for a 68.4 percent indigenous population (USDOC, Bureau of the Census, 2000).

The 1993 figures show that of the Inupiat population, 81.60 percent of the NSB population resided in the five communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut (North Slope Borough, 1995); 49.2 percent lived in Barrow. In 1998, 61.4 percent of the NSB population resided in Barrow and 38.57 percent lived in the other seven Borough villages; 81.80 percent lived in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut (North Slope Borough, 1995, 1999).

In the potentially affected communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut, there are no significant "other minorities." In Point Lay "other minorities" comprised 2.8 percent of a total population of 246 in 1998; in Wainwright 1.3 percent of a total population of 649; in Atqasuk 3.4 percent of a total population of 224 in 1998; and in Nuiqsut 1.4 percent of a total population of 420. In Barrow in 1998, "other minorities" constituted 16.8 percent of the total population of 4,641, but the Inupiat minority population is the only minority population allowed to conduct subsistence hunts for marine mammals. "Other minorities" are not allowed to participate in the subsistence marine mammal hunt and do not constitute a potentially affected minority population (North Slope Borough, 1999).

With the NSB's homogenous Inupiat population, the identification of a "reference" or "control" group within the potentially affected geographic area, for the purposes of analytical comparison to determine if the Inupiat are affected disproportionately, is not possible. This is because a non-minority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope.

(2) Income

According to the U.S. Department of Commerce, the average household income in 1993 for the State of Alaska was $64,652, and the average State per capita income was $23,000. Based on Department of Commerce data, the Alaska Department of Labor has portrayed the NSB as having one of the highest per capita incomes in the State; but data collected by the NSB 1993 Census of Population and Economy take exception to these figures, based primarily on different methods used in data collection. The U.S. Department of Commerce uses a sampling procedure, while the Borough conducts house-to-house household surveys. Also, Federal figures include "transfer payments" such as unemployment, welfare, Social Security, and Medicare/Medicaid payments. The NSB survey includes all income reported to the IRS, including Alaska Permanent Fund and Alaska Native Claims Settlement Act corporation dividends. The NSB figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. When corrected for ethnicity, the average Inupiat household income was $44,551 and for non-Inupiat it was $74,448. The average Inupiat per capita income was $10,765 and the non-Inupiat per capita income was $29,525. Of all the households in the NSB surveyed, 23 percent qualified as very low-income households, and another 10 percent qualified as low-to-moderate-income households. As 66 percent of the total households surveyed were Inupiat, it would appear that a large part of the households falling in the very low- to low-income range are Inupiat. Poverty-level families in the NSB numbered 88, or 6 percent of all households. Poverty level thresholds used by the NSB were based on the U.S. Bureau of the Census, March 1996 Current Population Survey, in which low income is defined by the U.S. Census Bureau as 125 percent of poverty level (North Slope Borough, 1995; North Slope Borough, 1999).

The NSB 1998/99 Economic Profile and Census Report showed household income increasing from $54,645 in

1993 to $63,884 in 1998. The average Inupiat household income increased by an average of $11,685, from $44,551 to $56,236. The average Inupiat per capita income rose from $10,765 in 1993 to $12,550 in 1998. A total of 105 households qualified as poverty level, and 37 qualified as very low income. This translates into a total of 381 individuals living below the poverty level--an increase of 12 individuals since 1993 (North Slope Borough, 1999). The 2000 Census found an average per capita income of $20,540 and a median household income of $63,173. The 2000 census found 132 Families (8.6% of a total 1,538 NSB families) in poverty status in 1999 (397 individuals 18 years and over) (USDOC, Bureau of the Census, 2000).

c. Consumption of Fish and Game

As defined by the North Slope Borough Municipal Code, subsistence is "an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (State of Alaska, Dept. of Natural Resources, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Inupiat culture, but it does underscore that it is a primary cultural and nutritional activity upon which Native residents of the North Slope depend. For a more complete discussion of subsistence and its cultural and nutritional importance, see Section IV.C.14 Subsistence-Harvest Patterns. For statements of the traditional importance of subsistence practices, see the Inupiat traditional knowledge commentary in Section IV.C.14, "Effects on Subsistence-Harvest Patterns," and Section IV.C.15, "Effects on Sociocultural Systems." See also "Cumulative Effects" Sections IV.F.8.n and IV.F.8.p and the "Affected Environment" sections (Section III.C.3 and III.C.4) for these resources for more traditional knowledge.

Potential effects focus on the Inupiat communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut within the NSB. The sociocultural and subsistence activities of these Native communities could be affected by disturbance to key subsistence species that would lead to disruption, displacement, or long-term changes in species' populations. Communities could be affected by accidental oil spills as well. Possible oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Interestingly, after the *Exxon Valdez* spill, testing of subsistence foods for hydrocarbon contamination from 1989-1994 revealed very low concentrations of petroleum hydrocarbons in most subsistence foods. In fact, the U.S. Food and Drug Administration concluded that eating food with such low levels of hydrocarbons posed no significant risk to human health (Hom et al., 1999). They recommended avoiding shellfish, which accumulate hydrocarbons. Of course, human health could be threatened in areas affected by oil spills but these risks can be reduced through timely warnings about spills, forecasts about which areas may be affected and even evacuating people and avoiding marine and terrestrial foods that may be affected. Federal and State agencies with health-care responsibilities would have to sample the food sources and test for possible contamination.

Whether subsistence users would use potentially tainted foods is entirely another question that involves cultural "confidence" in the purity of these foods. Based on surveys and findings in studies of the *Exxon Valdez* spill, Natives in affected communities largely avoided subsistence foods as long as the oil remained in the environment. Perceptions of food tainting and avoiding use remained (and remain today) in Native communities after the *Exxon Valdez* spill, even when agency testing maintained that consumption posed no risk to human health (Alaska Department of Fish and Game, 1995a; Hom et al., 1999; Burwell, 1999).

The ability to assess and communicate the safety of subsistence resources following an oil spill is a continuing challenge to health and natural resource managers. After the *Exxon Valdez* spill, neither the analytical testing program nor the procedures for communicating the results to local subsistence users were completely convincing to most subsistence users. The safety of subsistence users' food remains at issue because scientific conclusions often were not consistent with Native perceptions about environmental health. According to Peacock and Field (1999), a discussion of subsistence food issues must be cross-disciplinary, reflecting a spectrum of disciplines from toxicology, to marine biology, to cultural anthropology, to cross-cultural communication, to ultimately understanding disparate cultural definitions of risk perception itself. Any effective discussion of subsistence resource contamination must deal with the conflicting paradigms of Western science and traditional knowledge, as well as the vocabulary of the social sciences in reference to observations throughout the collection, evaluation, and reporting process. True restoration of environmental damage, according to Picou and Gill (1996), "must include the reestablishment of a social equilibrium between the biophysical environment and the human community" (Field et al., 1999; Nighswander and Peacock, 1999; Fall et al., 1999). Since 1995, the subsistence restoration effort that has been ongoing as a result of the *Exxon Valdez* oil spill has improved by taking a more comprehensive approach, by partnering with local communities, and by linking scientific methodologies with traditional knowledge (Fall et al., 1999; Fall and Utermohle, 1999).

d. Effectiveness of Stipulations and Required Operating Procedures

One way BLM has tried to address Native concerns about noise and disturbance impacts has been to include local Inupiat Traditional Knowledge in the text of Planning Area IAP/EIS's. This process was followed for the *Northeast NPR-A Planning Area IAP/EIS*, and these concerns are found in this document in the Subsistence and Sociocultural sections that analyze noise and oil-spill impacts (see also the analyses of potential impacts to Subsistence-Harvest Patterns Section IV.C.14 and Sociocultural Systems Section IV.C.15). Traditional Knowledge used in these analyses is peer reviewed by local and regional Native groups on the North Slope. Traditional Knowledge is considered in the planning and decision-making processes, as well as in the formulation of new mitigation measures. The BLM is also part of an Alaska-wide Department of Interior Memorandum of Understanding with Alaska tribes on Government-to-Government consultation signed by all the Alaska DOI Agency Regional Directors.

In general, the stipulations and ROP's articulate minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487), and protection of subsistence pursuits helps to guard against potential sociocultural disruptions that then fall under the purview of environmental justice. Stipulation H-1 specifies that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP-H-1 would direct the lessee to develop and implement a plan--in consultation with directly affected subsistence communities and the SAP--to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area. Specifically the program is designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel would be working, with the intent of reducing any potential conflicts with subsistence.

ROP F-1 states "Aircraft use shall be conducted in a manner that will minimize impacts to wildlife and birds." Assuming that aircraft operators were cognizant of the potential effects of aircraft on wildlife and took the appropriate actions to minimize those effects, disturbance impacts to terrestrial mammals could be reduced substantially.

ROP E-4 and ROP E-5 regarding location and design of permanent oil and gas infrastructure would reduce impacts to caribou from oil development activities. Stipulation C-1 would put restrictions on the types of heavy equipment used and the seasons of allowable use and would be beneficial to wildlife by reducing the amount of habitat disturbed during exploration. Use of low-pressure vehicles may also reduce the mortality of small mammals. Stipulation D-1 would prohibit exploratory drilling in lakes, streams, lakebeds, and active floodplains unless impacts to wildlife are minimal, and would reduce the potential for damage to the riparian habitats that are important to many species of terrestrial wildlife including moose, bear and wolverine. Disturbance impacts to wolverines and moose would also be reduced.

ROP E-2 would require the lessee to minimize the development footprint, would be beneficial to terrestrial wildlife in that it would reduce the amount of habitat lost and decrease disruption of caribou movements. At the same time, it would also reduce the amount of gravel habitats created which may be used to advantage by ground squirrels. Caribou may also use gravel pads for insect relief habitat though the negative effects to caribou from development footprints would outweigh any positive impacts associated with the creation of additional insect-relief habitat. Overall, the impact of this ROP would be beneficial to most terrestrial wildlife. ROP E-5 would require that pipelines and roads be designed to facilitate caribou passage. ROP E-4 would require that permanent oil and gas infrastructure be designed, located, constructed and operated to minimize adverse effects on caribou movements.

ROP E-6 would require a 500-ft setback from shallow lakes, streams, lakebeds, estuaries and other active floodplains and would generally be beneficial to terrestrial mammal species that are dependant upon riparian habitats by reducing the potential for habitat loss and disturbance impacts. ROP E-8 would require that coastal facilities be designed, sited, and constructed to prevent significant changes to oceanographic circulation patterns and water-quality characteristics and to maintain free passage of marine and anadromous fish. It would be beneficial to bears by protecting prey species.

ROP I-1 would require an orientation program for all employees and would generally be beneficial to terrestrial mammals. Education of employees should reduce the potential for harassment and direct mortality of wildlife. ROP J-1 would require lessees to prepare and implement bear-interaction plans to minimize conflicts between bears and humans. ROP A-1 would require proper handling of garbage and waste and would reduce the potential for bears and foxes to be attracted to both permanent and temporary facilities. These stipulations would benefit bears by reducing both the number of bears killed in defense of life and property (DLP) and the number of bears becoming habituated to anthropogenic food sources. Measures designed to avoid attracting bears to work sites should also reduce the attraction of arctic foxes.

With ROP C-1, disturbance of birds from ground transport and other exploration and development activities would be mitigated and essential habitat protected by restricting vehicle use to the winter season to minimize disturbance of most species (except species present during winter) and vegetation-damaging and erosion-causing activities; minimizing motorized ground vehicle use within one mile of any raptor nest during the nesting season 15 April through 15 August (gyrfalcon nests beginning 15 March), and by prohibiting such vehicles within ½ mile of known raptor-nesting sites.

ROP A-1 on garbage/waste handling and food and ROP J-1 on polar bear/human interaction plans would prevent the attraction of polar bears to camp sites that could result in the taking of polar bears in human/bear interactions. Under Overland Moves Stipulation C-1, BLM/operators planning winter activities (including seismic operations) within 25 mi of the coast would consult with FWS to prevent disturbance of denning polar bears. Activities would be prohibited within 1 mile of known bear dens. This consultation would prevent most disturbances of denning polar bears under Alternative A. ROP E-1, requiring aircraft traffic to maintain an altitude of 1,500 ft (except on takeoffs and landings) would reduce the number of disturbances of marine mammals and other wildlife. This ROP would also prohibit the hazing or chasing of wildlife. The ROP would reduce the number of disturbances of marine mammals and other wildlife.

Under the Marine Mammal Protection Act (MMPA), harassment or "taking" of marine mammals is prohibited unless the lessees have a Letter of Authorization (LOA) that would allow them to unintentionally harass marine mammals during their operations. To limit and avoid excessive harassment or taking of non-endangered marine mammals the MMPA requires lessees to have an LOA to conduct activities that may harass or take marine mammals. This requirement is expected to limit disturbance of marine mammals associated with seismic activities and other oil and gas activities in the Northwest NPR-A Planning Area.

Stipulations A-1, A-2, ROP A-6 and ROP A-7 regarding HAZMAT, spills and proper handling of petroleum and chemical products would be beneficial to all terrestrial wildlife species by reducing the potential of direct mortality due to oiling or ingestion of toxic materials and contamination of habitat, prey species and forage species. Stipulations A-1, A-2, and A-3, and ROP's A-6, A-7, A-8 would provide increased protection to fish and fish habitat during fuel use, handling, and storage. The effects of fuel and oil spills on marine fish would be mitigated for Alternative A by waste prevention, handling, and disposal and spills stipulations (A-1 through A-3) and ROP's (A-3 through A-8). Potentially adverse situations involving hazardous materials and wastewater would be mitigated by 1) immediate cleanup of fuel spills and other hazardous materials using contingency plan procedures approved by EPA, ADEC, and OSHA; 2) storing spill cleanup materials at all fueling and maintenance areas as mandated; 3) storing fuels in lined/diked areas at least 500 ft from lakes and streams as mandated; 4) prohibiting fuel storage on lake or river ice or active floodplains; and 5) prohibiting the refueling of equipment within 500 ft of lakes or streams (boats, aircraft excepted). Stipulations A-1, A-2, and A-3 on fuel spill prevention, handling and disposal and cleanup would reduce potential marine pollution and effects on marine mammals in the Dease Inlet/Admiralty Bay area where oil exploration and development may occur under Alternative A.

e. In-Place Mitigation and On-Going Mitigation Initiatives

In evaluating potential sociocultural impacts, BLM has produced a substantial Environmental Justice analysis for Alaska as it relates to the Alaska Native subsistence way of life. An Environmental Justice analysis was also prepared for the Northeast NPR-A IAP/EIS. BLM has also sought the expertise of MMS social scientists who have written Environmental Justice analyses for MMS Lease Sales 144 and 170, the Liberty Project EIS, and the Beaufort Sea and Cook Inlet Multiple Sale DEIS's.

The Northeast NPR-A IAP established procedures and advisory bodies to address subsistence monitoring and research concerns. Stipulation 61 delineated a conflict avoidance procedure to address subsistence concerns with oil and gas exploration and development activities. Through it, lessees consult with the NSB, affected communities, and the Subsistence Advisory Panel, a special body created in 1998 to represent subsistence issues. Under the existing IAP for the Northeast NPR-A, representatives from Federal, State, and NSB agencies, oil industry, environmental groups, academia, and other interested parties were invited to participate on a Research and Monitoring team. This team, chartered under the Federal Advisory Committee Act, was set up to coordinate research and monitoring projects related to the effectiveness of stipulations and surface resource impacts and uses the advice of the Subsistence Advisory Panel. The Research and Monitoring Team operated for two years and has recently been recast as the North Slope Management Oversight Group (NSMOG). Advised by a Science Technical Advisory Panel (configured on the old RMT model), NSMOG will be an inter-agency, inter-governmental group that will develop a more comprehensive and coordinated slope-wide agenda for conducting resource inventories, monitoring, and research.

Stipulation 59 of the Northeast NPR-A IAP directs industry to prepare subsistence plans that specify plans for monitoring the effects of oil industry drilling on subsistence activities (specifically Nuiqsut for drilling activities in the Northeast NPR-A). To date, Phillips Alaska, BP, and Anandarko have prepared these plans and they have been accepted by the BLM. Plans require the lessee to hire local Subsistence Representatives (SR's) as points of contact with potentially affected villages. These SR's field local subsistence issues that arise from oil activities and communicate them to the lessee who resolves them. More complicated issues may involve monitoring and the lessee is tasked with establishing a monitoring plan that is approved by the BLM, the Research and Monitoring team, the Subsistence Advisory Panel (SAP), the local and tribal governments, and the NSB Planning Commission. The Lessee also conducts public community meetings to field developing subsistence issues. Subsistence issues and other SR business are tracked by the SR in a log book. This log book is used to generate biannual reports that summarize issues gathered from individuals and public meetings and their resolutions, any required monitoring efforts and results, any lessons learned and steps taken to prevent future subsistence conflicts, and any ongoing and unresolved issues. No formal biannual reports have been prepared, but Phillips Alaska circulated an informal memorandum in March 2002 that identified its Nuiqsut SR's, their activities working at the Nanuq drilling site and as ice road monitors, permitting progress for the Puviag project, community meetings conducted, and the desire to publish a newsletter summarizing winter drilling activities.

The BLM has also fostered tribal government participation in the EIS planning process through the formation of the SAP. The panel is made up of representatives from the communities of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright, as well as BLM decision-makers, and a representative from the NSB. Since its inception, the panel has met ten times in Barrow, Nuiqsut, and Wainwright and has developed an ongoing dialogue on the issues that would serve to guide the BLM in its decision-making on future exploration and development activities in the Northwest NPR-A. In Nuiqsut, the oil industry, in coordination with the local community, has established and partially funded a Subsistence Oversight Panel to field the concerns of local subsistence hunters and to monitor local subsistence resources.

The BLM held scoping meetings during the EIS planning process, with Inupiat translators in attendance to provide clarification and to allow the participation of non-English speakers. The Environmental Justice process followed for the Northwest NPR-A draft IAP/EIS included: 1) initial scoping, 2) notices in North Slope newspaper and radio station, and 3) follow-up meetings that included discussions specific to Environmental Justice concerns. Environmental Justice concerns were solicited from meetings on the North Slope with the communities of Point Lay on February 7-8, 2002, Wainwright on December 5, 2001, Barrow on December 10, 2001, Atqasuk on December 6, 2001, Nuiqsut on December 11, 2001, and Anaktuvuk Pass on February 8, 2002. From this process, the BLM received feedback on specific Environmental Justice concerns, documented additional concerns of the Inupiat residents, and conducted a special subsistence workshop with the NPR-A SAP to discuss community issues and identify possible mitigation measures. The BLM maintains an open dialogue on Environmental Justice with the communities of the North Slope, specifically by way of the SAP.

Major concerns expressed at these meetings included:

- Protecting Native allotments, hunting and fishing camps, and cultural sites (all 6 communities);
- Identifying and protecting important subsistence areas (all 6 communities);
- Protecting caribou migration routes (all 6 communities);
- Cleaning up contaminated sites (5 communities);
- Access restrictions to subsistence areas and resources (5 communities);
- Studying and maintaining the health of wildlife (3 communities);
- Providing natural gas to local communities (3 communities);
- Conducting caribou and fish studies (3 communities);
- Seismic disturbance of caribou, fish, and whales (3 communities);
- Better use of Traditional Knowledge (3 communities);
- Developing a mechanism for regulating and monitoring guides and outfitters (3 communities);
- Fish contamination from contaminated sites (3 communities);
- Providing more local hire (3 communities);
- Updating outdated resource data (2 communities);
- Involving local people in scientific studies of resources (2 communities);
- BLM's need to develop a clear government-to-government policy (2 communities);
- Providing river setbacks or buffers to protect historic fishing sites (2 communities);
- Including local people in the planning process (2 communities);
- Improving mitigation as it relates to oversight and enforcement (2 communities); and
- Disturbance from staging areas, roads, docking facilities, and pipeline access (2 communities).

The Environmental Justice concerns were presented to BLM management and incorporated into environmental study designs and the new mitigating measures/stipulations included in the Northwest IAP/EIS. These include:

1. revising/clarifying consultation procedures concerning oil and gas and related activities and potential impacts to subsistence users and uses (specifically with regard to subsistence cabins and campsites);
2. strengthening the requirements of annual subsistence plans submitted by industry to improve communication and avert subsistence conflicts with oil and gas and related activities;
3. conducting in-depth subsistence harvest studies of the communities of Nuiqsut, Atqasuk and Barrow to

assess the impact of oil and gas development on subsistence activities in and near these communities;

4. conducting research on caribou movement, impacts of winter exploration on tundra vegetation, and baseline soil contamination and hydrology studies; and
5. sending letters to all known NPR-A aircraft users to make them aware of subsistence conflicts with local residents created by aircraft use.

Part of BLM's sensitivity to the Inupiat way of life is to ask when it can come to villages to hold meetings. The BLM tries to accommodate village schedules, and BLM continues to take a more collaborative approach in its public involvement and has learned the value of spending more time in these local communities. The BLM has hired a subsistence specialist in its Northern District Office in Fairbanks as a community liaison whose job is to maintain contacts with local North Slope Native communities and make sure that scoping and public meetings are scheduled so as not to conflict with local activities. The BLM also writes executive summaries for its EIS's that it believes make projects easier for the public to assess. The BLM feels this cooperative approach can lessen the stress of the agency's public involvement mandate, and it welcomes suggestions on how to make this process better.

Current efforts undertaken by BLM to assess resources in the Northwest NPR-A area include studies on

1. water resource assessment,
2. baseline levels of existing contaminants,
3. impacts to vegetation from seismic trails, ice roads and ice pads,
4. caribou displacement from seismic and other winter exploration activities, and
5. subsistence harvest resource and land use studies (cooperatively with the ADF&G, Subsistence Division) in Nuiqsut, Barrow, and Atqasuk.

Studies proposed to the Research Monitoring Team (RMT) to address monitoring issues in the Northeast NPR-A and to establish better baseline information include a number of studies on vegetation, fisheries and lakes, birds (waterfowl and loons, raptors, and shorebirds), mammals (caribou, moose, muskoxen, wolves, wolverines, grizzly bears, and furbearers), and marine mammals (polar bears). The BLM also promotes studies that directly address the standing issues and concerns of Native stakeholders.

Studies under consideration by the RMT that would specifically address subsistence, sociocultural, and environmental justice concerns include:

1. finishing and publishing a study of vibroseis noise levels under lake ice and disseminate the results to local communities;
2. developing and implementing a cooperative monitoring program asking for hunters' concerns and documenting the status and change of subsistence resources conditions and uses;
3. integrating subsistence monitoring with fish and wildlife monitoring to understand the relationships between fish and wildlife populations and the landscape, and the effects of human activities on the abundance and distribution of these resources;
4. assessing the historic and current importance of the Northeast NPR-A area for subsistence harvest;
5. increasing outreach and education and the dissemination of information to local communities;
6. evaluating the effectiveness of current mitigation measures to protect subsistence users, uses, and resources and to revise or develop new mitigation, if necessary; and
7. monitoring socioeconomic health of local communities as conditions change.

Other ongoing and MMS-funded studies that apply to sociocultural impacts are the *Arctic Nearshore Impact Monitoring In Development Areas (ANIMIDA)* study (that was designed specifically to meet requests from the

Inupiat community); the *Quantitative Description of Potential Effects of OCS Activities on Bowhead Whale Hunting Subsistence Activities in the Beaufort Sea* study; the *Alaska Marine Mammal Tissue Archival Project*; the *Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow*: *Past and Present Comparison Study*; and the *North Slope Borough Economy, 1965 to Present* study. These studies are discussed in detail in the cumulative section Sec. IV.F.8.m - o.

f. Benefits of Alternative A

Alternative A would generate increases in NSB property taxes, averaging about 0.5 percent above the present level of NSB revenues in the early years and tapering to less than 0.1 percent in the latter years. This amounts to revenue to the NSB of about $1.4 million in the first year of production tapering to less than $0.1 million in the later years. Revenue to the State of Alaska under Alternative A would be about $67 million in the first year of production, tapering to $7 million in the latter years (based on the Federal royalty rate of 16.67 percent). According to law, the Federal Government must share 50 percent of this royalty with the State; and the State must share a portion of its royalty with the affected local government. The affected local government is assumed to be the NSB. These revenues would be a benefit of activities under Alternative A.

The BLM refunds to the State of Alaska a portion of fees received from leasing in the NPR-A. These funds are for communities that have experienced adverse effects from oil development. Local North Slope communities applied for and received a total of $28 million in grants from Northeast NPR-A leasing in 1999. Atqasuk received 2 grants totaling $199,000, Barrow received 4 grants totaling $3,280,000, Nuiqsut received 8 grants totaling $8,896,200, and the NSB received 10 grants totaling $15,624,800. Much of the award to the NSB went toward surveying fish resources, monitoring caribou, performing waterfowl surveys, and subsistence-harvest research monitoring. The Northeast NPR-A Resale in June 2002 made another $33,000,000 available for community grants; the deadline for grant applications had not yet closed as of this writing (August 2002).

The NSB received almost $2 million from the State under the federally funded Coastal Impact Assistance Program. Industry local hire initiatives are increasing in terms of the variety of programs being offered to train and attract Inupiat workers for long-term employment on the North Slope. The BLM cannot require local hire, but BLM and other Federal Agencies can inform the operator of Native concerns for more local employment from nearby oil and gas developments.

g. Conclusion--First Sale

(1) Effects on Subsistence Species and Subsistence-Harvest Patterns

The effects of oil and gas activities are expected to be greater under Alternative A than under any other alternative. Effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowheads whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally < 1 year), and to have no regional population effects. If a field is developed in critical Teshekpuk Lake caribou herd (TLH) insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect-relief areas may be disrupted, with unknown effects on the productivity of the herd. Effects from crude-oil spills on birds could range from minor, when confined to terrestrial and freshwater aquatic habitats where the mortality of few waterfowl, shorebirds, raptors, and passerines is likely to be relatively low to moderate if a spill were to enter a river delta or nearshore marine habitats occupied by loons, large numbers of sea ducks whose populations have declined, black guillemots, or Ross' gulls.

Overall, effects are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable or undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would be elevated from low to moderate or high effects because one or more important subsistence resource would then have become unavailable, undesirable for use, or less available for a period greater than 2 years.

(2) Effects on Subsistence Communities

As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, effects on subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. But, if development were to take place in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would be elevated from low to moderate or high effects because one or more important subsistence resources would have then become unavailable, undesirable for use, or less numerous for a period greater than 2 years.

(3) Effects on Sociocultural Systems

As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable or undesirable for use, or experiencing overall population reductions, effects on subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. If development took place in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would be elevated from low to moderate or high effects because one or more important subsistence resource would have become unavailable or undesirable for use, or less numerous for a period greater than 2 years. Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and development activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil spill cleanup. Altogether, subsistence effects could periodically disrupt--but not displace--ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

(4) Effects on Environmental Justice

The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. The only potential environmental justice-related effect on the Native villages from Alternative A activities might be long-term population and productivity effects on the Teshekpuk Lake caribou herd as a result of development in critical insect-relief areas. In that case, disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--all communities that harvest caribou from the Teshekpuk Lake herd.

h. Multiple Sales

(1) Subsistence Resources and Harvest Patterns

For multiple sales under Alternative A, effects on resources would increase as the intensity of development activity increases, although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowheads whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects--the same effects levels expected for a single sale. Some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under multiple sales.

Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. With a southern pipeline route to TAPS Pump Station 2 as a potential outcome of multiple sales, some disruption of CAH caribou migration would be expected. A second gas pipeline from the southern part of the Planning Area to Prudhoe Bay might be constructed. An increase in the number or length of roads and pipelines under the multiple sales development scenario is expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect is expected to persist over the life of the oil fields and may reduce productivity of the TLH. This level of effect on caribou would elevate expected effects on community subsistence-harvest patterns to high or very high effects because one or more important subsistence resources would have than become unavailable or undesirable for use, or less numerous for a period up to 5 years or longer.

(2) Sociocultural Systems

For multiple sales under Alternative A, effects on resources would increase as development activities increase, although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowheads whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. But with increased effects anticipated for TLH caribou, elevated effects would be expected on communities, because this important subsistence resource would become unavailable or undesirable for use, or experience population reductions for a period up to 5 years or longer.

(3) Environmental Justice

The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. The only potential environmental justice-related effect on Alaska Native residents from multiple sales under Alternative A might be long-term population and productivity effects on the Teshekpuk Lake caribou herd as a result of development in critical insect-relief areas.

i. Conclusion--Multiple Sales

(1) Effects on Subsistence Resources and Harvest Patterns

For multiple sales under Alternative A, effects on resources would increase as development activities increase, although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), with no regional population effects--the same effects levels expected for a single sale. Some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. But with increased effects anticipated for TLH caribou, elevated effects would be expected on the communities, because this important subsistence resource would become unavailable or undesirable for use, or experience population reductions for a period up to 5 years or longer.

(2) Effects on Sociocultural Systems

Although anticipated subsistence effects could cause chronic disruption of sociocultural systems for a number of years through the disruption of traditional practices for the harvesting, sharing, and processing of subsistence resources, subsistence impacts still would not be expected to displace existing institutions or ongoing social systems.

(3) Effects on Environmental Justice

The Environmental Justice Executive Order includes consideration of potential effects on Native subsistence activities. The only potential environmental justice-related effect on Alaska Native residents from multiple sales under Alternative A might be long-term population and productivity effects on the Teshekpuk Lake caribou herd as a result of development in critical insect-relief areas. In such case, disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--all communities whose residents harvest caribou from the Teshekpuk Lake herd.

17. Coastal Zone Management

Under Alternative A, all BLM-administered lands in the Planning Area would be available to oil and gas leasing (Map 15). Restrictions on seismic surveys, exploratory drilling, and the siting of permanent facilities in the Planning Area would be included in lease stipulations, ROP's, and as terms and conditions of approval for subsequent permit applications at the exploration and development stages. No Special Areas, wilderness study areas, or Wild and Scenic Rivers would be proposed. The entire Planning Area would be open to recreational OHV use. Protective measures include applying the stipulations and required operating procedures described in Alternative A and identifying visual resource management (VRM) areas.

The NPR-A Federal lands are excluded from the coastal zone, as noted in the introductory section of the No Action Alternative Sec. IV.B.17. However, Section 307(c)(3)(B) of the Federal Coastal Zone Management Act requires that Federal applicants include, as part of their application, a certification that activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone would be conducted consistent with the State's coastal management program. The State may concur with or object to an applicant's certification. The following analysis is based on the hypothetical scenarios developed for proposed oil and gas activities in the NPR-A and for the non-oil and gas activities that may occur. At the time specific plans for exploration and development are submitted for any activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone, the applicant would be required to submit a consistency certification to the State.

All standards of the ACMP and policies of the North Slope Borough (NSB) Coastal Management Program (CMP) are examined herein for potential conflicts with activities identified in Section IV.A.1.

a. Effects of Non-Oil and Gas Activities

While the type of non-oil and gas activities would be the same as they are for the No Action Alternative, under Alternative A, the level and duration of activities could increase.

b. Effects of Oil and Gas Activities

Under the hypothetical development scenario for Alternative A, it is estimated that the drilling of 6 to 16 exploration wells and 2 to 24 delineation wells could occur. However, because of the limited availability of drill rigs, no more than a few wells are expected to be drilled at one time. For this exploration scenario, no permanent pads, roads, or airstrips would be constructed, and therefore, no gravel or rock needed, and no impacts from these activities would occur. For development, it is estimated that up to 8 production pads (connected by roads), one airstrip, one pump station, two staging bases and up to 230 mi of pipeline construction could occur. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. These activities would require up to 2 staging bases. These bases, depending on the location of the activity, would most likely be located at existing sites or refurbished abandoned sites. Camp Lonely and Umiat were used as staging areas for past NPR-A operations. Additional sites, including previous Husky/USGS well sites (Inigok), abandoned DEW-Line sites (Liz-C in Peard Bay), or expanded facilities in communities (Barrow, Atqasuk, and Wainwright) could serve as staging areas. It is likely that the first operations in Northwest NPR-A would be staged out of the Prudhoe Bay Unit or the Kuparuk Unit facilities. Materials and equipment likely would be moved by marine transport in summer months and by trucks over packed snow or ice roads in the winter months. Aircraft could access remote sites at all times of the year.

(1) Effects of Disturbances

There are three main areas of concern related to the ACMP and the NSB CMP. They concern: 1) the habitat; 2) subsistence and water-quality standards of the ACMP; and 3) the related enforceable policies of the NSB CMP. Activities could include construction of portions of pipeline corridors, including any offshore portions (such as inlets and bays) within the Borough boundary. Development activities that occur adjacent to coastal areas (including the Colville [pipelines] and Ikpikpuk rivers) that could have reasonably foreseeable effects on coastal resources or uses of the coastal zone--including activities described in exploration plans and development and production plans--could be subject to the statewide standards and the Borough district policies of the ACMP. Projects located in the coastal zone requiring a license or permit on the ACMP list of permits requiring consistency reviews are subject to the ACMP statewide standards and NSB CMP enforceable policies.

In the following analysis, policies of the NSB CMP are assessed in conjunction with the statewide standard most closely associated with each one.

(a) Coastal Development (6 AAC 80.040)

Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that could be placed inland do not displace activities that depend on shoreline locations (to include marine, lakes, and river waterfronts). The oil and gas activities hypothesized for this scenario include some coastal staging areas. These staging areas have either been used in the past or would represent expanded use of existing facilities in villages. Most of these hypothesized staging areas would be water-dependent, based on the use of marine transportation to move materials and equipment into the staging area. Additionally, exploration and development and production activities may occur in proximity to or actually along shorelines. At the time specific proposals are presented for review and approval, further NEPA analysis and the guidance provided by the CZMA regulations at 15 CFR 950 would assist in determining whether this policy is applicable. If it is determined that there are reasonably foreseeable effects to any coastal use or resource of the coastal zone, it is anticipated that such development could proceed in keeping with this policy.

(b) Geophysical Hazard Areas (6 AAC 80.050)

This statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards could occur. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the Planning Area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas must "maintain the natural permafrost insulation quality of existing soils and vegetation" (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). It is anticipated that the use of BLM's current management practices and site-specific requirements would address these concerns at the time proposals are submitted for review and approval.

(c) Recreation (6 AAC 80.060)

This statewide standard requires coastal districts to designate areas for recreational use if 1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or 2) the area has potential for high-quality recreational use because of physical, biological or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within NPR-A as high-quality recreational use areas. The BLM's current management practices and stipulations--developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and exploratory oil and gas activities to protect visual/recreation values--would reduce conflicts, and Alternative A would be consistent with this standard.

(d) Energy Facilities (6 AAC 80.070)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. The ROP's related to Facility Design and Construction Section II.C.5 address concerns related to this standard.

Criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). The NSB CMP also requires that "transportation facilities and utilities must be consolidated to the maximum extent possible" (NSB CMP 2.4.5.2[f] and NSBMC

19.70.050. K.6).

Section IV.C.10 indicates that oil development--including an aboveground pipeline that may bisect migration routes in caribou insect-relief areas--may disrupt caribou movement to and from these areas. Extensive development in caribou insect-relief areas could result in the loss of some of those areas for relief from insects. ROP E-2--in an effort to reduce the amount of habitat and insect-relief area loss and decrease disruption of caribou movements--requires lessees to minimize the development footprint. ROP E-4 requires that permanent oil and gas infrastructure be designed, located, constructed and operated to minimize adverse effects on caribou movements. ROP E-5 requires that pipelines and roads must be designed to facilitate caribou and subsistence user passage. ROP E-6, which requires a 500-ft setback from shallow lakes, streams, lake beds, estuaries and other active floodplain, would generally be beneficial to terrestrial mammal species that are dependent upon riparian habitats by reducing the potential for habitat loss and disturbance impacts. This requirement applies unless the applicant can demonstrate that adverse effects would be minimal. ROP E-8 requires that coastal facilities be designed, sited, and constructed to prevent significant changes to oceanographic circulation patterns and water-quality characteristics and to maintain free passage of marine and anadromous fish. These requirements would reduce impacts of oil development and address concerns related to this statewide standard and the related North Slope Borough policies.

Construction associated with energy-related facilities under Alternative A and that has reasonably foreseeable effects on coastal uses and resources of the NSB also must comply with siting standards that apply to all types of development. Additional siting standards are discussed later under Habitats and Air, Land, and Water Quality.

(e) Transportation and Utilities (6 AAC 80.080)

This statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches.

The NSB CMP contains several additional policies related to transportation that may be relevant to this analysis. All but one of the policies are "best-effort policies" and subject to some flexibility if: 1) there is a significant public need for the proposed use and activity; 2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated; and 3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. "Transportation development, including pipelines, which significantly obstructs wildlife migration" is subject to the three conditions listed above (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). ROP E-5 requires that pipelines and roads be designed to facilitate caribou passage. ROP E-4 requires that permanent oil and gas infrastructure be designed, located, constructed and operated to minimize adverse effects on caribou movements. These requirements would reduce impacts of oil development and address concerns related to these policies.

Transportation facilities are expected to be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9) that discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6) that requires transportation facilities and utilities be consolidated to the maximum extent practicable.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of "Minimization of Negative Impacts," requires that alterations to shorelines, watercourses, wetlands, and tidal marshes and significant disturbance to important habitat associated with transportation and utilities be minimized. ROP E-6, which requires a 500-ft setback from shallow lakes, streams, lake beds, estuaries and other active floodplain, would generally be beneficial to terrestrial mammal species that are dependent upon riparian habitats by reducing the potential for habitat loss and disturbance impacts. This requirement applies unless the applicant can demonstrate that adverse effects would be minimal. ROP E-8 requires that coastal facilities be designed, sited, and constructed to prevent significant changes to oceanographic circulation patterns and water-quality characteristics and to maintain free passage of marine and anadromous fish. These requirements would reduce impacts of oil development and address these concerns related to this policy.

(f) Mining and Mineral Processing (6 AAC 80.110)

Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of docks, pads, roadbeds, berms and causeways to protect the tundra. The ACMP statewide standards require that mining and mineral processing be compatible with the other standards; adjacent uses and activities; State and national needs; and district programs (6 AAC 80.110 [a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent non-coastal alternative is available to meet the public need (6 AAC 80.110 [b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). If gravel is not obtained from inland sites, constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Gravel extraction activities must be approved by the AO and would be conducted in accordance with existing regulations and BLM management practices.

(g) Subsistence (6 AAC 80.120)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. The NSB CMP Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable subsistence user access to a subsistence resource. Development that would reduce or restrict access can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of best effort policies.

Several important NSB CMP policies relate to adverse effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems."

Access to subsistence resources and subsistence hunting could be affected by minor reductions in subsistence resources and changes in subsistence resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and activities that include pipeline construction; structure placement; and construction of support-bases, pump-stations, and roads. Disruptions in access to resources and resource contamination would be minimal. Impacts would be further minimized through protections afforded by stipulations (identified in Section II.C.5) to protect marine and terrestrial mammals, waterfowl, and fishing resources. Roads and pipelines would be constructed to provide for unimpeded subsistence access and wildlife crossings. The analyses included in Section IV of effects on the various subsistence species and the stipulations and ROP's that address protections for these species indicate that no subsistence species would be impacted to the extent that they would become unavailable for subsistence or significantly reduced in number. Based on the analysis of disturbance effects of various activities on subsistence-harvest patterns described in Section IV.C.14, potential Alternative A conflicts with the subsistence policies would be reduced by subsistence Stipulation H-1 and ROP H-1.

(h) Habitats (6 AAC 80.130)

Part (a) of the statewide Habitats standard lists 8 types of habitat that are subject to the ACMP including offshore areas, estuaries, wetlands and tideflats, rocky islands and seacliffs, barrier islands and lagoons, exposed high-energy coasts, rivers, streams and lakes, and important upland habitat. Part (b) of the standard requires that these 8 habitats be managed to maintain or enhance the biological, physical, and chemical characteristics of the habitat. Part (c) provides management guidance for the first 7 of the habitats. Part (d) includes a provision to allow uses and activities to occur that do not conform to parts (b) and (c) of the standard if: 1) there is significant public need; 2) there are no feasible and prudent alternatives; and 3) all feasible and prudent steps to maximize conformance with the standard have been taken.

The ACMP statewide standard for habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 [b]). This overall policy is supported by an NSB CMP policy requiring that development "be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes" (NSB CMP 2.4.5.2 [b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. The analyses in Sections IV.C.8 through IV.C.11 indicate that resources would not be subject to significant disturbance from these activities. There are no conflicts with the activities hypothesized under Alternative A; however, as additional exploration and development proposals are brought forward, the more focused analysis required for those plans may identify site-specific concerns related to this statewide standard and related district policies.

Activities may affect several of the habitats identified in the statewide habitat standard, including lagoons, wetlands, rivers, lakes, and streams. Much of the uplands in the NSB are considered wetlands. Therefore, onshore development activities would need to be designed and constructed to avoid 1) adverse effects to the natural drainage patterns, 2) destruction of important habitat, and 3) the discharge of toxic substances (6 AAC 80.130 (c)(3)). Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline-road complex (Sec. IV.C.9), impoundments would benefit some waterfowl by creating additional habitat, but could displace other nesting shorebirds.

Caribou may be disturbed and their movements altered by activities associated with this Alternative, but disturbances are not expected to affect migrations and overall distribution. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes this practice and provides a set of guidelines and an intent statement specifically to implement the policy. There is no inherent conflict between the crossing requirements and the assumed activities.

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow (6 AAC 80.130 (c)(7)). Pipeline and road construction (including gravel extraction) could affect these waterways and would need to be conducted in a manner that ensures the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. Stipulation B-1 addresses ice roads and water use. Overland moves and seismic work are addressed in Stipulation C-1 and ROP C-1. Facility design and construction are addressed in ROP's E-1 through E-8. These measures would address concerns related to the statewide standard and the related district policies.

(i) Air, Land, and Water Quality (6 AAC 80.140)

The air, land, and water-quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies.

Water quality can be affected by accidental oil spills, deliberate discharges and emissions, and gravel operations. As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel-storage units with a capacity > 660 gal (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 ft of a coast, lake, or river shoreline "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous-materials storage areas, dumps, etc.)" must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: 1) there must be a significant public need, 2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and 3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. Effects of oil spills are discussed in (2) of this section.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that "development resulting in water or airborne emissions comply with all state and federal regulations." Discharges of muds, cuttings, and drilling fluids are closely regulated. ROP A-3 addresses compliance with EPA, ADEC, and AOGCC regulations and procedures. The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells. Cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations. If muds and cuttings were to be stored on the surface, sediments and other contaminants could be flushed into the watershed. The potential for this is reduced by requiring that wastes be stored in lined and bermed areas and disposed of before spring breakup.

Because discharges are carefully regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4) that requires "industrial and commercial development be served by solid waste disposal facilities which meet state and federal regulations." Any onshore development under Alternative A must meet the statewide standard and the district policy related to solid waste disposal. Compliance with existing regulations and ROP's A-3 through A-8, related to solid and liquid waste handling and hazardous material disposal and cleanup, ensure that there is no inherent conflict between the proposed activities and the ACMP water quality-provisions. Alternative A is consistent with this standard.

Air quality also must conform to Federal and State standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air-quality effects under Alternative A in Section IV.C.6 indicates that conformance is anticipated, and that no conflict between air quality and coastal policies should occur.

(j) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of national, State, or local history or prehistory.

The NSB has developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is:

> likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall (1) be required to avoid the sites; or (2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance.

The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." These NSB CMP policies clearly establish what is required. The analysis in Section IV.C.2 states that paleontological resources are not ubiquitous in the Planning Area and it is quite possible that oil and gas activities would have no impact on these resources simply because those activities would occur where paleontological resources are not present. In addition, most activities would occur during the winter months and the impact to any buried paleontological resources would be low. The likelihood of impacting surface paleontological materials is also low because of their isolated and rare occurrence and because of guidance governing oil and gas exploration activities in the areas in which they are most likely to occur.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence-use areas as well as cultural sites. There is no inherent reason to assume conflict with these policies.

(2) Effects of Spills

The likelihood of a future spill would be greatest for small spills, such as fuel spills. The oil spill analysis in Section IV.A.2 includes a discussion of small spills of crude or refined oil from facilities and pipelines both onshore and offshore. Under Alternative A, 130 small crude oil spills (averaging 3 barrels in size) and 323 small, refined oil spills (averaging 29 gal) are projected. Stipulation A-1 requires development and implementation of spill contingency plans before transportation of fuel. In addition, Stipulation A-3 prohibits refueling of equipment near waterbodies and Stipulation A-2 requires dikes for fuel storage areas. Stipulation D-1 prohibits exploratory drilling that might cause more-than-minimal impacts to hydrologic conditions.

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to a pad. For the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than in a summertime terrestrial spill. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration except that they could occur during snow-free months. Cleanup from these spills might be more invasive because of the non-frozen surface environment. The analysis for small spills assumes that most spills are contained or cleaned up. The effects of such spills are expected to be minor and, given the mitigating measures addressing prevention and response assumed for Alternative A, no conflicts with any of the statewide standards or district enforceable policies are anticipated.

The oil spill analysis in Section IV.A.2.a includes discussion of large spills and states that the most likely number of large spills (greater than or equal to 500 barrels) is 0. The analysis of effects on coastal zone management is based on reasonably foreseeable effects. A large spill would be an accidental and unlikely event, and the limited analysis of effects on coastal management reflects those conclusions. The most likely number of spills for all Alternatives is 0.

A large spill would have greater impacts on subsistence resources, habitats, and land and water quality than the small spills analyzed in this IAP/EIS. Winter is the predominant activity season in the Planning Area, making the unlikely event of an accidental large spill even more unlikely to occur during the summer months. If a spill occurs during the winter months, cleanup efforts would be conducted during the winter months and would be less likely to impact the resources or uses of the coastal zone. However, even if a large spill were to occur during the summer months, it is not anticipated that any species would become unavailable or unharvestable as a result of such a spill. While localized availability and harvestablility could be impacted, it is expected that subsistence activities would continue outside the localized spill area. Habitats would also be impacted locally if a spill were to occur during summer months or breakup. Water quality in the area of the spill could be compromised but the effect would be short term.

c. Effectiveness of Stipulations and Required Operating Procedures

Mitigating measures are assumed to be in place for this analysis. Stipulations and ROP's are grouped into 10 categories:

- Waste Prevention, Handling, and Disposal, and Spills
- Ice Roads and Water Use
- Overland Moves and Seismic Work
- Oil and Gas Exploratory Drilling
- Facility Design and Construction
- Air Traffic
- Oil Field Abandonment
- Subsistence
- Orientation Program
- Miscellaneous Activities

All of these provide for specific actions or restriction of actions that advance the likelihood of relevant activities being conducted consistent with the ACMP statewide standards and enforceable policies of the district program. Energy facilities (6 AAC 80.070) are addressed in several of the ROP's under the heading of Facility Design and Construction. These procedures address concerns related to this statewide standard and related district policies. The statewide standard for subsistence (6 AAC 80.120) and related district policies are specifically addressed in the stipulation and ROP's under "Subsistence." However, all of the stipulations and ROP's applicable to Alternative A would result in increased protection of subsistence species, maintaining their availability for subsistence uses, and reducing conflicts with subsistence activities. Similarly, several of the measures address concerns related to the statewide standard for "Habitats" (6 AAC 80.130). Specifically, the measures provided for "Ice Roads and Water Use," "Overland Moves and Seismic Work," and "Facility Design and Construction" would result in enhanced habitat protection. The statewide standard on "Air, Land, and Water Quality" (6 AAC 80.140) and related district policies are also addressed in several of the categories. ROP A-3 would address compliance with EPA, ADEC, and AOGCC regulations and procedures related to discharges and water quality. The remaining ROP's under this category relate to solid and liquid waste handling and hazardous material disposal and cleanup. All of these would provide protections to the quality of the air, land, and water in and adjacent to the Northwest NPR-A Planning Area.

d. Conclusion--First Sale

There are no inherent conflicts between development envisioned under Alternative A and the statewide standards and enforceable policies of the NSB CMP. With mitigating measures and regulatory oversight, it should be possible to comply with all of the standards and policies relevant to oil and gas activities that have reasonably foreseeable effects on the coastal resources or uses of the coastal zone. Applicable policies would be more precisely addressed when specific proposals are brought forward by lessees. All plans that may have reasonably foreseeable effects must be accompanied by a consistency certification for State review and concurrence. No permit would be issued for activities having reasonably foreseeable effects unless the State concurs or the Secretary of Commerce overrides the State's objection.

e. Multiple Sales

Although the duration and extent of activities would increase, the types of activities would remain the same. For multiple sales, it is projected that 18 to 48 exploration wells and 6 to 48 delineation wells could be drilled, and up to 16 production pads and 595 mi of pipeline may be required. The level of activities does not change the applicability of the relevant policies of the ACMP and the district program; they remain the same regardless of the number of sales held. Applicable policies would be addressed at the time each proposal is submitted to BLM for approval. No permit would be issued for activities having reasonably foreseeable effects on coastal uses or resources of the coastal zone unless the State concurs or the Secretary of Commerce overrides the State's objection.

f. Conclusion--Multiple Sales

The potential for conflict with the statewide standards of the ACMP and the enforceable policies of the NSB CMP is the same as for a single sale. No conflicts are anticipated.

18. Recreation Resources and Wilderness

a. Effects of Non-Oil and Gas Activities

The nature of impacts from non-oil and gas activities under Alternative A would be the same as described under the No Action Alternative. However, certain activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances such as camps, excavations, and aircraft activity would all likely increase. Impacts would be minimal and short term in nature, as described under the No Action Alternative, but the total area impacted could increase to 1,000 acres (up from 500 acres in the No Action Alternative). This represents an increase from one camp in the No Action Alternative to two camps under Alternative A.

Although the amount of supplies and material transported by winter overland moves may increase under this Alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails (see Visual Resources, Sec. IV.C.20) is expected to noticeably increase from the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

Under Alternative A, seismic survey work would continue and increase from one operation (under the No Action Alternative) to three seismic operations. This includes both 2-D and 3-D operations. Assuming three crews working per season, ongoing seismic operations are expected to affect no more than 1,500 acres (three crews @ 500 acres impacted/crew) at a time or, about 1,000 acres more than the No Action Alternative seismic option. Linear green trails (see Visual Resources, Sec. IV.C.20) resulting from these operations would increase from the No Action Alternative in direct relationship to increased seismic operations.

A total of 8 wells (6 exploration wells and 2 delineation wells) is projected under the $18/bbl oil scenario; the projected number of exploration/delineation wells increases to 40 wells (16 exploration wells and 24 delineation wells) under the $30/bbl oil scenario. Due to the limited number of drill rigs available, no more than one rig is available with oil at $18/bbl and no more than four are available with oil at $30/bbl. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary, on-site location of structures (i.e. drilling rigs); noise from generators, vehicles, aircraft, etc.; human presence and associated activity--all would have adverse, short-term impacts on solitude, naturalness, or primitive/unconfined recreation during the winter season. These impacts are expected to be greatest within a 2-mi radius of a drill site, an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 64,000 acres (8 wells @ 8,000acres/well) assuming oil at $18/bbl and this would jump to 320,000 acres with oil at $30/bbl.

In addition to the short-term impacts that would result from exploratory drilling operations, summer season visual impacts to the area's naturalness would result from the greening of vegetation under vacated ice pads, airstrips, and roads (see Visual Resources, Sec. IV.C.20).

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact but almost unnoticeable from several hundred feet away.

(b) Development

The following discussion assumes oil prices up to $30/bbl and gas prices up to $4.27/Mcf (2002$). Under such price scenarios, up to 8 production pads, a pump station, 230 mi of pipeline, and two staging areas could be constructed. Impacts would be the most intense at and around development and production facilities during construction. With the cessation of construction and closure of material sites, the remaining structures, human presence, and associated activity and noise would still have adverse impacts on solitude, naturalness, or primitive/unconfined recreation. Because production could occur for 30 years, these impacts would be long-term. These long-term, adverse impacts are expected to be greatest within 2 mi of production or staging sites (an area of about 8,000 acres per site). Additionally, pipelines and associated facilities would impact recreation values. Pipelines would be elevated about 5 ft and, except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to recreation values from pipelines are expected to be minimal. This equates to about 640 acres per mile of pipeline. The long-term loss of solitude, naturalness, or primitive/unconfined recreation from all of these development aspects together would impact an area of up to approximately 235,200 acres ([8,000 acres/pad x 8 pads] + [8,000 acres/staging area x 2 staging areas] + [8,000 acres/pump station] + [640 acres/mi x 195 mi of pipeline]).

(2) Effects of Spills

Most spills (65 to 80%) would be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation resulting from spills likely would be confined to the same area described above.

A large spill that reaches a river and moves rapidly downstream would have disastrous short-term (and possibly long-term) impacts on recreation values. Fishing, boating, camping, scenic values, and other recreation pursuits would be severely impacted as a result of an oil spill in a riverine environment that is used by recreationists. The obvious short-term effects would be the oil residue in areas of use. The long-term effects would possibly be the loss of fishing, and diminished scenic value of the area, as oil residue may take a long time to dissolve and vanish.

(3) Impacts to Wilderness Values

Impacts to wilderness values of naturalness and outstanding opportunities for primitive recreation or solitude would be as described above and in Visual Resources Section IV.C.20 . Under Alternative A, no areas would be protected by wilderness designation.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-2 and A-3 under "Waste Prevention, Handling, and Disposal and Spills" would greatly increase the protection of wilderness and recreation resources. These stipulations would help reduce, if not eliminate, the possibilities of larger fuel spills in pristine areas, or areas that can ill afford any type of fuel spill. These two stipulations would not unduly restrict recreationists from using the area's resources for their endeavors and yet would adequately protect these resources from being impacted from fuel spills. In addition to the above stipulations, ROP's A-1 and A-2 dealing with the handling of garbage would help protect the area's recreation/wilderness resources as well as the users.

Other stipulations and ROP's that would benefit the recreation/wilderness resources and users of the area are stipulation C-1 (for wilderness only) and ROP's A-5, A-8, and C-1 (for both recreation and wilderness) and F-1 (for wilderness only).

d. Conclusion--First Sale

As compared to the No Action Alternative, there would be an increase of approximately 1,500 acres to 2,500 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. Short-term impacts from ongoing oil and gas exploration drilling activities would impact 64,000 acres (at $18/bbl of oil) and 320,000 acres (at $30/bbl of oil). Oil and gas development would result in a long-term loss of solitude, naturalness, and/or primitive/unconfined recreation from approximately 8,000 acres (with oil at $18/bbl) to approximately 235,200 acres (with oil at $30/bbl)--representing 0.09 percent and 2.7 percent of the Planning Area, respectively--for the life of production fields and pipelines. In the context of the Planning Area's undeveloped land base (approximately 8.8 million acres), these impacts are overall not significant, but they could have some site-specific or local significance.

e. Multiple Sales

It is projected that multiple lease sales under Alternative A would result in an additional 0 to 5 oil/gas fields (total 0 to 10 fields) being developed. Exploratory well numbers would increase, as would delineation wells. An additional 510 mi of pipeline in and east of the Planning Area would be added. Total pipeline mileage for new oil, gas, and service lines could reach 740 mi. A total 395 mi of new oil and gas pipelines is projected to be developed in the Northwest NPR-A Planning area alone (Table IV-29); an additional 395 mi of pipeline is projected for outside of the Planning Area.

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts resulting from noise, aircraft, and other ongoing activities would not have additive effects. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. At $18/bbl for oil, there would be no production pads, no pipeline miles and no staging areas and therefore, no real facility increase over that needed for a single sale. However, if oil goes to $30/bbl, the affected area would total up to approximately 545,600 acres ([8,000 x 8 pads] + [8,000 x 1 staging area] + [640 acres x 740 mi of new oil and gas pipeline]).

f. Conclusion--Multiple Sales

Long-term impacts would be cumulative for multiple sales with $18/bbl oil, however, the cumulative impact would not be much above those in the first sale. If oil should rise to $30/bbl, long-term cumulative impacts from multiple sales would be to the maximum projected level, ultimately affecting an estimated 545,600 acres, of which 324,800 would be within the Planning Area (about 3.7 percent of the Planning Area).

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are considerably reduced by restricting these activities to winter months. Few recreationists visit the area at any time, especially during winter months.

19. Wild and Scenic Rivers

The BLM has identified 22 streams as meeting the minimum standard for eligibility for WSR designation. This section, analyzes the decision by BLM that none of these eligible streams is suitable for inclusion in the National Wild and Scenic Rivers System, and that none of these streams would receive special protection as a special management area or wilderness. Under Alternative A, the entire Planning Area would be available to oil and gas leasing, and restrictions on oil and gas exploration and development activities would be included in lease stipulations, ROP's, and mitigation required as part of future permitting actions. As discussed in Section II.B.11 and II.F.3 and Appendix 11, river values in the Planning Area include the unpolluted and free-flowing nature of the streams listed in Table III-38 as well as subsistence resources and use, fisheries, wildlife, input of fresh water to lagoons, and cultural resources. In the case of the Colville River--the only potential wild river area--the lack of road access would also be considered a river value because of the requirement that wild river areas are vestiges of primitive America, generally accessible only by trail. Further, the Colville River has outstandingly remarkable scenic values that might be impacted under this alternative.

a. Effects of Non-Oil and Gas Activities

The infrastructure and economic development in the area and local communities are expected to lead to some additional vehicular use for non-oil and gas activities, which could cause some additional erosion of stream banks, particularly at subsistence use sites. More subsistence cabins are also expected. It is possible that there will actually be some decline in the time spent on subsistence activities if significant numbers of local residents obtain employment under this alternative.

The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not noticeably impacted by non-oil and gas activities, although they are used for subsistence. This situation is likely to continue as a result of the distance from local communities and difficulties of access.

The entire Planning Area would be classified as "open" to off-highway vehicle (OHV) use, so only emergency closures or limitations could be applied. Use of OHV's is very low now and is expected to remain low even though it would be expected to expand as vehicular technology improves and more cash enters the economy. The impacts of unregulated OHV use would include potential negative impacts on river values including fish, wildlife, cultural, and fossil resources. However, these impacts would be minor unless use expands more than anticipated.

The Colville River riparian area is managed by the State of Alaska and the Arctic Slope Regional Corporation. These entities could authorize improvements such as airstrips, lodges, cabin sites, or storage facilities in the riparian area that would impact the scenic quality and primitive roadless nature of the river.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Seismic exploration and cross-country moves may impact river values as described in the analysis for the No Action Alternative. Cross-country moves may cause river ice to freeze in unnatural patterns, and could perhaps cause some ponding of water behind artificially created ice dams during breakup, which would constitute a negative effect on the free-flowing nature of the affected stream. This theoretical potential effect on river values has not been reported previously on the coastal plain.

The effects of disturbances under Alternative A on water quality, free flow, and the outstandingly remarkable values of subsistence, fish, and wildlife are described elsewhere in this section. In general, the expected impacts on these resources are somewhat greater than those under the No Action Alternative. While any surface-disturbing activity could affect river values, the potential adverse effects of Alternative A would be the greatest of all the leasing options because it includes critical river habitat within the lease area.

(2) Effects of Spills

Under Alternative A, the effects of spills on free flow, water quality, and the outstandingly remarkable values of subsistence, fish, and wildlife are described elsewhere in this section. Because Alternative A has the largest area and least restrictive conditions, spills would have the greatest potential for significant impacts of the alternatives considered. The petroleum residue from a spill would be flushed from river areas within a few years, although effects on subsistence, fish, and wildlife could persist longer. Spills associated with seismic exploration have the potential to cause minor impacts to water quality in individual eligible streams.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-3, C-1, and C-2 would limit the impacts that oil and gas exploration and development would have on river values. Without these stipulations, greater impacts from spills and greater damage to stream banks at river crossings would be expected.

Stipulation B-1 would be somewhat effective in preserving in-stream flows in eligible rivers and in protecting overwintering habitat for fish. This stipulation would entail some risk because it would allow withdrawal of stream water so long as resident fish populations are not endangered. This could be taken to allow complete dewatering of streams during periods when fish are not present, which would negatively impact in-stream flows.

Stipulation D-1 and ROP E-6 would entail some risk to riparian areas and water quality because of somewhat subjective language with regard to acceptable impacts to fish wildlife, vegetation, and hydrologic condition.

Stipulation E-1 could prove effective in limiting impacts of oil and gas development on river values, provided effective site-specific analysis and ongoing monitoring studies are sufficient to improve the effectiveness of stipulations and operating procedures.

ROP's A-1, A-2, A-3, and A-4 could contribute to protecting water quality from the effects of exploration. Without these procedures, impacts to water quality would be expected to increase. ROP C-1 would reduce the likelihood of impacts to the free flow of streams by reducing the likelihood of additional freeze down and unnatural breakup of rivers. ROP C-1 would also provide protection from rutting and changes in drainage patterns for riparian areas.

ROP E-8 could be effective in limiting impacts to river values, particularly fisheries and subsistence activities.

ROP's F-1 and I-1, along with stipulations G-1, H-1, and J-1, would help to limit negative impacts to river values.

d. Conclusion--First Sale

Under Alternative A, the impacts of the first sale on Wild and Scenic River values would be limited in scope. The areas of primary concern are potential damage to riverbanks, and potential withdrawals of water, particularly in winter. The Colville River adjacent to the Planning Area would likely see the greatest negative impact to river values because it is not under BLM management and would likely be crossed by access trails, ice roads, and pipelines. The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not impacted by oil and gas activities and this situation is likely to continue because of the low potential for development. The other eligible rivers in the Planning Area would have intermediate potential for negative impacts.

e. Multiple Sales

Multiple sales do not change the analysis above, although they would expand the scope of the affected area.

f. Conclusion--Multiple Sales

Multiple sales do not change the analysis above, although they would expand the scope of the affected area. Multiple sales would have little additional impact on river values.

20. Visual Resources

Under Alternative A, the Colville River area would be designated Visual Resource Management (VRM) Class II.

The other 21 rivers identified as eligible for designation as Wild and Scenic Rivers and identified estuarine areas would be designated VRM Class III (Map 21). These VRM classes extend ½ mi from the banks of the identified water bodies. The rest of the Planning Area would be designated VRM Class IV. Implementation of VRM prescriptions would take place in individual environmental analysis of each proposed activity.

a. Effects of Non-oil and Gas Activities

The kinds of activities other than oil and gas expected under Alternative A are the same as under the No Action Alternative. However, certain of these activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances such as camps, excavations, and aircraft activity all likely would increase. The number of camps would increase to two camps per season; however, only one would be operating at a time, thus the impacts from the camps would be the same as under the No Action Alternative.

Although the amount of supplies and materials transported by winter overland moves may increase under this alternative, these moves generally follow the same routes. Therefore, neither the length nor number of green trails is expected to noticeably increase from the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

Under this alternative, seismic survey work would continue but would increase from one operation (under the No Action Alternative) to three operations each winter season. Assuming three crews working per season, ongoing seismic operations are expected to affect 1,500 acres annually, or about 1,000 acres more than under the No Action Alternative. Green trails (see the No Action Alternative) resulting from these operations could increase several fold from the No Action Alternative, with approximately 300 mi of intermittent green trails visible from the air during any one summer season (increase from 100 mi under the No Action Alternative).

For the first sale, between 8 to 40 exploration or delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than 4 wells are anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs, bermed drill materials; equipment and housing), vehicles, aircraft, human presence and associated activities would all have adverse, short-term impacts on visual quality during the winter season. These impacts are expected to be greatest within ½ mi of each drill site, but because of the size of the drill rigs, their placement on built-up pads and the relatively flat treeless landscape, impacts could easily extend farther. Ultimately, landscape features at each well location will determine site lines and distances. A ½-mi impact distance around a well site would encompass approximately 500 acres while a 2-mi distance would encompass approximately 8,000 acres. For analysis, it will be assumed that an area of approximately 4,000 acres will be impacted per well site. Accordingly, under this alternative, there would be a temporary loss of visual quality over an area of approximately 16,000 acres for the 4 wells being drilled at any one time.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails--the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop every time ice pads are constructed or snow is compacted, but when it does, it can be very detectable from the air for 2 to 5 years or longer. There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 2,000 acres (40 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

(b) Development

Under the first sale, a total of as many as 8 production pads and 230 mi of pipeline are anticipated under this alternative. Although with the cessation of construction activities and closure of material sites, the intensity of impacts from the development phase likely would be reduced for the production phase, remaining structures, and associated activities would have adverse impacts on visual quality. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest from 1/2 mi to 2 mi of the pad sites (or an area of about 4,000 acres for each pad). Pipelines are expected to be elevated about 5 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines are expected to be minimal beyond about 1/2 mi. This equates to about 640 acres per mile of pipeline. Under this alternative, production pads would impact up to 32,000 acres while pipelines would impact up to 147,200 acres.

Under this alternative, one to two staging bases and one pumping station are also expected. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities, or about 4,000 acres per staging base. Accordingly, under this alternative there would be long-term loss of visual resources over an area of approximately 4,000 acres to 8,000 acres from the staging bases and approximately 3,500 acres from the pumping station.

(2) Effects of Spills

Most spills (65% to 80%) would be confined to a pad. Spills not confined to a pad usually are confined to the limited area immediately around the pad or pipeline. Therefore, impacts on visual resources resulting from spills likely would be confined to the same area described above under development activities.

c. Effectiveness of Stipulations and Required Operating Procedures

The Colville River area would be designated VRM Class II under Alternative A. As such, the level of change to the landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the landscape. The other 21 rivers identified as eligible for designation as Wild and Scenic Rivers and the estuarine areas would be designated VRM Class III. As such, the level of change to the characteristic landscape should be moderate. Management activities may attract the attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the landscape. The rest of the Planning Area would be assigned a VRM Class IV. As such, the level of change to the characteristic landscape could be moderate. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements found in the predominant natural features of the landscape.

d. Conclusion--First Sale

As compared with the No Action Alternative, there would not be an increase in adverse, short-term impacts to visual resources from activities other than oil and gas exploration and development.

Short-term impacts from ongoing oil and gas exploration activities would impact approximately 1,500 acres from seismic camps. The greening and ring effect of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact approximately 1,500 acres. Short-term impacts from oil and gas exploratory drilling would impact approximately 16,000 acres. Seismic operations would result in approximately 300 mi of green trails.

Oil and gas development would result in the long-term loss of visual resources of approximately 190,700 acres (or around 2.3 percent of the Planning Area) for the life of production fields and pipelines.

e. Multiple Sales

For multiple sales, between 24 and 96 exploration or delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than 3 wells are anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs, bermed drill materials, equipment and housing), vehicles, aircraft, human presence and associated activities all would have adverse, short term impacts on visual quality during the winter season. These impacts are expected to be greatest within a 1/2-mi to 2-mi radius of each drill site, which is an area of approximately 4,000 acres impacted per drill site. Accordingly, under this alternative there would be a temporary loss of visual quality over an area of approximately 12,000 acres for the 3 wells being drilled at any one time.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads (as described above). There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 4,800 acres (96 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

Under multiple sales, a total of as many as 16 production pads and 740 mi of pipeline are anticipated under this alternative. With the cessation of construction activities and closure of material sites, the intensity of impacts from the development phase likely would be reduced for the production phase; however, remaining structures, and associated activities would have adverse impacts on visual quality. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest within 1/2 mi of the pad sites (or an area of about 4,000 acres for each pad site). Pipelines are expected to be elevated about 5 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines are expected to be minimal beyond about ½ mi. This equates to about 640 acres per mile of pipeline. Under this alternative, production pads would impact up to 64,000 acres while pipelines would impact up to 473,600 acres.

Under this alternative, three staging bases and one pumping station are expected. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities, or about 4,000 acres per staging base. Accordingly, under this alternative there would be long-term loss of visual resources over an area of approximately 12,000 acres for the staging bases and approximately 3,500 acres from the pumping station.

f. Conclusion--Multiple Sales

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and pads and other ongoing activities would not be cumulative. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent that such facilities are necessary to support exploration and production. It is anticipated that such facilities would impact about 6.6 percent of the Planning Area and would affect a total of approximately 569,900 acres.

21. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared comprehensive impact analyses on those resources within Northwest NPR-A Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section IV.C.7)

Effects of First Sale: Impacts from activities other than oil and gas exploration and development would involve a small fraction of the Planning Area. The overall impact from non-oil and gas activities would be minor to negligible.

The impacts of oil and gas exploration would include vegetation disturbance on 0.3% to 6% (33,800 to 549,000 acres) of the Planning Area per year from 2-D and 3-D seismic surveys. Ice roads and pads could impact <870 acres per year. Development could permanently destroy vegetation on <790 acres and alter plant species composition of <2,220 acres. Unless these impacts occurred to a rare plant species, these impacts would not likely adversely affect any plant species or community. Small oil spills could affect <5 acres and would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.

Effects of Multiple Sales: Compared to the impacts of the first sale, there would be a small increase in the amount of disturbance from seismic activities that would be evident at any one time. Up to 2,090 acres around and under ice pads and roads could be disturbed. Development activities could cause the destruction of vegetation on <1,530 acres and the alteration in plant species composition of <4,660 acres. Oil spills could affect <10 acres of vegetation within the Planning Area. Recovery from spills would take a few years to two decades. Impacts would be negligible without seismic exploration. With seismic exploration, from 0.1 to 2.0 percent (11,300 to 183,100 acres) of the Planning Area would be affected every other year. Complete recovery could vary from a year to decades. This would be a minor impact to vegetation communities, though if a moderate to high level of disturbance occurred in the area of a population of one of the rare plant species, the effect on that particular taxon could be moderate to severe.

Soils (Section IV.C.1 *)*

Effects of First Sale: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be negligible. Impacts from seismic surveys and winter exploration would be expected to be minor to negligible. Development activities would cause loss or disturbance of up to 790 acres of soils. The duration of these impacts would be permanent. Oil spills would be cleaned up immediately causing minimal contamination to soils.

Effects of Multiple Sales: There will be little impact to soils from exploration activities. Development could permanently destroy soils on up to 1,530 acres.

Water Resources (Section IV.C.3)

Effects of First Sale: Seismic activities may have short-term impacts on 20 to 80 acres annually and long-term (several years to several decades) on 2 to 8 acres annually.

The potential short-term impacts from exploration and delineation drilling would be water removal from up to 130 lakes and riverine pools, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 3,000 acres. Long-term impacts from development of gravel roads, pads and pits could impact up to 1,500 acres.

Effects of Multiple Sales: Annual impacts from seismic activities would be the same as for the first sale. Although shared infrastructure could reduce impacts, overall impacts from other oil and gas activities could be double that for the first sale.

Freshwater Quality (Section IV.C.4)

Effects of First Sale: Seismic and exploratory activity would create short-term (usually one season) and localized effects on water quality. Long-term impacts from seismic activity would be less than an acre. Development gravel structures could result in hundreds of acres of impounded water for each production pad with resultant impacts on turbidity from erosion. Oil spills could result in water quality degradation along short stretches of some rivers for a few weeks and about 7 ponds or small lakes could become toxic to sensitive species for about 7 years.

Effects of Multiple Sales: Long-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale. Oil spills could result in waters of up to 9 ponds or small lakes remaining toxic to sensitive species for about 7 years.

Estuarine Water Quality (Section IV.C.5)

Effects of First Sale: The effects of regulated discharges on estuarine water quality would be negligible. The effects of gravel-island construction and buried-pipeline construction would probably be temporary and minor, especially for facilities along the naturally turbid Beaufort Sea coast. Short docks and causeways in NPR-A bays would probably not affect hydrologic conditions, but long causeways with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions. Site-specific effects could be further reduced through additional mitigation developed as a result of subsequent NEPA assessments. If a 500- 900-bbl spill occurred during the ice-covered season, the effects would be minor. If it occurred during the open-water or broken ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of a spill. Because of the difficulty of responding to open-water and/or broken-ice spills, the level of effects for Alternative A, which would not restrict offshore drilling to the ice-covered season, would be slightly greater than for other alternatives.

Effects of Multiple Sales: The effects of multiple sales on estuarine water quality would probably be slightly less than twice that for the first sale.

D. Alternative B

1. Soils

a. Effects of Non-Oil and Gas Activities

The types of activities and associated impacts that may affect soils under Alternative B include those analyzed under the No Action Alternative and Alternative A. Effects would be similar to those evaluated under Vegetation Sec. IV.D.7 below.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Those areas subject to oil and gas exploration activities would see effects similar to those described under Alternative A. The number of exploration and delineation wells might be reduced to a range of 7 to 30 with up to 1 acre of soil lost or disturbed from well cellars.

The effects of development would be similar to the evaluation under Alternative A with a reduction in the number of activities. The fixed size of development areas would remain the same, but the number of areas could change. Up to 4 fields are projected to be developed, for a loss or disturbance of up to 400 acres of soils. Material sites would result in up to 140 acres disturbed. The projected 205 mi of pipelines would create a VSM-attributed disturbance or loss of soils of up to 6 acres.

(2) Effects of Spills

Oil spill impacts to soils would be the same as described in Alternative A. Oil spills may impact soils as the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled and they minimize surface disturbance. The area affected is limited to that area immediately adjacent to and covered by the spill.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's would be the same for Alternative B as they are for Alternative A. The effectiveness of the measures would the same as described under Alternative A.

d. Conclusion--First Sale

Impacts to vegetation from activities other than oil exploration and development under Alternative B would be unlikely to cause loss of soils and any impacts would be expected to be negligible.

Impacts from exploration that requires winter operations again would be unlikely to cause loss of soils. Any impacts would be expected to be minor to negligible. Well drilling would result in up to 1 acre of soils lost or disturbed from well cellars.

Development would cause loss or disturbance to soils through the construction of gravel pads, roads, and airstrips for each oil/gas development; potential construction of one pump station within the Planning Area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the loss or disturbance of up to 600 acres of soils. The duration of these impacts would be permanent. The areal extent of impacts to soils from oil spills would be similar to the area of vegetation affected. Spills would be cleaned up immediately, causing minimal disturbance to soils.

e. Multiple Sales

It is assumed that additional lease sales under Alternative B would result in additional exploration activities. The annual level of seismic operations is assumed to stay the same. The total number of exploratory and delineation wells would increase by 14 to 42 wells (for a total of 21 to 72 exploration and delineation wells) drilled from ice pads, resulting in up to 1 acre of soils lost or disturbed from well cellars.

The development scenario projects that up to 8 fields would be developed. The area of lost or disturbed soils would follow that of direct impacts to vegetation. Similar to the area of vegetation loss, soils loss or disturbance would be up to 800 acres. Soil loss or disturbance from material sites would increase to up to 140 acres. Pipeline impacts would stay about the same as Alternative A, specifically that 210 mi of VSM-supported pipelines would result in up to 6 acres of lost or disturbed soils. The incidence of oil spills also would double, raising the total acres affected to up to 10.

f. Conclusion--Multiple Sales

Generally, under Alternative B, impacts are similar in nature to Alternative A. Some impacting elements, such as pad size, would vary in quantity and some fixed elements, such as pipeline requirements, would remain approximately the same, irrespective of the intensity of development. Impacts to soils from exploration activities would be small to negligible, while development impacts would affect small- to moderate-sized areas. The duration of these impacts could be short term, ranging from several years, if the vegetation is disturbed, to several decades if the soils are destroyed. The overall impact to soils of the Northwest NPR-A Planning Area would progress from negligible (with seismic) to minor (with exploration drilling) to moderate (with development).

2. Paleontological Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative B, the type of non-oil and gas activities would be the same as they are in the No Action Alternative. However the level of activity and duration could increase by as much as a factor of 3. Despite this increase in activity, the impact on paleontological resources--which are buried relatively deeply--would still be minimal.

b. Effects of Oil and Gas Activities

Under Alternative B, the level of seismic activity is expected to increase beyond that of the No Action Alternative because most of the Northwest NPR-A Planning Area would be open for oil and gas exploration, increasing lessees' need for additional seismic data. While the types of potential impacts to paleontological resources would be the same in Alternative B as those described in the No Action Alternative, the level of seismic activity would increase the possibility that impacts could occur. While the level of seismic activity for Alternative B would probably be about the same as it would be for Alternative A, the levels of other oil and gas activities would be somewhat reduced, because Alternative B is slightly more environmentally restrictive than Alternative A. In the areas open to exploration under this alternative, the deeply buried context of most paleontological remains generally precludes any significant impact to the resource.

Paleontological resources are not ubiquitous in the Planning Area, as are habitat and wildlife. As a result, it is quite possible that oil and gas exploration or development activities would have no impact on paleontological resources simply because oil and gas operations would occur where paleontological resources are not present.

(1) Effects of Disturbances

Under Alternative B, the level of oil and gas activity in the Planning Area would probably be slightly reduced from that of Alternative A. As previously mentioned, because most of the activity would occur during the winter months, the potential for impact to buried paleontological resources remains relatively low. The likelihood of impacting surface paleontological materials is also low because of their isolated and rare occurrence and because of stipulations governing oil and gas exploration activities in the areas in which they are most likely to occur.

The drilling of as many as 12 exploration wells and 18 delineation wells could occur as a result of the first lease sale under Alternative B. However, because of the limited availability of drill rigs, no more than a few wells would be expected to be drilled at one time. If the estimated maximum 30 exploration and delineation wells were to be drilled, drilling would certainly occur over the span of several winter seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips would be constructed for exploratory drilling and, therefore, no gravel or rock needed, no significant disturbance of the ground would occur and buried paleontological resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of exploratory drilling would be the creation of the drill hole itself. It is possible that drilling the hole could impact important accessible paleontological material, but the likelihood of that occurrence is minuscule.

The effects of disturbance from development (i.e., the construction of as many as 6 production pads, 1 to 2 staging bases, and approximately 205 mi of pipeline) could occur under Alternative B. Surface disturbance resulting from this work would impact approximately 200 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to paleontological resources would result from the excavation of material for construction of the permanent facilities. If the pads/roads/airstrip material source is terrestrial, then extraction of material could impact paleontological resources. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of VSM's. Depending on the depth at which the VSM's are set, it is possible (though highly unlikely) that buried paleontological resources could be impacted. If buried pipelines were to be used, disturbance and impacts to paleontological resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline. The potential for impacts to surface paleontological resources under this alternative have been previously discussed.

(2) Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, when cleanup is less invasive than in a summertime terrestrial spill. In any case, paleontological resources usually are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities, except that they could occur during the snow-free months. Although cleanup from these spills might be more invasive because of the nonfrozen surface environment, there would be little chance that subsurface paleontological resources would be impacted. If present, surface paleontological remains could be impacted in the same manner as surface cultural material. However, since the occurrence of significant surface paleontological remains is far less common than the occurrence of cultural remains, the probability of any impact is remote.

c. Effectiveness of Stipulations and Required Operating Procedures

Under Alternative B, stipulations C-1b and E-1, and ROP C-1c would apply to paleontological resources. These measures provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface. In addition, stipulations A-1, A-2, and A-3 and ROP's A-6 and E-1 help to prevent large fuel or crude oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. The National Historic Preservation Act (NHPA) requires that an archaeological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities, such as the construction of buried pipelines, are considered undertakings. If paleontological resources were to be identified during the survey, Federal law would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

Additionally, it should be noted that any post-leasing activity engaged in by a lessee would require an action/site-specific NEPA document tiered off this or other EIS's. In that event, the protection of paleontological resources in the Planning Area would follow the established and proven permitting procedures developed by the BLM as the result of past NPR-A activities.

d. Conclusion--First Sale

Under Alternative B, the potential impacts to paleontological resources would be slightly reduced from those in Alternative A because of the increased environmental constraints. These constraints benefit paleontological resources because of the high probability of paleontological resources being located near lakes, streams and rivers, which are afforded more protection from oil and gas exploration under stipulation E-1. In addition, because less land would be available for oil and gas leasing under Alternative B than under Alternative A, there is less of a chance of impact to buried or surface paleontological resources under Alternative B.

e. Multiple Sales

Under Alternative B, the potential for impacts to paleontological resources would be slightly less when compared with Alternative A as a result of the probable decrease in oil and gas activity. While the scattered nature of paleontological deposits and the fact that the locations of most remain unknown (making it somewhat difficult to assess the likelihood and severity of potential impacts), the environmental constraints present in Alternative B are expected to further reduce potential impacts.

f. Conclusion--Multiple Sales

Under Alternative B, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be as previously described. At the same time, the probability of the occurrence of such impacts should decrease slightly from those assumed under Alternative A. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development should decrease slightly when compared to Alternative A.

3. Water Resources

a. Effects of Non-Oil and Gas Activities

Non-oil and gas management actions within the Planning Area that could affect water resources under Alternative B would be similar to those in the No Action Alternative. Because surface-disturbing activities--as defined by events of such magnitude, extent, and duration as to create the effects discussed Section IV.C.3--are not expected, there probably would be no significant long-term effect on water resources. However, there may be some sites that require remediation from earlier exploration or military activities, which are discussed under Hazardous Materials Sec. III.A.1.f.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Exploration and development activities within the Planning Area that may affect water resources under Alternative B would be similar to those under Alternative A, except that the number and frequency of these activities would decrease somewhat (Table IV-03). The decrease would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. Seismic activities probably would decrease from the Alternative A level (Section IV.C.3) but still would occur seasonally at transitory locations, when snow is sufficient to cover the tundra and lakes and rivers are frozen. Significant thermokarst erosion of damaged winter seismic trails made under current practices has not been observed, but such erosion is possible if less than ideal snow conditions were to occur, particularly because snow cover is so strongly influenced by wind scour and drift that may expose areas of tundra to surface disturbance (Walker et al., 1987). Observations by BLM personnel and others (National Research Council 2003) indicate that short-term impacts, such as diversions of shallow water tracks and limited ponding, are estimated at about 1 percent of the proposed seismic lines (Section IV.A.1.b.), but newer, low-ground-pressure equipment could reduce this significantly, to about 8 acres from seismic operations. Long-term impacts due to thermokarst erosion, such as diversions of shallow water tracks and limited ponding, are estimated at about a tenth of an acre affected by seismic operations. Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987).

The estimated total winter water pumpage for the levels of exploration and development activities (Section IV.A.1.b.4) under Alternative B could be over 295 million gallons, or the equivalent of 905 ac/ft. As noted in Section IV.C.3.b , a typical large tundra lake used as a winter water source could have from less than ten to over 100 ac/ft of water available for pumping. This estimate assumes the ADNR drawdown limitation of 15 percent of the under-ice water volume, though under Alternative B this is not a requirement. While water withdrawal from riverine pools is generally not permitted by ADF&G, it is allowed under Alternative B. Given that the seasonal variability of water depth in rivers is much greater than that of lakes, and combining that with movements of any overwintering fish population (also greater in rivers than it is in lakes), safe amounts of water removal from isolated deep pools within the largely frozen (up to 95%) rivers would be hard to determine. Depending on the areas leased and number of exploratory wells drilled, annual water usage for exploration under Alternative B could require pumping water from as few as 9 to as many 90 or more lakes during a winter's exploration season. If more than 15 percent of the under-ice volume were to be removed, then fewer lakes would be required, but less of the critical overwintering habit would remain in the pumped lakes. As noted previously (Section IV.C.3.b.1), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some exploration and development likely would be near these critical aquatic habitat areas. The likelihood of exploration and development activities occurring in an area that contains critical aquatic habitat increases the risk of disturbing stream banks and shorelines, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

Gravel construction of pads, roads, and an airstrip would cover about a 100-acre footprint per field, or a total of 400 acres under Alternative B. In the coastal plain of the North Slope--where low surface gradients limit flow and permafrost is ubiquitous--gravel construction can create significant water impoundments and thermokarst erosion, equivalent to twice the area directly covered by gravel, or up to 800 acres. A dock and staging areas would also be possible under Alternative B. This could significantly increase the gravel requirements, depending on the size, number of pads and type of structures required, estimated at up to 100 acres per site. Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 acres per site, or from 80 to 400 acres total under Alternative B. Unlike the ice roads and pads, gravel structures and pits would create long term impacts over the life of the field(s).

If oil pipelines were to result from development under Alternative B, up to 205 mi of pipelines could effect up to 500 acres of water resources, primarily through temporary impoundments, diversions and sedimentation during construction. If gas pipelines were also constructed, impacts could double--up to 1,000 acres.

(2) Effects of Spills

Under Alternative B, the potential number and extent of oil spills and cleanup would decrease somewhat from those under Alternative A (Sec. IV.A.2). Alternative B--because it includes leasing in most of the critical lake and river habitat--would have almost the same adverse effects on water resources as discussed for Alternative A.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations that protect water resources under Alternative B are similar to those under Alternative A. Additionally, stipulation E-1 requires site investigation and potential mitigation that would protect critical lake and river habitat in certain areas. Stipulation E-8 would allow causeways and docks in river mouths and deltas, which could create flow diversions and impoundments, especially during spring breakup when ice-jam flooding is common.

d. Conclusion--First Sale

Under Alternative B, the impacts of activities other than oil and gas exploration and development are expected to be similar to but slightly less extensive than those under Alternative A. The potential short-term impacts from exploration and delineation would be water removal from up to 90 lakes and riverine pools, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 2,000 acres. Long-term impacts from development of gravel roads, pads and pits, such as melting of permafrost and disrupting drainage patterns, could impact up to 1,000 acres. Alternative B protects limited areas of special aquatic resources, but many areas adjacent to streams and lakes identified as critical aquatic habitat would still be available to leasing. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative B, because it includes most of the critical lake and river habitat in the leasing, would be only slightly less than Alternative A.

e. Multiple Sales

While the effects of oil and gas exploration and development from multiple lease sales could be up to several times greater than the first sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation from channel alteration or gravel removal, might not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and lessen adverse effects to the water resources. Even where infrastructure is shared, both long- and short-term impacts (as noted above)--as well as recovery times--could increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. Since roads pose the single most significant impact (because of unavoidable diversions, impoundments, and increased sediment runoff), limiting the length of the roads would bring about the greatest reduction in impacts to the water resources. While difficult to quantify, multiple sales could result in short-term impacts (from exploration and delineation) of water removal from up to 180 lakes and riverine pools, and (during construction), increased water impoundments, diversions, thermokarst erosion and sedimentation of over 4,000 acres. Long-term impacts from development of gravel roads, pads and pits could impact over 2,000 acres of water resources from water impoundments, diversions, and thermokarst erosion.

f. Conclusion--Multiple Sales

Adverse impacts from multiple lease sales could be up to several times greater than from a single sale, though indirect impacts might take years to develop. While shared infrastructure could reduce the adverse effects to water resources of multiple sales, both long- and short-term impacts, as noted above--as well as recovery times --could increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity.

4. Freshwater Quality

a. Effects of Non-Oil and Gas Activities

As discussed under Alternative A, ground-impacting actions other than seismic operations would not affect water quality.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Exploration activities within the Planning Area that could affect water quality under Alternative B are 2-D and 3-D seismic activity, ice-road construction, and ice-pad construction, with effects similar to those described in Alternative A. Under Alternative B, total acreage with high damage to vegetation caused by seismic trails would be slightly less (10% to 15% less) than that for Alternative A (Sec. IV.C.4.b), causing slightly fewer effects to water quality. Total miles of seismic trails and resulting water degradation would also be 10 to 15 percent less than that for Alternative A.

For Alternative B, annual ice-pad and road construction (45 to 370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 17 to 130 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water pumped from a 2- to 4-acre source. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

Development activities within the Planning Area that could affect water quality under Alternative B are ice road and ice pad construction and spills, the same as for Alternative A.

Because of the continuing need for ice roads, annual water use during development would be similar to that for exploration, with water needed for construction of about 300 acres of ice road withdrawn from 15- to 130-acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water sources equivalent to an additional 12 acres of lake for each field. After major construction was finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring about 5 to 10 total acres of lake for water supply for all field(s). The areas affected would shift each year, as the ice roads are realigned and moved to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrips would cover about a 100-acre footprint per field, or a 100- to 200-acre total under Alternative B. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not occur within the area unavailable for leasing under Alternative B.

(2) Effects of Spills

Spills are another agent that would impact water quality. A number of small crude spills (each averaging 4 bbl) and smaller fuel spills (each averaging 0.7 bbl) are estimated to occur under Alternative B. About 8 percent of crude spills can be reasonably expected to reach tundra waters. For Alternative B, this calculation results in an estimate of 1 to 7 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of 1 to 7 ponds or small lakes, making their waters toxic to sensitive species for about 7 years. These spill locations, however, would not occur within the area unavailable for leasing under Alternative B.

For this alternative, analyses of the effects of a 325-bbl spill reaching the Colville River in summer (in the first case) and Teshekpuk Lake in summer (second case) are presented. In the first case, the high rate of waterflow in the Colville River would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake also would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of the oil slick and the underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for less than a summer, until the slick were either cleaned up or the oil were stranded on the shoreline.

At the level of activity estimated in Alternative B, it is unlikely (though possible) for a spill to enter the marine environment. Along the TAPS tanker route, for instance, zero spills is statistically the most likely number of spills ≥ 1,000 bbl projected to occur under Alternative B.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are locally and marginally at toxic levels. A spill ≥ 1,000 bbl could temporarily (for about a month) contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm acute-toxic criterion could occur over a few tens of square miles during the first several days of such a spill.

However, such a spill is unlikely under this alternative and marine water quality is not anticipated to be affected by spillage of NPR-A crude.

c. Effectiveness of Stipulations and Required Operating Procedures

Effectiveness of stipulations would be similar to that under Alternative A. Stipulation A-1 would be effective in establishing a quick response to any potential crude-oil and fuel-oil spill. Stipulations A-2 and A-3 and ROP's A-3, A-4, E-1, E-6, and E-7 would help prevent oil spills from reaching freshwater streams and lakes and would help prevent freshwater degradation. Stipulation E-1 would help protect the listed water bodies from possible effects from oil and gas activities.

d. Conclusion--First Sale

Effects under Alternative B are similar to those in Alternative A for both oil and gas activities, and for activities other than oil and gas. Water quality over a few hundred acres could be affected by construction or placement of ice or gravel roads and other structures. Oil spills could result in waters of up to seven ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of major rivers or streams from an oil spill. The spreading of a similar-sized spill over a major lake for a few weeks could be considered an effect on water quality.

e. Multiple Sales

During peak exploration, annual ice pad and road construction (45- to 370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 19 to 170 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 6 acres of lake.

Because of the continuing need for ice roads, annual water use during development for ice road construction would be similar to that for exploration, requiring extraction of water from 19 to 179 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction was finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 15 acres of lake for water supply for all fields. Temporary upslope impoundment of snowmelt waters by ice roads could cover another 40 acres.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a 100- to 300-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 600 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

For analysis in Northeast NPR-A EIS (USDOI, BLM and MMS, 1998), the effects of a 325-bbl spill reaching the Colville River and Teshekpuk Lake in summer were analyzed; that analysis is hereby incorporated by reference. In the Colville River, the high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment. Similar effects would be expected in the unlikely case an oil spill reache d any the rivers bodies for this assessment.

As noted in the EIS for the Northeast NPR-A (USDOI, BLM and MMS, 1998), an oil spill similar to the spill estimated for Alternative B reaching Teshekpuk Lake also would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres

(0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected to any of the large lakes in the Planning Area, if an oil spill were to occur.

f. Conclusion--Multiple Sales

Long-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale. Oil spills could result in waters of up to nine ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville or other major rivers and streams from an oil spill. The spreading of a similar-sized spill over about 60 acres of any large water body for a few weeks could be considered an effect on water quality.

5. Estuarine Water Quality

Under Alternative B, there would be no leasing in the proposed Kasegaluk Lagoon Special Area. The offshore waters in Admiralty Bay, Dease Inlet, Elson Lagoon, Peard Bay and the Kuk River would be available for leasing, but permanent oil and gas facilities would be prohibited. Offshore exploratory drilling would be allowed only during the winter solid-ice season, but offshore construction and resupply might continue during the open-water season. The standard stipulations and ROP's--plus stipulation E-1 which would prohibit permanent oil and gas facilities within and adjacent to waterbodies--would apply.

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities under Alternative B would be similar to those activities under Alternative A (see Sec. IV.C.5.).

b. Effects of Oil and Gas Activities

The effects would be different from those for Alternative A because the proposed Kasegaluk Lagoon Special Area would be unavailable for leasing and in other estuarine areas open-water exploratory drilling would be prohibited. The exclusion of Kasegaluk Lagoon from leasing and geological exploration means that there would be no discharges or construction of exploration platforms there. These restrictions would reduce the likelihood of spills in Kasegaluk Lagoon; however, the lagoon still might be affected by spills from exploratory operations in adjacent offshore State and Federal waters. Further, fuel for onshore operations might be transported across navigable portions of Kasegaluk Lagoon.

There would be no open-water offshore exploratory drilling, so there would be less likelihood of an open-water blowout. There would still be an extremely small likelihood of a large open-water spill in NPR-A bays for three reasons: even though there could be no drilling during the open-water season, fuel for winter operations on gravel islands might be barged to the islands during open water; there might be an open-water spill during development; and there might be an open-water spill on the Beaufort Sea shelf that drifts into a bay. However, the restriction of exploratory drilling to the ice-covered period would aid greatly in spill response. If a blowout were to occur offshore during winter, the oil would probably be deposited on the ice cover. On-ice spill responses by Alaska Clean Seas (Alaska Clean Seas, 1999a, b and c) are generally effective, so all of the oil could probably be recovered.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulation E-1, which would prohibit permanent oil and gas facilities within and adjacent to waterbodies, would help to avoid unacceptable effects on water quality from causeways etc. Further, the proposed stipulations and ROP's about fuel transportation (stipulations A-1 and -3) would help to reduce the effect of open-water fuel spills that might occur in spite of the restriction on open-water drilling. The effectiveness of the other stipulations and ROP's with Alternative B would be similar to their effectiveness with Alternative A.

d. Conclusion--First Sale

The effects of regulated discharges and of disturbance from permitted construction would be similar to those under Alternative A, except in Kasegaluk Lagoon, which would be unavailable for leasing and where there would be no effects. Wintertime spill effects on estuarine water quality would be similar to those under Alternative A, but open-water spill effects would be much lower than with Alternative A.

e. Multiple Sales

It is assumed that additional lease sales under Alternative B would result in additional exploration and development activities. The annual level of seismic operations is assumed to stay the same as for the first sale.

f. Conclusion--Multiple Sales

The effects of multiple sales on estuarine water quality would be slightly less than twice that for the first sale because of technological improvements in extended reach drilling and spill response.

6. Air Quality

Impacts to air quality would result from air emissions. Supporting materials and discussions are presented in Section III.A.3.b (description of existing air quality on the North Slope of Alaska).

a. Effects of Non-Oil and Gas Activities

The potential impacts on air quality that would be caused by non-oil and gas activities would be negligible. A discussion of air pollutants is provided in the No Action Alternative (Section IV.B.6).

b. Effects of Oil and Gas Activities

Activities under Alternative B are projected to be less than under Alternative A. Effects on air quality from air emissions, oil spills, oil-spill cleanup, accidental emissions, and other effects would be less than those discussed under Alternative A (Section IV.C.6). Effects on air quality from air emissions likely would be only a very small percent of the maximum allowable Prevention of Significant Deterioration (PSD) Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards. Principally because of the atmospheric dispersion of emissions, the other effects of air-pollutant concentrations from exploration, development and production activities (or accidental emissions) would not be sufficient to harm vegetation, though a light, short-term coating of soot over a localized area could result from oil fires. Mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control discharges.

The Alaska Department of Environmental Conservation (ADEC) regulates and permits air-quality emissions within the Northwest NPR-A Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including the need to obtain construction and operating permits. Construction air-quality permits include prevention of significant deterioration requirements.

c. Effectiveness of Stipulations and Required Operating Procedures

None of the stipulations or ROP's is applicable to air quality.

d. Conclusion--First Sale

The air-quality analysis is based on the specific emission controls and emission limitations that the operators would apply to meet the appropriate State regulations and permit requirements for any development and production activities. The effects of Alternative B activities would cause only small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Ambient Air Quality Standards (NAAQS). Therefore, effects from Alternative B (first sale) would be minimal.

e. Multiple Sales

Impacts on air quality from air emissions, oil spills, oil spill cleanup, accidental emissions, and other effects to air quality would be less than those discussed under Alternative A (Section IV.C.6), because both the area offered for lease and the level of activities would be less. Activities would not occur in the area unavailable for leasing.

f. Conclusion--Multiple Sales

Air quality effects of activities under multiple sales would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and NAAQS. Effects of Alternative B multiple sales would be low.

7. Vegetation

Ground-impacting management actions within the Northwest NPR-A Planning Area that could affect vegetation under Alternative B include those analyzed under the No Action Alternative and those resulting from exploratory drilling and development of oil and gas resources (analyzed under Alternative A).

a. Effects of Non-Oil and Gas Activities

The impacts of management actions under Alternative B would be similar to those described under the No Action Alternative, except that the total areal extent of archaeological/paleontological excavations could increase to 4 acres per year from the 1 acre of the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

If it is assumed that impacts to vegetation from any of the disturbance factors below would occur to different land-cover classes in proportion to their occurrence in the Planning Area (Table III-06) (with the exception of the three water classes), then these impacts--whether or not quantified as to area involved--would occur among the land-cover classes as presented in Table IV-23. However, this assumption would be invalid if a development scenario were to involve a location relevant to stipulations E-1 or J-1 or ROP E-6 (see below), or if additional mitigation measures (see below) were implemented to provide preferential protection of riparian willow stands or certain wetland types over other vegetation types.

(a) Exploration

Under Alternative B, it is assumed that two seismic surveys, in some combination of 2-D and 3-D surveys, would occur in the Planning Area during each winter season. Characteristics and areal extent of impacts from each survey would be the same as analyzed under the No Action Alternative. Thus, total area impacted per year by 2-D seismic surveys within the Planning Area would be < 45,000 acres if up to two crews were involved. Medium- to high-disturbance levels would occur on < 11,300 acres per year and, after 9 years of recovery for any single year's activity, that level of disturbance would remain evident on < 320 acres. The tundra area impacted by 3-D seismic surveys would be < 366,000 acres per year if up to two crews were involved. There would be < 92,000 acres of medium to high disturbance per year and < 120 acres remaining after 9 years. Overall, depending on the combination of survey types and the number of line-miles actually accomplished per survey, the range of areas impacted per year by all seismic operations would be 22,500 to 366,000 acres.

Impacts of exploratory drilling under Alternative B would be of the same type as described under Alternative A, but there might be 7 to 30 wells drilled under Alternative B rather than 8 to 40 projected under Alternative A, for a total of < 170 acres affected under ice pads. If 1 to 6 of these ice pads would be maintained over a summer, vegetation would likely die around their perimeters, affecting < 0.3 acres total. Under Alternative B, it is assumed that 0 to 2 ice roads would be built per year rather than 0 to 3 under Alternative A, affecting < 420 acres per year. Well cellars around the 7 to 30 wells would replace < 0.02 acres of tundra.

(b) Development

The impacts of development would be of the same type as described under Alternative A, but the number of oil/gas fields developed under Alternative B are assumed to be 0 to 4 rather than 0 to 5 under Alternative A, resulting in the destruction of < 400 acres of vegetation under gravel pads. Tundra vegetation would be affected by dust and gravel spray on < 144 acres and the effects of changing moisture regimes might occur on < 800 acres. Any pump stations required would each affect the same area as under Alternative A. Material sites would cause the destruction of tundra vegetation on < 140 acres, with moisture regime changes around them affecting another < 20 acres. Up to 70 mi of aboveground pipelines (field gathering pipelines and trunk lines) would be constructed within the Planning Area under Alternative B, as opposed to < 95 mi in Alternative A, with tundra disturbance from VSM's affecting < 2.1 acres. The miles of aboveground trunk pipelines needed outside of the Planning Area is projected to be 135 mi (the same as for Alternative A), disturbing 4.1 acres of tundra vegetation. The impacts of ice roads or off-road vehicles during winter construction of these aboveground pipelines would affect < 255 acres of tundra within the Planning Area and < 490 acres outside the Planning Area. The same length of buried trunk pipelines for gas--25 mi within the Planning Area and 170 mi outside of the Planning Area--would be as likely under Alternative B as under Alternative A, affecting up to 45 acres and 310 acres, respectively.

(2) Effects of Spills

Under Alternative B, it is assumed that there would be 390 spills of crude or refined oil as a result of the first lease sale, in contrast to the 454 spills under Alternative A. The effects of these spills would cover a total of < 4.3 acres of tundra vegetation. The probability of a seawater pipeline leak would decrease with the number of pipeline miles, and the probability of a blowout would remain low.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's that would reduce the acreage of impacts to vegetation under Alternative B are those that would reduce the areal extent of gravel cover or alterations to tundra during exploration or development (ROP's E-2 and I-1) and those that would reduce the probability of oil spills reaching the tundra or spreading farther if they were to reach the tundra (stipulations A-1 and A-2; ROP's A-3, A-4b and c, A-6, A-7, A-8, E-1, and I-1). Stipulations E-1 and J-1 and ROP E-6 would not reduce the acreage of vegetation impacted by an action, but might shift the impacts from more valuable wetland or riparian vegetation types to habitats perceived as lesser in value. Stipulations and ROP's that would reduce the level of impacts to vegetation (though not the areal extent of impacts) are stipulation A-1 and ROP's A-6 and A-7 (by providing better clean-up of spills), and stipulation C-1b and ROP's C-1c, d, and e, and I-1 (by reducing impacts of off-road vehicles). Stipulation G-1 and ROP E-7 may increase the probability that altered vegetation would eventually be returned to a natural, or at least more productive, state. These stipulations would be effective in reducing impacts to vegetation.

d. Conclusion--First Sale

Impacts to vegetation from activities other than oil exploration and development under Alternative B would involve either disturbance or destruction, and would involve a small fraction of the Planning Area. The impacts of oil exploration and development would be the same types as for Alternative A, but would cover fewer acres because of the reduced level of activity by the oil/gas industry. Exploration activities would include: vegetation disturbance on 22,500 to 366,000 acres per year from seismic surveys; construction of ice roads on < 420 acres per year and ice pads on < 170 acres; and permanent, minor vegetation destruction, and alteration from the construction of exploration well collars. Development would involve destruction of vegetation on < 50 acres and the alteration in plant species composition of < 1,915 acres, for a total of effects over < 2,565 acres. Since these impacts from development would affect < 0.03 percent of the total acres in the Planning Area, they would not be likely to adversely affect any plant species or communities. However, if a development were placed over a population of rare plant species, the effects on that particular taxon could be severe. Oil spills would affect < 4.3 acres of vegetation within the Planning Area.

e. Multiple Sales

It is assumed that additional lease sales under Alternative B would result in additional exploration activities and another 0 to 10 fields being developed. The annual level of seismic operations is assumed to stay the same as for the first lease, and it is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 15 to 36 from the 5 to 12 for a single sale, and delineation wells to 6 to 36 from 2 to 18, for a total for of 21 to 72 exploration and delineation wells drilled from ice pads. Vegetation destruction from well cellars would increase to 0.008 to 0.026 acres, and vegetation death around ice pad perimeters would increase to 0.2 to 0.7 acres. Tundra would recover from the latter in 1 to a few years. Since the number of exploratory and delineation wells is assumed to be greater after the second and subsequent sales than after the first sale, it may follow that the area affected per year by ice roads and pads would increase proportionally to < 1,940 acres.

With the assumption of another 0 to 10 oil/gas fields developed, the total vegetation that might be destroyed by burial under gravel fill would double to < 800 acres. The area of vegetation around gravel pads that would undergo change from dust or moisture regime impacts would double to < 1,600 acres. The impacts of developing material sites would increase correspondingly with the number of oil/gas fields. This would mean the destruction of vegetation on a total of < 280 acres and effects of moisture regime changes on a total of < 40 acres. If additional pump stations would be needed, the area of vegetation affected would increase accordingly. The VSM-supported pipeline miles within the Planning Area would more than triple under multiple sales, from 70 to 240 mi, and pipelines outside the Planning Area are projected to increase from 135 mi for a single sale to 245 mi with multiple sales. Buried gas trunk lines would increase from 0 to 100 mi within the Planning Area and from 170 to 270 mi outside of the Planning Area. The resulting total, both within and outside of the Planning Area for all sales under Alternative B would be 1,780 acres of vegetation destruction/alteration by off-road vehicle or ice road use during winter construction, and 720 acres by trenched gas transport lines. The incidence of oil spills also would double, raising the total acres affected to < 8.6. The probability of a blowout would remain low.

f. Conclusion--Multiple Sales

The impacts of oil exploration under Alternative B would include about double the vegetation disturbance from seismic work as under a single-sale scenario for Alternative B, and about one third less than Alternative A. The extended period of time over which multiple sales activity would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time between the first sale and subsequent sales. Exploration activities also would result in < 0.03 acres of permanent vegetation destruction around well cellars and alteration, per year, of < 1,940 acres around and under ice pads and roads. Development activities from all lease sales under Alternative B would cause the destruction of vegetation on ≤ 1,260 acres inside and outside the Planning Area and the alteration in plant species composition of ≤ 4,050 acres, for a total of effects on ≤ 5,310 acres. These levels are roughly twice those of a single sale under Alternative B and roughly 85 percent of the levels of multiple sales under Alternative A. The portion of this area within the Planning Area (3,920 ac) represents about 0.04 percent of the total landcover present. This level of impact would not be likely to adversely affect any plant species or communities. However, if a development were placed over a population of rare plant species, the effects on that particular taxon could be severe. Oil spills would affect < 8.6 acres of vegetation within the Planning Area, twice the area affected under Alternative B, single sale, and 86 percent of the area affected under Alternative A multiple sales.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

(1) Effects of Non-Oil and Gas Activities

Actions and impacts associated with Alternative B that could cause disturbance to fish are similar to those described under the No Action Alternative. Measurable effects on arctic fish populations in the Planning Area over the life of this IAP/EIS are not expected.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

1) Exploration

Under this alternative, it is assumed that two 2-D or 3-D seismic operations would occur each year in the Planning Area. While Alternative B is likely to involve more seismic surveys than the No Action Alternative, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. As a result, seismic surveys associated with Alternative B are expected to have the same overall effect on fish as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations). While Alternative B is likely to involve more fuel spills than the No Action Alternative, the amount of fuel entering fish habitat is not expected to significantly increase since spills are anticipated to be small (< 5 gallons) and are likely to occur on developed pads. Hence, fuel spills associated with Alternative B are expected to have the same overall effect on fish populations as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations).

Construction-related activities that may affect arctic fish include water withdrawal related to the construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling.

Under Alternative B, it is anticipated that 5 to 12 exploration wells and 2 to 18 delineation wells would be drilled in the Planning Area as a result of the first lease sale, for a total of 7 to 30 wells on ice pads. Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), water needs would equate to approximately 2 million gallons for each drill pad, for a total of 14 to 60 million gallons of water. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that 0 to 2 ice roads, 25 to 50 mi long, would be built each season for a maximum annual water need of 150 million gallons. Water needed for three drilling rigs, associated camps and airstrips, and maintenance of roads, pads, and airstrips would add approximately another 85 million gallons to the annual water use budget. Total annual maximum water need is estimated at 295 million gallons, 30 percent less than the 424 million gallons required by Alternative A. Assuming that a typical large tundra lake (1 mi long and >6 ft deep) has approximately 20 to 40 million gallons available for pumping (USDOI, BLM 1998), the decreased water need would equate to about 4 fewer lakes being pumped for Alternative B than for Alternative A.

Assuming water needs are reduced from Alternative A to Alternative B, potential impacts to fish in relation to water withdrawal in rivers and lakes is slightly reduced. Water pumping could still adversely affect arctic fish, depending on the location of the withdrawal and the quantity of freshwater withdrawn. Withdrawals from rivers are of greater concern than lakes because of the smaller habitable space in overwintering pools. The reader is referred to the discussion of water withdrawal in the Fish section of Alternative A for further details on impacts (Sec. IV.C.8.a).

Assuming that the Authorized Officer follows the common practices when approving water withdrawals, lake water withdrawal associated with Alternative B might be expected to kill a small number of individual fish, but would not be expected to have a measurable effect on arctic fish populations in the Planning Area. Exploratory drilling on lakebeds and streams could also impact fish under Alternative B. Impacts are the same as described in Alternative A.

2) Development

Activities related to development that could impact fish include excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways, and water withdrawals.

Material sites (for gravel extraction) needed for construction of roads, pads, pipelines, and airstrips have not been identified in the Northwest NPR-A Planning Area. One likely source would be river drainages. Other possibilities include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, and using ice or composite pads. In Alternative B, it is assumed that 4 oil and gas fields would be developed rather than the 5 fields projected under Alternative A. Each field would be expected to have a footprint of about 100 acres, requiring one million square yards of gravel. Total gravel needs for four fields would equal four million square yards. This represents a 20 percent decrease in gravel needed for pads from Alternative A. Using composite (blended mixtures of sand/silt/foam) could potentially reduce gravel needs by 33 to 50 percent. Decisions regarding future gravel use and location of pits would be made on a case-by-case basis.

Direct and indirect impacts to fish from gravel extraction are similar to Alternative A, though fewer in-river sites should reduce overall impacts to fish. As was the case in Alternative A, beneficial aspects of gravel extraction are available in the form of deep pits that can be used by fish as overwintering habitat. Based on the documented successful use of reclaimed gravel pits by fish, future mitigation of gravel pits should incorporate prescriptions that create fish habitat when feasible.

Impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be the same under Alternative B as Alternative A. Impacts from erosion should be short term and proper placement of these structures, in combination with adequate and properly sited drainage systems, should lead to minimal fish loss. Impacts of water withdrawal needed during development are similar to those discussed in the exploration portion of this analysis and remain the same as described in Alternative A.

Up to 205 mi of pipeline in and east of the Planning Area to the Kuparuk oil field (Table IV-29) could be constructed during production activities under the first sale in Alternative B. Compare this to 230 mi of pipeline constructed in Alternative A. Impacts are expected to be similar to Alternative A with no measurable effect on arctic fish populations in the Planning Area. Peak gas production is slightly reduced (by 18 Bcf/yr) from Alternative A to B (Table IV-05). The construction of overland gas pipelines through waters supporting fish is likely to displace small numbers of fish short distances. However, those affected would soon reoccupy that habitat upon completion of the activities and would be otherwise unaffected. For these reasons, natural gas exploration and development is not likely to have a measurable effect on fish populations.

(b) Effects of Spills

The individual effects of oil on fish for Alternative B are the same as discussed for Alternative A. The oil-spill assessment estimates that the amount of crude oil spilled during the first sale from a small spill would be up to 336 bbl for Alternative B versus 393 bbl for Alternative A (Table IV-20). Large spill volumes are identical for both Alternatives (500 or 900 bbl) (Table IV-19). The volume of refined oil spills estimated in Alternative B is 194 bbl versus 226 bbl estimated in Alternative A (Table IV-20). The reduction in the two types of spills is not expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative B are expected to have the same overall effect on arctic fish as discussed for Alternative A (specifically, no measurable effects on arctic fish populations in the Planning Area over the production life of the field). The effects of a natural gas blowout or seawater pipeline spill on arctic fish populations would be expected to be similar to those described under Alternative A (specifically, no measurable effects on arctic fish populations in the Planning Area over the production life of the field).

(3) Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, and A-3, and ROP's A-6, A-7, and A-8 would provide increased protection to fish and fish habitat during fuel use, handling, and storage. ROP E-6 and ROP E-8 would be beneficial to fish habitat and to fish. Stipulation B-1 would provide protection against water withdrawals from rivers and certain lakes. ROP C-1 would protect rivers and lakes from additional freezedown. Stipulation D-1 would reduce impacts during oil and gas exploratory drilling. ROP E-3 would reduce potential for disruption of fish passage.

(4) Conclusion--First Sale

Construction of pads, roads, airstrips, and fuel spills associated with Alternative B activities might be expected to kill a small number of individual fish but is expected to have no measurable effect on arctic fish populations. Increased mortality would be anticipated if water withdrawals from river pools were to occur. Potential mortality from water withdrawals in lakes is also possible, although limits on withdrawal and monitoring of water quality should minimize concerns. The lesser extent of exploration activity under Alternative B (as compared to Alternative A) represents a corresponding 30 percent lower water budget. This would also lessen the potential for fish kill in lakes. Gravel requirements for oil and gas field pads under Alternative B are 20 percent less than under Alternative A. Gravel extractions can lead to habitat enhancement under certain situations. Seismic surveys, non-oil and gas activity, causeways, and seawater spills associated with Alternative B are not expected to have a measurable effect on arctic fish populations in the Planning Area over the production life of the field. These last conclusions mirror those from Alternative A.

(5) Multiple Sales

It is assumed that additional lease sales under Alternative B would result in an additional 0 to 10 oil/gas fields being developed, exploratory well numbers would increase from 5 to 12 under the single-sale scenario to 15 to 36 for multiple sales, and that delineation wells would increase from 2 to 18 for the first sale to 6 to 36 for multiple sales (Table IV-05 and Table IV-07). An additional 270 mi of pipeline within the Planning Area would be projected (Table IV-29). Seismic activity would remain the same.

Water withdrawals would increase in proportion to the increase in activity level. Given the large quantity of lakes in the area likely to be developed, increased water use would not be expected to impact fish more severely than under a single sale. Gravel pads and roads for multiple sales would be likely to have about twice the effect on arctic fish as the first sale. It is estimated that the amount of crude oil spilled (small spills) would double. Spill impacts would also double, though they would still be minor. However, if there were not enough time between activities to allow for full recovery, or if the level of activity were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations would be likely to be greater than estimated herein for multiple sales.

(6) Conclusion--Multiple Sales

Seismic surveys and pipelines associated with multiple sales would be expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads and roads would be expected to have about twice the effect as the first sale. Fuel and oil spills would be likely to have a greater (though still minor) effect on arctic fish populations than the first sale. Insufficient recovery time between sales (and/or greater levels of activity) would be likely to result in greater effects than estimated herein for multiple sales. The impacts under multiple sales are the same for Alternatives A and B.

b. Marine Fish

Under Alternative B, lagoons and estuaries along the western coast of the Planning Area, including proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet) would not be open to oil and gas leasing. No permanent oil and gas structure would be allowed either in the Dease Inlet/Admiralty Bay area or in Elson Lagoon. Oil and gas exploration and development activities in the northern portion of the Planning Area adjacent to Dease Inlet/Admiralty Bay area and Elson Lagoon would be subject to issue/area-based stipulations. Exclusion of marine construction from these coastal areas would reduce the probability that oil- and gas-related activities associated with Alternative B would have a measurable effect on marine fish populations. The activities and events most likely to have some effect on marine fishes in Alternative B would be seismic surveys, and oil or diesel fuel spills.

(1) Effects of Non-Oil and Gas Activities

Activities not related to oil and gas exploration and development are not likely to have a measurable effect on marine fishes.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

While there is some difference between Alternatives A and B, these differences would not result in a measurable change in their effect on marine fish populations. The effect from seismic surveys, for instance, would likely be similar to that of Alternative A (specifically, no measurable effect).

(b) Effects of Spills

The exclusion of permanent facilities from coastal waters in the NPR-A would reduce the probability that an oil or diesel spill associated with Alternative B would adversely affect marine fish. Spilled hydrocarbons could reach nearshore marine waters if an onshore oil or diesel spill were to enter from a river. Depending on the amount of oil reaching nearshore waters during summer, the estimated 500- or 900-bbl oil spill under Alternative B is projected to adversely affect a small percentage of the marine fish population in the Planning Area. For a discussion of how spilled oil affects marine fish, see Section IV.C.8.b.2.b.

(3) Effectiveness of Stipulations and Required Operating Procedures

Waste prevention, handling, and disposal and spills stipulations (A-1 through A-3) and ROP's (A-3 through A-8) reduce the potential for introducing fuel and oil spills into environments inhabited by marine fishes. Because accidental spills occur, the preparation for, and response thereof, has the potential to greatly mitigate the magnitude of potentially adverse effects of petrochemical spills on marine fishes. Hence, the stipulations and ROP's may reduce the number of individual fishes impacted by a spill and the degree of lethal and sublethal effects upon them.

(4) Conclusion--First Sale

Based on the assumptions discussed in the text, seismic surveys, and oil or diesel fuel spills associated with Alternative B are not expected to have a measurable effect on marine fish populations. Depending on the amount of oil reaching nearshore waters during summer, the estimated 500- or 900-bbl oil spill under Alternative B is projected to adversely affect a small percentage of the marine fish population in the Planning Area.

(5) Multiple Sales

The most likely activities or events to affect marine fish as a result of multiple oil and gas lease sales include seismic surveys, fuel spills, and oil spills. Additional NPR-A lease sales would add to the seismic surveys from the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat. However, such events would likely be infrequent. Seismic surveys associated with multiple sales in Alternative B are expected to have the same overall effect on marine fish as discussed for the first sale. If several lease sales were to occur under Alternative B, considerably more exploration activity would be expected to occur in the Planning Area. The same number and volume of spills are estimated under Alternative B as for Alternative A.

(6) Conclusion--Multiple Sales

Seismic surveys in the multiple sales case would be likely to have a slightly greater overall effect on marine fish than the first sale under Alternative B. The effects from estimated oil or diesel fuel spills is the same under Alternative B as for under Alternative A. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than for a single sale.

c. Essential Fish Habitat

Essential Fish Habitat (EFH) is unlikely to be affected by activities under Alternative B (see discussion in the No Action Alternative Sec.IV.B.8.c). The potential impacts to the few salmon that are present in the Northwest NPR-A Planning Area would be much the same as those for all other fish species. Consequently, impacts on salmon, as part of EFH, are evaluated in the general fisheries analysis for this alternative.

9. Birds

This section discusses potentially adverse effects of management actions on nonendangered birds within the Northwest NPR-A Planning Area under Alternative B. Such actions, including oil and gas exploration, potentially may result in: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by refined products, wastewater, and solid/liquid wastes of various toxicity. This analysis assumes stipulations in Table II-02 are in place; also, it assumes that stipulations allowing discretion in the level of protection are applied in their most restrictive interpretation. Nearly all of the approximately 70 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northwest NPR-A portion of the Arctic Coastal Plain (ACP). Principal bird groups considered here include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Non-Oil and Gas Activities

Effects from management actions other than oil and gas exploration under Alternative B are likely to be about the same as those discussed under Alternative A (Section IV.C.9). This is because the projected level of activity (except number of acres disturbed by excavation and collection) is the same (Table IV-28).

b. Effects of Oil and Gas Activities

The Planning area would not be open to oil and gas leasing and exploration in the Kasegaluk Lagoon proposed Special Area under Alternative B (Map 16). In addition, stipulations prohibiting permanent oil and gas facilities would be applied to all marine coastal areas, the northeastern portion of the Planning Area surrounding Dease Inlet to south of Smith Bay, major river corridors, and numerous small tracts incorporating large lakes and other aquatic and terrestrial habitats. These restrictions represent substantial environmental protection. Exploration activity for the first sale could vary considerably depending on the price per barrel of oil (Table IV-05). Thus, the number of exploration/delineation wells could vary from 5/2 at a low price to 12/18 at a high price, exploration/delineation rigs from 1 to 3; 1 to 2 staging bases and 0 to 6 production pads are projected. The number of pipeline miles projected is 0 because it is doubtful commercial development would occur without there being exceptions to many of the stipulations. If only exploration were to occur, it probably would take place over a period of 7 years.

(1) Effects of Disturbance

(a) Seismic Exploration

Two seismic operations are expected to occur each winter under Alternative B, compared to three under Alternative A. It is not likely that this decreased frequency would result in effects substantially different from the negligible effects indicated under Alternative A. This is because camps and survey areas are occupied for brief periods, and wintering bird species are present in low densities, thus disturbance incidents are likely to be few and of short duration.

(b) Oil and Gas Development

All routine oil and gas exploration, development, and production activities under this alternative are somewhat less than under Alternative A, thus it is likely that local disturbance effects would be somewhat less, unless most or all developments were to occur in a limited portion of the Planning Area (e.g., the Dease Inlet area). Making the Kasegaluk Lagoon Special Area unavailable for exploration and development removes a small proportion of the higher density areas for Pacific loon, white-fronted goose, and long-tailed duck. Because most potential effects would already be quite low, this would not be likely to result in significant reduction of effects. Overall effect of routine oil and gas activities at the regional population level would be likely to be negligible for most activities and species, but could be elevated to minor for species that are uncommon, decreasing, or recently declined. Effects of air traffic and gravel mining are likely to remain at the minor level.

(2) Effects of Spills

One large spill is assumed for Alternative B (Table IV-19). Because areas of higher probable oil and gas resources and development in the northern portion of the Planning Area would be available for leasing under this alternative, an oil spill would be likely to contact approximately the same areas as under alternative A, and thus produce about the same adverse effects. There would be a reduction in probability of offshore spill occurrence because permanent facilities would not be allowed in these waters, thus these areas would be accessed from onshore facilities. Stipulations applied to all marine areas, the northeastern portion of the Planning Area surrounding Dease Inlet to south of Smith Bay, major river corridors, and other areas, could reduce somewhat the chance of spilled oil entering aquatic habitats, and thus the chance of contacting loons, waterfowl, and shorebirds. These additional protective measures of Alternative B are not likely to reduce most effects of an oil spill below the minor level (as determined for Alternative A), but could reduce spill effects in marine waters or river delta areas where concentrations of waterfowl or other species occur to below the moderate level. Small crude/refined oil spills are reduced somewhat from the 130 crude/323 refined oil spills projected for Alternative A to 112 crude/277 refined--not likely to reduce the already small effect (negligible) anticipated from small spills.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate effects on birds of four types of problems that may result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, contamination of waterbodies occupied by birds, and mortality of fish that are prey for fish-eating birds.

ROP C-1 would mitigate disturbance of nesting raptors and other birds occupying surrounding areas by requiring that motorized ground-vehicle use be minimized within 1 mi of any raptor nest during the nesting season--15 April through 15 August (gyrfalcon nest beginning 15 March)--and possibly prohibiting such use within ½ mi of active raptor nests.

Stipulation E-1 could minimize disturbance of resources of significant concern such as raptors and other birds occupying surrounding areas (as determined through site-specific investigations) which may require additional design features or mitigation (including up to 1-mi setbacks for projects)

ROP E-6 could mitigate disturbance of breeding waterfowl--and shorebirds in particular--by restricting approval of permanent oil and gas facilities (which could include vehicle and aircraft noise and activity on roads and airstrips) to those that are likely to cause minimal effects within 500 ft of various waterbodies and their floodplains.

ROP F-1 could mitigate aircraft disturbance of birds by requiring aircraft use to be conducted so as to minimize impacts to birds.

Stipulation J-1 could mitigate disturbance of raptors and other birds occupying surrounding areas in the Colville River Special Area by requiring that all reasonable efforts be made to locate permanent oil and gas facilities (which could include vehicle and aircraft noise and activity on roads and airstrips) as far from raptor nests as feasible.

ROP E-6 could reduce the loss (burial) of wetland habitats--important for breeding waterfowl (shorebirds in particular)--by restricting approval for location of permanent oil and gas facilities within 500 ft of the floodplains of various wetlands to those projects that are likely to cause minimal impacts.

Stipulation E-1, to minimize loss of habitats occupied by breeding and post-breeding birds and foraging raptors--and any effect this might have on their breeding success--may establish setbacks of up to 1 mi in and adjacent to the active floodplain of selected waterbodies. Additional design features and mitigation (developed through site-specific analysis) would be required if resources of significant concern were to be found.

Stipulation J-1 could reduce impacts on important habitats of raptors and other birds occupying surrounding areas in the Colville River Special Area by requiring permittees to minimize alteration of high-quality raptor-foraging habitat, particularly in wetland and riparian habitats.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where waterbirds--and nesting or brood-rearing birds occupying adjacent habitats--could become contaminated and die, by requiring storage and fueling to take place in diked and impermeably lined areas at least 100 ft from the active floodplain of non-fish-bearing and 500 ft from the active floodplain of fish-bearing waterbodies.

Stipulation A-3 may prevent spilled fuel from entering waterbodies where waterbirds--and nesting or brood-rearing birds occupying adjacent habitats--could become contaminated and die, by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing and 100 ft of the active floodplain of non-fish-bearing waterbodies.

ROP C-1 may prevent spilled fuel from entering waterbodies where waterbirds--and nesting or brood-rearing birds occupying adjacent habitats--could become contaminated and die, by recommending that refueling of most equipment take place at least 500 ft from the active floodplain of fish-bearing and 100 ft from the active floodplain of non-fish-bearing waterbodies.

ROP E-6 may prevent spilled fuel or leaking pipeline oil from entering waterbodies where waterbirds--and nesting or brood-rearing birds occupying adjacent habitats--could become contaminated and die, by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species), by requiring storage and fueling to take place in diked and impermeably lined areas at least 100 ft from the active floodplain of non-fish-bearing and 500 ft from the active floodplain of fish-bearing waterbodies.

Stipulation A-3 may prevent spilled fuel from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species), by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing and 100 ft of the active floodplain of non-fish-bearing waterbodies.

Stipulation B-1 could prevent winter die-off of fish prey of fish-eating birds (e.g., loons, mergansers, terns) (which could adversely affect the breeding success of these waterbird species), by prohibiting water withdrawal from shallow, fish-bearing lakes in winter.

ROP C-1 may prevent spilled fuel from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species), by recommending that refueling of equipment take place at least 500 ft from fish-bearing and 100 ft from other waterbodies.

ROP E-6 may prevent spilled fuel or leaking pipeline oil from entering waterbodies where fish prey of fish-eating waterbirds could become contaminated and die (which could adversely affect the breeding success of these waterbird species), by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife.

These stipulations and required operating procedures would minimize disturbance of most bird species from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where waterbirds or fish prey of fish-eating birds could become contaminated, and prevent contamination of surrounding nesting and brood-rearing habitats. The measures do not specifically establish minimum aircraft altitudes for routine flights over areas of high bird density. Also, the lack of a specific stipulation for summer use of ground vehicles in high-bird-density areas (except in the vicinity of raptor nest sites) could result in lowered nest success in local areas. In most cases, the stipulations and ROP's are likely to affect a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a given species' regional population.

d. Conclusion--First Sale

Under Alternative B, disturbance effects from non-oil and gas activities, winter seismic surveys, and routine oil and gas activities for most species are likely to be negligible or minor for uncommon/decreasing species, as under Alternative A. Effects of air traffic and gravel mining are likely to remain at the minor level under Alternative B. Effects of a large spill for most species are likely to remain at the minor level; moderate effects where waterfowl or other birds concentrate may be reduced by stipulations covering marine waters and major rivers that drain into this habitat.

e. Multiple Sales

If multiple sales occur under Alternative B, it is likely that disturbance from development activity and any oil spill effects would be concentrated in the northern portion of the Planning Area, as under Alternative A, where stipulations governing various activities apply. Disturbance associated with multiple sales is likely to result in a substantial increase of effects locally--and potentially at a regional level for species that are uncommon and/or decreasing in numbers--over that expected from the first sale, especially if sales are concentrated in the northern Planning Area. However, the overall effect of routine oil and gas activities at the regional population level is likely to be negligible for most activities and species because there still is a relatively low level of activity projected, and most species populations are scattered over a large area. Effects could be elevated to the minor level for species that are uncommon, decreasing, or recently declined. Effects of gravel mining are likely to remain at the minor level because some sites probably would be used for several projects. The effects of air traffic under multiple sales--particularly if developments are concentrated in a limited portion of the Planning Area--could increase to a moderate level, especially for species with limited habitat preferences, small and/or declining populations (e.g., red-throated loon, yellow-billed loon, king eider, common eider, Sabine's gull, gyrfalcon, peregrine falcon, snowy owl). Effects in this case could extend to regional populations and involve long-term changes in distribution.

The stipulations applied to marine areas and rivers also could reduce the probability that an oil spill would reach areas where birds concentrate (e.g., waterfowl in marine waters or rivers) by providing setbacks from aquatic habitats and by prohibiting permanent facilities in marine waters. Even though limited somewhat in extent when compared with Alternative A, the multiple sales scenario for Alternative B could elevate the overall probability of spill occurrence in, for example, the northern part of the Planning Area. This would increase the potential for oil to reach waterfowl concentration areas well above that for the first sale, causing substantial mortality. Effects from pipelines required to transport oil to existing eastern pipelines would be likely to be considerably less than for the first sale because only shorter accessory lines would be constructed to individual successive projects.

f. Conclusion--Multiple Sales

Although the projected level of activity is somewhat less under Alternative B than under Alternative A, and despite additional protective stipulations applied to marine and riverine areas (and elsewhere in the Planning Area), and even with no leasing allowed in the extreme western portion, the probable concentration of development in the northern portion would be likely to result in negligible to minor levels of disturbance and minor to moderate levels of oil spill mortality among the affected species of varying sensitivity and vulnerability. In other words, even though Alternative B is more limited than Alternative A, no significant reduction in overall effects on birds would be expected.

Effects of multiple sales over a longer period in the northern Planning Area (or other parts of it) could elevate the overall probability of disturbance and spill occurrence in that area. The increased potential for disturbing breeding birds, and for spilled oil to reach waterfowl or other water bird concentration areas could cause mortality well above that of the first sale.

10. Mammals

a. Terrestrial Mammals

(1) Effects of Non-Oil and Gas Activities

Under Alternative B, Kasegaluk Lagoon would be proposed for designation as a Special Area. Over the long term, this would result in protection of some terrestrial mammal habitat from development. Kasegaluk Lagoon would be closed to recreational OHV use. In the remainder of the Planning Area, recreational OHV use in the summer would be limited to designated trails. Over the short term, these designations would have no practical effect on terrestrial mammals as virtually no recreational OHV use currently occurs. Over the long term, if recreational OHV use were to increase substantially, having designations in place could reduce conflicts between wildlife and OHV use.

Air traffic, excavation, and the presence of resource inventory survey camps would all be expected to increase somewhat under Alternative B as compared to the No Action Alternative, but would be slightly less in extent than under Alternative A. Impacts would be similar to those under the No Action Alternative, but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from the camps and along aerial survey routes. The disturbance reactions of caribou and other terrestrial mammals would be expected to be brief, lasting for a few minutes to less than 1 hour. Some terrestrial mammals might avoid inventory survey and recreation camps during the 6 to 12 weeks of activities, while bears and foxes could be attracted to the camps by food odors. Impacts from recreation and overland moves would be the same as the No Action Alternative. Current management practices and stipulations attached to land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

(2) Effects of Oil and Gas Activities

Under Alternative B, oil and gas leasing and exploration would be allowed in the Planning Area, with the exception of the Kasegaluk Lagoon Proposed Special Area (Map 16). In addition, stipulations prohibiting permanent oil and gas facilities would be applied to all marine coastal areas, the northeastern portion of the Planning Area surrounding Dease Inlet to south of Smith Bay, major river corridors, and numerous small tracts incorporating large lakes and other aquatic and terrestrial habitats.

(a) Effects of Disturbances

1) Seismic

Two seismic operations would occur in the Planning Area each winter. Impacts to terrestrial mammals would be similar to those discussed under the seismic option of the No Action Alternative but would be greater in frequency and extent. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from seismic camps. The disturbance reactions of caribou and other terrestrial mammals would be expected to be brief. Some terrestrial mammals might avoid seismic camps, while bears and foxes could be attracted to the camps by food odors. The potential for disturbance of hibernating bears would be greater because of the increased level of seismic activity occurring in the Planning Area. A greater number of lemmings and voles could be killed or disturbed by surface vehicles. These impacts would not be expected to be significant on a population level.

2) Exploratory drilling

Under Alternative B, 2 to 24 exploration wells and 6 to 16 delineation wells are projected to be drilled. Impacts to terrestrial mammals would be the same as those discussed under Alternative A, but somewhat less in extent and frequency as less exploration would occur.

3) Oil and Gas Development

Under this alternative, four oil fields are projected to be discovered and developed. Primary effects on terrestrial mammals would come from construction of facilities and related activities such as: roads and pipelines; motor-vehicle traffic; foot traffic near facilities and camps; aircraft traffic; small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou is through disruption of the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas.

a) Caribou

Impacts to caribou would be the same as those discussed under Alternative A, but would be slightly less in extent as fewer fields would be developed. Infrastructure and activities in oil fields could still delay or deflect movements of TLH caribou between coastal insect-relief areas and foraging habitat farther inland. If an oil field or fields were developed near the coast, production pads, pipelines, within-field roads, and other facilities (e.g., housing, airfield, processing plant) could be located within important TLH insect-relief habitat (Map 50). Movements of the TLH caribou from coastal insect-relief areas to foraging areas farther inland during the mosquito season (late June to mid-July) would be adversely affected by pipelines and roads with vehicle traffic. There could be increased energy costs to caribou. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. Impacts to the WAH and CAH would be the same those as discussed under Alternative A.

b) Other Mammals

Impacts on moose, muskoxen, grizzly bears, wolves, wolverines, foxes, and small mammals would be the same as those discussed under Alternative A, but could be less in extent as fewer fields would be developed.

(b) Effects of Spills

Under Alternative B, an estimated 112 small crude-oil spills (averaging 3 bbl in size) and 277 small refined-oil spills (averaging 29 gal) are estimated to occur over the production life of the leases. A maximum of one large spill (500 or 900 bbl) could occur. The extent of environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The general effects of spills on terrestrial mammals would be the same as those discussed under Alternative A, but somewhat less in frequency or extent, as fewer small spills would be anticipated. Impacts from large spills would be the same as under Alternative A.

(3) Effectiveness of Stipulations and Required Operating Procedures

The stipulations for Alternative B are the same as those for Alternative A. They would therefore have the same level of effectiveness as that described under Alternative A.

(4) Conclusion--First Sale

The effects of oil and gas activities on terrestrial mammals would be similar to but somewhat less than those projected under Alternative A. Habitat alteration would include the development of up to four oil fields and a northern pipeline to the TAPS. Some TLH caribou would be expected to be disturbed and their movements delayed along the pipeline during periods of air traffic and construction. Near oil fields, surface, air, and foot traffic would be expected to increase significantly and to displace some terrestrial mammals. If a field were to be developed in critical TLH insect-relief areas, movements of the TLH caribou from coastal insect-relief areas to foraging areas could be adversely affected by pipelines and road corridors. There could be increased energy costs to caribou. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. Spills would be expected to result in the loss of small numbers of terrestrial mammals, but impacts would not be significant on the population level.

(5) Multiple Sales

If several lease sales were to occur under Alternative B, considerably more exploration activity would be expected to occur in the habitat of the TLH and WAH caribou, with up to twice as many exploration wells being drilled. Up to 8 oil fields would be developed and the number of pipeline miles would be slightly less than Alternative A. A southern pipeline route to the TAPS Pump Station 2 could be constructed, resulting in some disruption of CAH caribou. An increase in the number of miles of roads and pipelines with development under multiple sales would be expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect would be expected to persist over the life of the oil fields and could reduce productivity of the TLH. The number of spills, small or large, is not expected to increase. However, the location of the spills could change. Spills in the multiple sales scenario would be expected to have about the same effect on terrestrial mammals and their habitats as under the first sale, but with a higher likelihood of impacts to CAH and WAH caribou, moose, grizzly bears, wolves, and wolverines.

(6) Conclusion--Multiple Sales

Multiple sales under Alternative B would be expected to cause disruption of TLH caribou movements to insect-relief areas along the coast and to also cause some disruption of CAH and WAH caribou. Impacts to grizzly bears, wolves, and wolverines would be higher than under the first sale as development would be located in higher density habitats for these species. When compared to Alternative A, fewer oil fields would be developed, but both the southern and northern pipelines would still be constructed. Impacts would be similar to those discussed under Alternative A, but somewhat less in extent as fewer fields would be developed.

b. Marine Mammals

Under Alternative B, the Kasegaluk Lagoon Special Area would not be made available for oil and gas leasing. No permanent oil and gas structure would be allowed in the lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area, including the Dease Inlet/Admiralty Bay area or Elson Lagoon. Oil and gas exploration and development activities in the northern portion of the Planning Area adjacent to Dease Inlet/Admiralty Bay area and Elson Lagoon would be subject to issue/area-based stipulations. Seven species of nonendangered marine mammals--ringed, spotted, and bearded seals; walruses; polar bears; and beluga and gray whales--commonly occur year round or seasonally in coastal habitats adjacent to the Planning Area. Under Alternative B, some individual polar bears and maybe spotted seals could be exposed to effects from oil and gas exploration and development and from other activities.

(1) Effects of Non-Oil and Gas Activities

Non-oil and gas activities that could affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative B would be similar to those for the No Action Alternative and Alternative A--local and short term, with no significant adverse effects to the marine mammal populations as a whole.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

Some potential noise and disturbance from aircraft traffic and seismic activities could occur along the coast, primarily in the Dease Inlet/Admiralty Bay area and these effects would be expected to be local and short term (generally <1 year).

The primary source of noise and disturbance would come from air traffic along the coast of the Planning Area, specifically from helicopters associated with the projected oil exploration activities. Aircraft traffic (several helicopter round trips/day during exploration centered out of Deadhorse-Prudhoe Bay traveling to and from NPR-A exploration facilities) is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches, respectively, along the coast and to polar bears using coastal habitats.

Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast would not be likely to result in the death or injury of any seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent.

Exploratory drilling would be assumed to occur during the winter (December to mid-April) over about nine years using 1 to 2 drill rigs (Table IV-05). If exploratory drilling activities were to occur near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. In any event, the number of bears lost as a result of such encounters would be expected to be very low.

Although most of the exploration activities would be assumed to occur onshore all across the Planning Area under Alternative B, seals and polar bears could be affected by possible oil exploration offshore drilling from an ice island on the coast of the Dease Inlet/Admiralty Bay area (Map 51, Map 57, Map 58, and Map 59).

(b) Effects of Spills

1) Effects from a Possible Large Onshore Spill

There is an estimated 0 to 33 percent chance of a 500- or 900-bbl pipeline spill occurring under Alternative B Table IV-19. If this spill were to occur near the Dease Inlet area, some of the oil could reach the marine environment. Some of the several hundred spotted seals that congregate in Dease Inlet/Admiralty Bay near the mouths of streams flowing into the inlet could be exposed to the spill. Such an event could result in the contamination and possible loss of a small number of spotted seals (perhaps 10 to 30 seals) from a population of about a thousand animals. The population would likely replace this loss within one year. The 500- or 900-bbl pipeline spill would not be likely to affect many ringed seals, bearded seals, walruses, polar bears, beluga whales, or gray whales because these species tend to occur offshore of Dease Inlet/Admiralty Bay during the summer open-water season and the 500- or 900-bbl spill would be expected to disperse before reaching migration routes and offshore habitats where these species could be exposed to the oil. Few, if any, ringed seals, bearded seals, walruses, polar bears, beluga whales, or gray whales would be likely to be exposed to such a spill and to suffer sublethal or lethal effects. These species' populations would not be affected by this spill.

Little or no significant contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected from a pipeline spill because only a very small amount of oil would be expected to reach feeding areas. A small fraction of the spill (1 to 5%) is expected to be widely dispersed in the water column and to be weathered and degraded by bacteria (USDOI, MMS, 1997:Sec. IV.A.3, *Spilled Oil Fate and Behavior in Marine Waters*). The amount of benthic prey killed or contaminated by the spill would likely be very small and would represent an insignificant proportion of the prey and benthic habitat available to walruses, bearded seals, and gray whales. Thus, the 500- or 900-bbl spill is not likely to have any food-chain effects on marine mammals.

Polar bears would be most vulnerable to a spill if it were to reach the barrier islands from Elson Lagoon to Point Barrow (Map 51). However, the number of bears likely to be contaminated or to be indirectly affected by a local contamination of seals probably would be small. Even in a severe situation, in which a concentration of perhaps 10 bears (such as at a whale-carcass site) were to be contaminated by a 500- or 900-bbl pipeline spill and all the bears died (a worst case), this one-time loss would not be expected to significantly affect the polar bear population of 2,272 to 2,500 bears (USDOI, FWS, 2002).

2) Effects from Small Onshore Spills

A range of 0 to 83 crude-oil spills of < 1 bbl and 0 to 28 crude-oil spills > 1 bbl and < 500 bbl (total volume of 0 to 336 bbl), and 0 to 277 small fuel-oil spills with an average size of 29 gal (less than half a barrel) are estimated to occur onshore under Alternative B for the first sale Tables App 9-07 and App 9-09 small onshore spills are expected to have little effect on seals, walruses, and polar bears. However if some of these spills were to occur in or contaminate streams in the Dease Inlet area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals could be exposed to contamination in nearshore habitats and could suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by any of the spills that were to reach the marine environment during early winter, resulting perhaps in the death of some pups (perhaps 10 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). If some of the spills were to reach the Dease Inlet area during the summer open-water season, some spotted seals that frequent the inlet could be exposed to the oil and could suffer sublethal and possibly lethal effects. Perhaps as many as a few hundred seals could be exposed to the contamination, with heavily oiled individuals suffering lethal effects (perhaps 10 to 30 animals). Smaller numbers of polar bears would be expected to be exposed to and affected by these small spills. The losses of small numbers of seals, and possibly a few polar bears, would not be expected to affect the seal and polar bear populations. These spills are not likely to affect walruses and beluga whales that occur offshore of Dease Inlet.

(3) Effectiveness of Stipulations and Required Operating Procedures

The effectiveness of the stipulations and ROP's under Alternative B is expected to be the same as for those under Alternative A

(4) Conclusion--First Sale

For Alternative B, the effects of activities other than oil and gas on marine mammals--particularly polar bears and spotted seals--along the coast of the Planning Area are expected to be local and to occur within about 1 mi of resource inventory survey activities, survey and recreational camps, and overland moves. The effects of oil and gas activities are expected to result in a small increase in potential noise and disturbance along the coast, primarily in the Dease Inlet-Elson Lagoon Area, and these effects are expected to be local and short term (generally <1 year). Under Alternative B, seals and polar bears could be affected by possible oil exploration offshore of an ice island and subsequent oil development on the coast of the Northwest NPR-A (Map 51, Map 57, Map 58, and Map 59). Effects of these activities would be local and would not be likely to affect marine mammal populations.

A small number of spotted seals (perhaps 10 to 30 animals), and no more than a few polar bears, could be adversely affected or killed by a 500- or 900-bbl crude-oil spill occurring onshore if it were to contaminate Dease Inlet, though these losses would not be significant to marine mammal populations. The effects of Alternative B would be expected to be short term, with no significant adverse effects on marine mammal populations.

(5) Multiple Sales

If several lease sales were to occur under Alternative B, considerably more exploration activity would be expected to occur in the southern and central part of the Planning Area, with the number of exploration wells drilled increasing from 15 (oil at $18/bbl) to 36 (oil at $30/bbl) for multiple sales from the projected 5 ($18/bbl) to 12 ($30/bbl) wells for one sale. The amount of development also would be expected to increase. The number of production pads (12) would double from those for one sale, and pipeline miles would increase to 685 mi for multiple sales from the 205 mi for one sale (Table IV-29). The number of small crude-oil and refined-oil spills however, is estimated to be about the same as under Alternative B for the first sale (Table IV-20). A small increase in potential noise and disturbance effects on marine mammals would be expected along the coast, primarily in the Dease Inlet-Barrow area, and these effects would be expected to be local and short term (generally <1 year).

(6) Conclusion--Multiple Sales

The effect of oil and gas activities under Alternative B with multiple sales is expected to be about the same as for the single sale, but the duration and extent of activities would occur over a longer period of time, as would potential disturbance effects.

11. Endangered and Threatened Species

This section discusses potentially adverse effects of management actions, including oil and gas exploration and development, on endangered and threatened species under Alternative B. Primary effects on bowhead whales would result from disturbance during their semiannual migration past the Planning Area. Primary effects on spectacled eider and Steller's eider exposed to such activities would be: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, staging, or migration periods; 2) alteration of habitats; and 3) effects from pollution of the environment by crude-oil and refined-oil products, wastewater, and solid/liquid wastes of varying toxicity. This analysis assumes stipulations and ROP's (Table II-02) are in place.

a. Consultation Assumptions

In accordance with the ESA Section 7 regulations governing interagency cooperation, the early consultation process was initiated when BLM requested notification from the U.S. Fish and Wildlife Service (FWS) (memorandum dated June 10, 2002) and the National Marine Fisheries Service (NOAA Fisheries) (letter dated June 10, 2002) of the listed and proposed species and critical habitat to be referenced in the memorandum and letter to follow requesting initiation of formal consultation for this project. The FWS responded (memorandum, dated July 24, 2002), specifying the threatened spectacled and Steller's eiders as the species to be included in the IAP/EIS for the Planning Area; and NOAA Fisheries responded (letter, dated July 26, 2002), specifying the endangered bowhead whale as the species to be included. These letters are reproduced in Appendix 10. No critical habitat is located within the Northwest NPR-A Planning Area.

The endangered bowhead whale may occur seasonally adjacent to or in the Planning Area, and the threatened spectacled and Steller's eiders occur seasonally in the Planning Area; each of these species may be exposed to activities associated with the Northwest NPR-A management plan. Sections 4(d) and 9 of the Endangered Species Act (ESA), as amended, prohibit taking of listed species of fish and wildlife without a special exemption. "Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harass" is further defined as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behaviors that include, but are not limited to, breeding, feeding, or sheltering. "Harm" is further defined as an act that may include significant habitat modification or degradation to the point at which it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NOAA Fisheries agreed that the proposed project was unlikely to adversely affect the bowhead whale and found that formal consultation was not required, as noted in their July 26, 2002 letter (Appendix 10). Section 7 consultation with FWS was reinitiated in September 2003 to address the BLM's Preferred Alternative developed for the Final IAP/EIS. Additional and updated information and analysis on the potential impacts of selected factors on spectacled and Steller's eiders can be in the *Biological Assessment for Threatened and Endangered Species with Respect to the Proposed Northwest National Petroleum Reserve-Alaska Integrated Activity Plan* (USDOI, BLM, 2003) prepared for the reinitiation of the Section 7 consultation with FWS.

b. Effects of Non-Oil and Gas Activities

Effects of management actions within the Planning Area on bowhead whales and spectacled and Steller's eiders under Alternative B could include altered distribution, abundance, and/or behavior resulting from disturbance (aircraft, human presence and activity) during breeding, staging, or migration periods and alteration and pollution of eider habitats. On the basis of non-oil and gas activities, effects on eiders could be somewhat greater than those discussed under the No Action Alternative Section IV.B.11 and less than those under Alternative A. The increase over No Action is because several categories of anticipated non-oil and gas activities--including aircraft surveys, duration of camp occupation, and area of ground disturbance--would be increased under Alternative B (Table IV-28) However, the effect of these differences could be lessened if Kasegaluk Lagoon, potentially used by eiders, were to be designated a Special Area and made unavailable for oil and gas leasing. The potential effects described under Alternative A could decrease if Kasegaluk Lagoon were to be designated a Special Area and made unavailable for leasing (no Special Area or wilderness designations are proposed under Alternative A). Alternative B also incorporates more Visual Resource Management areas, limitations on recreational OHV's, and airboat restrictions (which could decrease disturbance) than does Alternative A.

(1) Effects on the Bowhead Whale

Bowhead whales may be present in the Beaufort Sea off the northern Planning Area boundary primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea (Map 64). They may be present in the Chukchi Sea off the western Planning Area in April to early June during their northward spring migration. Under Alternative B, only under the exceptional circumstance of whales migrating near the coast coincident with the presence of barge traffic (or possibly air traffic to supply a shoreline camp), is it likely that bowheads would be disturbed by activities associated with the management plan. For example, in fall of 2000, when median distance of migrating whales offshore was just 11.0 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance from underwater or airborne noise would have existed. Effects from such exposure are likely to be negligible.

(2) Effects on Spectacled and Steller's Eiders

Spectacled eiders are widely distributed on lakes throughout much of the Planning Area in summer (Larned et al., 2001; Ritchie and King, 2002), and are essentially absent from the area from October to May. The highest densities occur in several areas from Dease Inlet west to the Chukchi coast and west of the village of Atqasuk to Peard Bay and Kuk River/Wainwright Inlet (Map 62). Steller's eiders are sparsely distributed in the Planning Area, particularly in the northwest portion between Dease Inlet/Admiralty Bay and the Chukchi coast, and nest attempts apparently are relatively infrequent (Map 62). They are absent from the area from late October to May. Effects of management actions on spectacled and Steller's eiders are likely to be similar to those discussed for other waterfowl species in Section IV.B.9 summarized below.

Most ground transport activities occur in winter and thus would not disturb eiders or affect their habitats. Eiders would likely be displaced from within 700 ft to 0.6 mi of large summer encampments, causing a local decline in nest attempts and success. Under Alternative B, occupation of large camps is anticipated to be 12 weeks (as under Alternative A) rather than 6 weeks as under the No Action Alternative Table IV-28. However, this difference would not likely alter the disturbance effects on birds significantly. The arctic breeding season is so short that individuals that are displaced when the camp would first be occupied probably would not return to the area to renest after 6 weeks (any more than 12 weeks) because of lack of mate availability and insufficient time remaining in either scenario to raise a brood. Also, those individuals that would be tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks. Local eider populations could experience minor declines in breeding success from disturbance in summers when camps are occupied, although this may not be as relevant to Steller's eiders with their scattered distribution. Effects of small, frequently moved camps would likely be negligible; those in place for 6 to 12 weeks could cause minor local loss of nest success and productivity. Overall habitat loss from non-oil and gas activities in Northwest NPR-A under Alternatives A and B is similar and expected to be negligible in its effect on eiders. Predators attracted to camps could decrease breeding success of local eiders. Waste removal and fuel spill cleanup could disturb local nesting or brood-rearing birds for varying periods, resulting in nest failure for those directly involved. Small groups of travelers on the Colville and other rivers at the level anticipated would be expected to cause minimal disturbance of eiders.

Routine air traffic into large camps could cause a range of effects from avoidance of certain areas by eiders to abandonment of nesting attempts or lowered survival of young. Regardless of where they would originate, such flights could pass over areas where eiders occur at higher density. Aerial survey flights for monitoring bird or caribou populations have considerable potential for disturbance of eiders because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects would likely be minimal. Other aerial surveys cover only a small percentage of the Planning Area. For this reason, the increase from 2 weeks under the No Action Alternative to 3 weeks under Alternative B that wildlife surveys would be flown--or increase of other surveys from occasional to several 1 to 2 week periods--is not likely to substantially increase disturbance in any given area (Table IV-28), Likewise, the fact that the aerial survey periods of Alternative B would be of shorter duration than those of Alternative A would not be likely to substantially decrease disturbance effects on eiders. In isolated areas, aircraft effects would likely be negligible; potentially minor effects could occur in the vicinity of large camps. Spills of refined-oil products are likely to be contained and cleaned up before contacting eiders. Quantitative effects resulting from most factors would likely be difficult to separate from natural variation in population numbers.

c. Effects of Oil and Gas Activities

Oil and gas leasing, exploration, and development/production would be allowed throughout the Planning Area except in the Kasegaluk Lagoon proposed Special Area under Alternative B (Map 16 and Table II-01). Making the proposed Special Area (potentially used by eiders) unavailable for oil and gas leasing--as well as a lower level of oil and gas activity (see below)--could result in somewhat lower effects than those discussed under Alternative A, which has no such restriction, and greater effects than for the No Action Alternative under which no oil and gas leasing is allowed. Exploration and development/production activity for the first sale could vary depending on the price per barrel of oil (Table IV-05). Thus, the number of exploration/delineation wells could vary from 5/2 to 12/18 and exploration/delineation rigs from 1 to 3. The number of staging bases projected is 1 to 2, the number of production pads 0 to 6, and 205 mi of pipeline are projected. If only exploration were to occur, activities would be expected to take place over a period of 7 years. If development occurs, activities would be expected to require 10 years. Production is projected to last 22 years. Development in the Planning Area would involve relatively small, interconnected gravel structures.

(1) Effects of Disturbance

(a) Seismic Exploration

Seismic surveys occur during winter months (December-April) when eiders and nearly all bowhead whales are absent from the region. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early-arriving eiders could occur, causing negligible increases in energy use. Because ROP's would require incineration and removal of waste materials generated by seismic crews from BLM lands, this activity is not expected to enhance the survival of predatory arctic foxes.

(b) Oil and Gas Development

Responses to disturbance can be categorized as 1) injury or death, 2) increased energy expenditures that affect physiological condition and rate of survival or reproduction; or 3) long-term changes in behavior, including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect from oil and gas development and production in Northwest NPR-A, although careful planning and scheduling could avoid most serious effects. Depending on location and season, oil and gas activities in areas where eiders occur potentially could cause increased disturbance from routine aircraft operations, gravel-mining operations, presence of gravel pads and facilities, and associated vehicle and foot traffic. Initial developments would likely occur in the extreme northern portion of the Planning Area (generally surrounding the Dease Inlet/Admiralty Bay area) and to Smith Bay and the Chukchi coast. Substantial numbers of spectacled eiders (Map 62) could be affected to some extent by individual disturbance events (e.g., passage of aircraft), although most incidents are expected to result in minor effects from which individuals would recover within hours to one day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially could adversely affect physiological condition, nest success, molt, and survival of individuals. Ultimately this could result in population-level effects although these usually are difficult to separate from natural variation in population numbers. The presence of facilities and construction of gravel structures would result in displacement from favored habitats and associated energy costs that may result in short-term negative effects during breeding, brood-rearing, or migration; however, the footprint of such structures is quite small so effects would not likely be evident at the regional population level.

1) Bowhead Whale

The bowhead whale migration route typically is well offshore (median 32.2 km) of where any oil and gas development would be likely to occur (Treacy, 2002), so it would be unlikely whales would experience intense or frequent disturbance from noise originating from Northwest NPR-A activities that would modify normal behavior.

2) Bird Concentrations

Disturbance effects could be particularly serious in areas where higher densities of spectacled eiders occur. Such areas are 1) west of Dease Inlet; 2) south of Barrow; 3) the southwest-central portion of the Planning Area; and 4) the western Planning Area south of Peard Bay, east of Wainwright, and east of the Kuk River (Map 62). Steller's eiders usually are sparsely scattered across the northern Planning Area (Map 63), with a somewhat greater concentration south of Barrow. Making estuarine areas unavailable for oil and gas leasing under this alternative could decrease the potential for disturbance of post-breeding eiders from aircraft, vessel, and personnel operations in these areas.

3) Air Traffic Effects

Air traffic is likely to be the most important source of disturbance associated with oil and gas development, helicopters being the most disturbing. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992), few comparable studies have been done of effects on other species at other phases of the annual cycle, or long-term effects on populations. Also, it is not known whether eiders and brant are at all comparable in this regard.

Aircraft routinely flying over the areas of higher density in the Planning Area noted above would be likely to cause at least minor effects in the local eider populations. For example, disturbance associated with development in the northern area, where the first is likely to occur, could adversely affect higher concentration areas of both eiders south of Barrow.

4) Structures

The presence of pads, short connecting roads, facilities, and drilling operations would be expected to displace local breeding individuals from the affected site, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals could relocate in nearby comparable habitat as suggested by studies at Prudhoe Bay (Troy and Carpenter, 1990). Such displacements would not be expected to cause long-term effects on population productivity--given the relatively small areas likely to be involved at specific sites (TERA, 1993; Troy and Carpenter, 1990)--but would be a long-term or permanent local result. Overall effect, particularly at the regional level, would likely be negligible. Permanent roads connecting to infrastructure to the east would not be constructed.

5) Gravel

Gravel within the Planning Area would likely be obtained from river drainages and transported to construction sites on ice roads during winter. The result of this activity--habitat burial--would displace any nesting individuals from the local area to undisturbed habitats (up to 50 acres), with potential for lowered productivity. Depending on location and extent of the mine site, overall effects could range from negligible to minor where mining eliminates breeding habitat of the spectacled eider, which is declining at a non-significant rate.

6) Pipelines

The presence of an aboveground pipeline would not be likely to represent a significant collision hazard, since migrating eiders generally fly at much greater altitude, and much movement during the breeding season is by swimming.

(2) Effects of Spills

A 500- or 900-bbl crude-oil spill from a pad or pipeline onto tundra and then into local lakes or other interconnected wetlands could cause mortality of small numbers of eiders, especially during the brood-rearing period later in summer. Numbers of individuals that would be oiled would depend primarily upon wind conditions and numbers and location of birds following entry of the spill into the water. It is likely the above effects would be negligible to minor with regard to the proportion of regional population involved. Because of the oil-absorptive capacity of tundra habitats, even if a spill were to enter a river, only a small proportion would be likely to enter the marine environment. Under Alternative B, almost all of the Northwest NPR-A coastline areas of potentially high eider use could be available for oil and gas leasing. Only in the Kasegaluk Lagoon area--which would be unavailable for oil and gas leasing under this alternative--would any oil spill reaching it have to originate from farther inland. If a spill were to reach a delta area, Elson Lagoon, Dease Inlet, or Chukchi Sea coastal waters, individuals staging before or during fall migration would be at risk, with the potential to elevate effects to a moderate level. This is less likely than under Alternative A, under which no areas would be removed from leasing. However, most spectacled eiders nesting in the western part of the Planning Area would migrate overland directly to Chukchi lagoons, avoiding potential Beaufort spills from the northern part of the Planning Area, but increasing potential exposure in the Chukchi area--unless Kasegaluk Lagoon were to be designated as a Special Area and were to be unavailable for leasing. As a result of their small average size, onshore oil spills reaching aquatic habitats would be expected to cause losses of fewer than 20 individuals, although potentially tens of individuals could be killed by cumulative total mortality from many small spills. The effect of such losses may not be detectable above the natural fluctuations of the population.

Physiological effects of oil on individual birds would be the same as described in the *Northeast NPR-A IAP/EIS* (1998). Lethal effects would be expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects that interfere with the reproductive process caused by oil ingested by adults during preening or feeding. Flocks of staging eiders could contact oil in nearshore or offshore areas. The spectacled eider population has declined 50 percent in 20 years so if substantial mortality were to occur, it could be significant.

d. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate effects on eiders of three types of problems that may result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, and contamination of waterbodies occupied by eiders. No stipulations specifically apply to bowhead whales.

ROP E-6 could mitigate disturbance of breeding eiders by restricting approval of permanent oil and gas facilities--which could include vehicle and aircraft noise and activity on roads and airstrips--to those that would be likely to cause minimal effects within 500 ft of various waterbodies and their floodplains.

ROP F-1 could mitigate aircraft disturbance of eiders by requiring aircraft use be conducted so as to minimize impacts to eiders.

ROP E-6 could reduce the loss (burial) of wetland habitats--important for breeding eiders--by restricting approval for location of permanent oil and gas facilities within 500 ft of the floodplains of various wetlands to those projects that are likely to cause minimal impacts.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die, by requiring storage and fueling to take place in diked and impermeably lined areas at least 100 ft from the active floodplain of non-fish-bearing and 500 ft from the active floodplain of fish-bearing waterbodies.

Stipulation A-3 may prevent spilled fuel from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die, by prohibiting the refueling of most equipment within 500 ft of the active floodplain of fish-bearing waterbodies and 100 ft of the active floodplain of non-fish-bearing waterbodies.

ROP C-1 may prevent spilled fuel from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die, by recommending that refueling of most equipment take place at least 500 ft from the active floodplain of fish-bearing waterbodies and 100 ft from the active floodplain of non-fish-bearing waterbodies.

ROP E-6 may prevent spilled fuel or leaking pipeline oil from entering waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated and die, by restricting approval of permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies to those projects that are likely to cause minimal impacts to wildlife.

These stipulations and ROP's would minimize disturbance of eiders from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a given species' regional population.

e. Conclusion--First Sale

Under Alternative B, disturbance effects of small summer camps would be negligible, though effects could be minor in the vicinity of large summer camps. Disturbance effects of routine oil and gas activities from overland transport of equipment, seismic surveys, and most gravel mining in winter would not occur since eiders are not present. In summer, the effects of air traffic to and from development sites and gravel mining that might eliminate breeding habitat are likely to be minor. Effects from crude-oil spills could range from minor, when confined to terrestrial and freshwater aquatic habitats where mortality would be likely to be relatively low, to moderate if a spill were to enter a nearshore marine staging area. Both disturbance effects and oil spill effects could be somewhat less extensive than for Alternative A as a result of the removal of Kasegaluk Lagoon from oil and gas leasing.

f. Multiple Sales

If multiple sales were to occur under Alternative B, construction activity could last 15 to 30 years, tapering off as existing infrastructure was used for each succeeding development. Under a multiple-sale scenario, depending on the oil price, up to 2 times the number of exploration and delineation wells could be drilled (21 to 72 for multiple sales versus 7 to 30 for the first sale [Table IV-05 and Table IV-07]); the number of fields expected to be developed could increase from 4 to a maximum of 8; and the number of projected production pads could increase from 0 to 6 for a single sale to 0 to 12 for multiple sales (Tables IV-04 and IV-06 and Tables IV-05 and IV-07). Pipeline mileage is projected to increase from 70 mi to 340 mi within the Planning Area and from 205 mi to 685 mi total. Effects from disturbance factors and habitat alteration or loss for each development are likely to be short term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially would be lost to species that were present before development. Surface, air, and foot traffic could increase substantially in some areas if oil field facilities associated with multiple sales were to be grouped in high-resource-potential areas; if these areas were located in higher concentration areas (as appears to be likely south of Barrow), greater numbers of individuals would be expected to be displaced and more species would be expected to be involved than with a single sale. Such effects could alter the populations of these local areas substantially, and effects could extend to regional populations and involve long-term changes in distribution. With multiple developments concentrated in a limited region, effects could be elevated to a moderate level.

The estimated number of onshore oil spills of size $\geq$500 bbl is expected to stay constant (i.e., 0 at $18/bbl, 1 at $30/bbl) regardless of lease program format (single sale or multiple sales) (Table IV-17). Also, the numbers and volume of small crude- or refined-oil spills, projected under the first sale scenario would be expected to remain constant for multiple sales. These small chronic spills generally are contained and cleaned up on pads and roads. Habitat contamination would be expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that was not effectively cleaned up would be likely to persist for several years, but would be expected to result in negligible to potentially minor effects. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

g. Conclusion--Multiple Sales

Displacement of eiders by disturbance and habitat alteration or loss is expected to increase substantially if development and production facilities were to be located in a limited region with higher resource potential (i.e., northern Planning Area). This also could occur in several portions of the Planning Area if multiple sales were held --potentially altering local populations in these areas--and effects could extend to the regional population and involve long-term changes in distribution. Although most effects that would be likely to occur throughout the Planning Area are expected to be short term and negligible or minor, moderate effects could occur if eider concentration areas were to be involved. Increases in crude-oil and refined-oil spills could result in the loss of substantial numbers of individuals, but these losses and recovery of cumulative lost productivity and recruitment might not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect could increase substantially from that discussed for the first sale if developments were relatively concentrated in a limited area.

12. Economy

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities under Alternative B would be the same as those discussed under Alternative A.

b. Effects of Oil and Gas Activities

The effects of oil and gas activities under Alternative B would be the same nature as those discussed under Alternative A, but slightly less. For a discussion of the effects of oil and gas activities on the economy see Section IV.C.12. The first Alternative B lease sale would generate economic activity primarily in revenues to government, employment, and personal income. The economic effects would be in the North Slope Borough (NSB), South Central Alaska, and Fairbanks.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's under Alternative B would not alter the economic effects.

d. Conclusion--First Sale

The economic effects of oil and gas activities resulting from the first sale under Alternative B would be 10 percent less than those under Alternative A.

e. Multiple Sales

The effect of multiple sales for Alternative B would likely heighten the economic effect in any given year, as exploration, development, and production resulting from subsequent lease sales occur in the same years. Multiple sales would lengthen the period of economic impact as lives of new fields extend beyond those field resulting from the earliest lease sales.

f. Conclusion--Multiple Sales

The economic effects of oil and gas activities resulting from the first sale under Alternative B multiple sales would be 10 percent less than that for Alternative A multiple sales.

13. Cultural Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative B, the type of non-oil and gas activities would be the same as they are under the No Action

Alternative; however, the level and duration of activity could increase by as much as a factor of 3 over the No Action Alternative. This means there would be a greater likelihood of impacts on cultural resources under this alternative than under the No Action Alternative, though impacts would still be minimal and less than under Alternative A.

b. Effects of Oil and Gas Activities

Under Alternative B, the level of seismic activity would be expected to increase beyond that of the No Action Alternative because most of the Northwest NPR-A Planning Area would be open for oil and gas exploration, increasing lessees' need for additional seismic data. While the types of potential impacts to cultural resources would be the same in Alternative B as those described in the No Action Alternative, the level of seismic activity would increase the possibility that impacts could occur. While the level of seismic activity for Alternative B would probably be about the same as for Alternative A, the levels of other oil and gas activities would be somewhat reduced because Alternative B is slightly more environmentally restrictive than Alternative A. However, the level of oil and gas activity would remain relatively high; in most instances (as described in Alternative A) any impacts that do occur would not be expected to be significant.

Cultural resources are not ubiquitous in the Planning Area, as are wildlife and habitat. Although cultural resources, because of their near-surface and surface contexts (as well as other factors), are more common than paleontological deposits, they are also more easily recognized and avoided. Because in most cases oil and gas activities could be conducted so as to avoid the locations of cultural resources, it is quite possible that oil and gas exploration or development activities would have limited impact on cultural resources.

(1) Effects of Disturbances

Under Alternative B, the level of oil and gas activity in the Planning Area would probably be slightly reduced from that of Alternative A. Because most of the activity would occur during the winter months, the potential for impact to buried cultural resources would remain relatively low. The likelihood of impacting surface cultural materials would also be low because of their isolated occurrence and because of stipulations governing oil and gas exploration activities in the areas in which they are most likely to occur.

The drilling of as many as 12 exploration wells and 18 delineation wells is projected to occur under Alternative B. However, because of the limited availability of drill rigs, no more than a few wells would be expected to be drilled at one time. If the projected maximum of 30 wells were to be drilled, drilling would certainly occur over the span of several winter seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips that require gravel or rock would be constructed during exploration, no significant disturbance of the ground would occur from gravel and rock extraction and emplacement, and buried cultural resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of the actual drilling would be the creation of the drill hole itself. It is possible that drilling the hole could impact important accessible cultural material, but the likelihood of that occurrence is minuscule.

Disturbance from development--the construction of as many as six production pads (connected by roads), one airstrip, one pump station, one staging base and approximately 205 mi of pipeline--could occur under Alternative B. Surface disturbance resulting from this work would impact approximately 200 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to cultural resources would result from the excavation of material for construction of the permanent facilities. If the pads/roads/airstrip material source were terrestrial, then extraction of material could impact cultural resources. Pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of VSM's. Depending on the depth at which the VSM's are set, it is possible (though highly unlikely) that buried cultural resources would be impacted. If buried pipelines were to be used, disturbance and impacts to paleontological resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline.

(2) Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than in a summertime terrestrial spill and resulting impacts to cultural resources would be minimal, if they occurred at all. Surface cultural resources would be more at risk than would those in a subsurface context. The effects of spills and spill cleanup associated with development could have a greater effect on both surface and subsurface cultural resources because they could occur during the snow-free months when cleanup procedures are more invasive.

c. Effectiveness of Stipulations and Required Operating Procedures

Under Alternative B, stipulations C-1b and E-1, and ROP C-1c would apply to cultural resources. These stipulations would provide protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact cultural resources that are near the surface. In addition, stipulations A-1, A-2, and A-3, and ROP's A-6 and E-1 would help to prevent large fuel or crude-oil spills, and consequently would reduce the small potential for impacts to cultural resources from spill cleanup. The NHPA requires that an archaeological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities, such as the construction of buried pipelines, would be considered undertakings. If cultural resources were to be identified during the survey, Federal law requires that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office. Any post-lease activity engaged in by a lessee would require an action/site-specific NEPA document. In that event, the protection of cultural resources in the Planning Area would follow the established and proven permitting procedures developed by the BLM as the result of past NPR-A activities.

d. Conclusion--First Sale

Under Alternative B, impacts to cultural resources from management activities other than oil and gas exploration and development would include displacement and/or destruction of resources and are anticipated to be minimal regardless of the level of seismic activity. Under Alternative B, the potential impacts to cultural resources from first sale oil and gas exploration and development would be slightly reduced from those in Alternative A because of the increased environmental constraints. These constraints would benefit cultural resources because of the high probability of cultural resources being located near lakes, stream and rivers, which are afforded more protection from oil and gas exploration under Stipulation E-1. In addition, because less land would be available for oil and gas leasing under Alternative B, there is less chance of impact to buried or surface cultural resources.

e. Multiple Sales

Under Alternative B, which would offer less area for leasing than Alternative A, the potential for impacts to cultural resources would be slightly less. While the scattered nature of cultural deposits and the fact that the locations of most remain unknown--making it somewhat difficult to assess the likelihood and severity of potential impacts--the environmental constraints present in Alternative B would be expected to further reduce potential impacts.

f. Conclusion--Multiple Sales

Under Alternative B, impacts to cultural resources from management activities other than oil and gas exploration and development should be slightly less than the probabilities given for Alternative A. For oil and gas exploration and development, the potential for impacts to cultural resources should also decrease slightly when compared to Alternative A.

14. Subsistence-Harvest Patterns

Under Alternative B, the Kasegaluk Lagoon Special Area would not be available for oil and gas leasing. No permanent oil and gas structures would be allowed in the lagoons and estuaries along the coast of the Northwest NPR-A Planning Area, including Dease Inlet/Admiralty Bay area or Elson Lagoon. Oil and gas exploration and development activities in the northern portion of the Planning Area adjacent to Dease Inlet/Admiralty Bay area and Elson Lagoon would be subject to issue/area-based stipulations.

Exploration and development/production activity for the first sale would vary depending on the per barrel price of oil. Thus, the number of exploration/delineation wells could vary from 5/12 to 12/18 and exploration/delineation rigs from 1 to 3. The number of projected staging bases is 1 to 2, the number of projected production pads is 0 to 6, and there are projected to be 205 mi of pipeline. If only exploration were to occur, activities would be expected to take place over a period of 7 years. If development also occurs, activities would be expected to require 10 years. Production is projected to last 22 years. Any development in the Planning Area would be expected to involve relatively small, interconnected gravel structures.

a. Effects of Non-Oil and Gas Activities

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from non-oil and gas activities under Alternative B on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) were analyzed earlier in this section (Sec. IV.D) and are summarized below.

The fall and winter harvest seasons are times when subsistence resources are available well past coastal areas and rivers accessible in the summer. Winter allows access to an expanded harvest area for ungulates and furbearers and can lead to greater potential industry and hunter contact and consequent disruption of harvest activities. Winter also is a time when wildlife are more vulnerable to natural environmental stresses limited forage, severe cold, high winds, and compacted snow cover. The effects on certain subsistence resources and their harvest from stresses produced from seismic activities may actually be more pronounced during winter.

Non-oil and gas activities would be expected to increase somewhat under Alternative B as compared to the No Action Alternative, but to be slightly less than those projected under Alternative A. A greater number of individual animals would likely be exposed to human activities than under the No Action Alternative. Disturbance reactions of caribou and other terrestrial mammals would be expected to be brief, lasting for a few minutes to less than 1 hour. Some terrestrial mammals may avoid inventory survey and recreation camps during the 6 to 12 weeks of activities, while bears and foxes may be attracted to the camps by food odors. Impacts from recreation and overland moves would be the same as the No Action Alternative. Over the long term, designation of Kasegaluk Lagoon as a Special Area would result in protection of some terrestrial mammal habitat from development.

Non-oil and gas activities would not be likely to have a measurable effect on arctic and marine fishes.

Effects on birds under Alternative B would be expected to be about the same as those discussed under Alternative A.

No significant adverse effects on marine mammal populations as a whole would be expected from non-oil and gas activities under Alternative B. Only under exceptional circumstances--when whales migrate near the coast coincident with the presence of barge traffic (or possibly air traffic)--would it be likely that bowhead whales would be disturbed by non-oil and gas activities; such effects would be negligible.

b. Effects of Oil and Gas Activities

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from oil and gas exploration and development activities under Alternative B on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) were analyzed earlier in this section (Sec. IV.D) and are summarized below.

(1) Effects of Disturbance

Impacts to terrestrial mammals from seismic surveying under Alternative B would be similar to those discussed under the seismic option of the No Action Alternative but would be greater in frequency and extent. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals; the disturbance reactions of caribou and other terrestrial mammals are expected to be brief. Some terrestrial mammals may avoid seismic camps while bears and foxes may be attracted to the camps by food odors. The potential for disturbance of hibernating bears under Alternative B would be greater than for the No Action Alternative because of the increased level of seismic activity. A greater number of lemmings and voles could be killed or disturbed by surface vehicles. These impacts would not be expected to be significant on a population level.

Seismic surveys associated with Alternative B would be expected to have the same overall effect on arctic and marine fish as discussed for the No Action Alternative (i.e., no measurable effect).

Camps supporting seismic surveys would be likely to be occupied for only brief periods and when wintering bird species are present in low densities, thus disturbance incidents would be likely to be few and of short duration

Most of the Planning Area would be open for leasing and development under Alternative B. Under Alternative B, 5 to 12 exploration wells and 2 to 18 delineation wells are projected to be drilled. Exploratory drilling is assumed to occur during the winter (December to mid-April) over about 9 years using 1 to 2 drill rigs. Four oil fields are projected to be discovered and developed.

Impacts to terrestrial mammals would be the same as those discussed under Alternative A though somewhat less in extent and frequency as less exploration would occur and fewer fields would be developed. Primary effects on terrestrial mammals would come from: construction of facilities; motor-vehicle traffic; foot traffic near facilities and camps; aircraft traffic; spills contaminating tundra, stream, and coastal habitats; and habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou would be through disruption of the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas. Pipelines, roads with vehicle traffic, and infrastructure and activities in oil fields could still delay or deflect movements of TLH caribou between coastal insect-relief areas and foraging habitat further inland. There could be increased energetic costs to caribou. Impacts to the WAH and CAH would be the same as discussed under Alternative A. Impacts to moose, muskoxen, grizzly bears, wolves, wolverines, foxes and small mammals would be the same as discussed under Alternative A but could be less in extent.

Potential impacts to fish from water withdrawal would likely be reduced from Alternative A to Alternative B. Impacts to arctic and marine fish populations from Alternative B activities would be expected to be similar to those described under Alternative A, with no measurable effect on arctic or marine fish populations.

Making the Kasegaluk Lagoon Special Area unavailable for leasing would remove only a small proportion of the higher density areas for Pacific loon, white-fronted goose, and long-tailed duck and would not be likely to result in significant reduction of effects where most potential effects already are quite low. Under Alternative B, overall effects of routine oil and gas activities at the regional population level would likely be negligible for most activities and species, but could be elevated to minor for species that are uncommon, decreasing, or recently declined. Effects of air traffic and gravel mining would be likely to remain at the minor level.

Some potential noise and disturbance from aircraft traffic and seismic activities could occur along the coast, primarily in the Dease Inlet/Admiralty Bay area, and these effects would be expected to be local and short term (generally <1 year). The bowhead whale migration route typically is well offshore. It is unlikely that whales would experience intense or frequent disturbance from noise originating from Northwest NPR-A activities that would modify their normal behavior. Aircraft noise would be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches along the coast and to polar bears using coastal habitats. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast would not be likely to result in the death or injury of any seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals if disturbances were frequent.

Seals and polar bears could be affected by exploration drilling if it occurred offshore from an ice island on the coast of the Dease Inlet/Admiralty Bay area. If exploratory drilling activities were to occur near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears might be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the operators would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. The number of bears lost as a result of such encounters would be expected to be very low.

(2) Effects of Oil Spills

Under Alternative B, an estimated 112 small crude-oil spills (averaging 3 bbl in size) and 277 small, refined-oil spills (averaging 29 gal) are assumed to occur over the production life of the fields in the Planning Area. A maximum of one large spill (500 to 149,999 bbl) is estimated to occur under alternative B (the same as for Alternative A). The extent of environmental impacts on subsistence species would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. There would be a reduction in probability of spill occurrence in coastal waters because permanent facilities would not be allowed in these waters. These stipulations would also reduce the chance of spilled oil entering aquatic habitats.

The overall effects of spills on terrestrial mammals, artic fish, and marine fish would be the same as discussed under Alternative A though somewhat less in frequency and extent. The additional protective measures could reduce spill effects in marine waters or river delta areas where concentrations of loons, waterfowl, shorebirds, or other bird species occur to below the moderate level. Few if any ringed seals, bearded seals, walruses, polar bears, beluga whales, or gray whales would be likely to be exposed to spills or to suffer sublethal or lethal effects. The amount of benthic prey killed or contaminated by spilled oil would likely be very small and represent an insignificant proportion of the prey and benthic habitat available to walruses, bearded seals, and gray whales.

Seawater spills would be expected to have the same effects under Alternative B as described under Alternative A.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations for Alternative B are the same as Alternative A and would therefore have the same level of effectiveness as described under Alternative A.

d. Conclusion--First Sale

The overall effects of oil and gas activities under Alternative B on subsistence resources and harvest patterns would be expected to be the same or less than Alternative A. Effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals would be expected to range from negligible to local and short term (generally <1 year), and to have no regional population effects.

If a field were to be developed in a critical Teshekpuk Lake caribou herd (TLH) insect-relief area, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect relief areas could be disrupted, with unknown levels of effects on the productivity of the herd. Effects from crude-oil spills on birds could range from minor, when confined to terrestrial and freshwater aquatic habitats where the mortality of few waterfowl, shorebirds, raptors, and passerines is likely to be relatively low, to moderate if a spill were to enter a river delta or nearshore marine habitat occupied by loons, large numbers of seaducks whose populations have declined, black guillemots, or Ross' gulls.

Subsistence-harvest patterns effects are expected to be the same or somewhat less than Alternative A, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and even with one fewer field being developed under Alternative B, moderate to high effects could still be expected on the productivity of TLH if development were to take place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects as one or more important subsistence resources would then have become unavailable, undesirable for use, or experienced reduced availability for a period greater than 2 years.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

e. Multiple Sales

For multiple sales under Alternative B, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals would still be expected to be local and short term (generally <1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, the TLH would see population effects and reduced productivity under the multiple sale scenario, some birds--with limited habitat, limited tolerance to disturbance, or declining populations--could experience long-term population effects, and there would be a small increase in potential noise and disturbance effects on marine mammals along the coast, primarily in the Dease Inlet-Barrow Area. Excluding Kasegaluk Lagoon from oil and gas leasing would reduce potential disturbance from exploration and development to subsistence hunters and practices near Point Lay and Wainwright.

Effects on subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. But with more development taking place and with a potential southern pipeline route to the TAPS Pump Station 2 being constructed, some disruption of CAH caribou during migration would be expected. A second gas pipeline from the southern part of the planning area would be constructed to Prudhoe Bay. The increase in the number or miles of roads and pipelines that would accompany development under multiple sales would be expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect would be expected to persist over the life of the project and could reduce productivity of the TLH. This level of effect on caribou would elevate expected effects on community subsistence-harvest patterns to high or very high effects, since one or more important subsistence resources would then have become unavailable, undesirable for use, or have experienced population reductions for a period up to 5 years or longer.

f. Conclusion--Multiple Sales

For the multiple sales under Alternative B, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally less than 1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor. But if caribou were to experience these population effects, the effects on community subsistence-harvest patterns would increase to high or very high, since one or more important subsistence resources would have become unavailable, undesirable for use, or have experienced population reductions for a period up to 5 years or longer.

15. Sociocultural Systems

This discussion is concerned with those communities in and adjacent to the Northwest NPR-A that could be impacted by ground-management actions within the Planning Area: Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. Under Alternative B, the Kasegaluk Lagoon Special Area would not be open to oil and gas leasing. No permanent oil and gas structures would be allowed in the lagoons and estuaries along the coast of the Northwest NPR-A Planning Area, including Dease Inlet/Admiralty Bay area or Elson Lagoon. Oil and gas exploration and development activities in the northern portion of the Planning Area adjacent to Dease Inlet/Admiralty Bay area and Elson Lagoon would be subject to issue/area-based stipulations.

The primary aspects of the sociocultural systems that could be impacted are 1) social organization, 2) cultural values, and 3) social health as described in Section III.C.4. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative A (Sec. IV.C.15).

a. Subsistence Resources and Subsistence-Harvest Patterns

The overall effects of oil and gas activities under Alternative B on subsistence resources and harvest patterns are expected to be the same or less than Alternative A. Effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally <1 year), and to have no regional population effects.

If a field were to be developed in critical Teshekpuk Lake herd (TLH) caribou insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect-relief areas could be disrupted, with unknown levels of effects on the productivity of the herd. Effects on birds from crude-oil spills could range from minor, when confined to terrestrial and freshwater aquatic habitats where the mortality of few waterfowl, shorebirds, raptors, and passerines would be likely to be relatively low, to moderate if a spill were to enter a river delta or nearshore marine habitat occupied by loons, large numbers of seaducks whose populations have declined, black guillemots, or Ross' gulls.

Subsistence-harvest patterns effects would be expected to be the same or somewhat less than those of Alternative A, with subsistence resources being periodically affected, but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and even with one fewer field being developed under Alternative B, moderate to high effects could still be expected on the productivity of TLH if development were to take place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects, since one or more important subsistence resources would then have become unavailable, undesirable for use, or have experienced reduced availability for a period greater than 2 years.

b. Effects on Subsistence Communities

Effects on the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-impacting activities, small oil spills, and exploration and development would be expected to be minor, with subsistence resources being periodically affected, but with no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects as one or more important subsistence resources would then have become unavailable, undesirable for use, or have experienced population reductions for a period greater than 2 years.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulation E-1 would prohibit permanent oil and gas facilities within and adjacent to waterbodies with identified subsistence values. Identified areas are on the Ikpikpuk, Alaktak, Chipp, Oumalik, Titaluk, Kigalik, Topagoruk, Meade, Inaru, Kugrua, Kuk, Alataktok, Ivasaruk, Kaolak, Ketik, Avalik, Kungok, and Colville Rivers, as well as Maybe Creek, fish-bearing, deep-water lakes, and important habitat on productive bays and lagoons, particularly Kasegaluk Lagoon, the mouth of the Kuk River, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay. Stipulation H-1 would specify that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP-H-1 would direct the lessee to develop and implement a plan, in consultation with the Research and Monitoring Team and the SAP, to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area. Specifically, the program is designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel will be working, with the intent of reducing any potential conflicts with subsistence.

d. Conclusion--First Sale

Effects would be the same or slightly reduced from Alternative A. As most subsistence resources would be expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. If development were to occur in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would elevate from low to moderate or high as one or more important subsistence resources would then have become unavailable, undesirable for use, or have experienced population reductions for a period greater than 2 years.

Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and development activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Altogether, subsistence-related effects periodically could disrupt--but not displace--ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. It is expected that designation of Kasegaluk Lagoon as a Special Area would be resisted by the communities of Point Lay and Wainwright as potentially too restrictive on traditional travel and subsistence hunting practices.

e. Multiple Sales

For the multiple sales under Alternative B, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowheads whales, beluga whales, and other marine mammals would still be expected to be local and short term (generally <1 year), and to have no regional population effects--the same effects levels expected for a single sale. Some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. With increased effects anticipated on TLF caribou, elevated effects would be expected on these communities, because this important subsistence resource would then have become unavailable, undesirable for use, or have experienced population reductions for a period up to 5 years or longer.

f. Conclusion--Multiple Sales

Anticipated subsistence-related effects could cause chronic disruption of sociocultural systems for a number of years and although traditional practices for the harvesting, sharing, and processing of subsistence resources could be disrupted, subsistence impacts would not be expected to displace existing institutions or ongoing social systems.

16. Environmental Justice

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by activities in the Northwest NPR-A Planning Area and Alternative B. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and potential effects could affect subsistence resources and harvest practices. Potential effects--from noise, disturbance, and oil spills--on subsistence resources and practices and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. For a detailed discussion of effects of oil and gas activities on Environmental Justice see the Environmental Justice analysis for Alternative A (Sec. IV.C.16.) and the cumulative analyses for subsistence-harvest patterns and sociocultural systems (Sec. IV.F.8.n and Sec. IV.F.8.o).

a. Effectiveness of Stipulations and Required Operating Procedures

See Section IV.C.16 for a detailed discussion of Environmental Justice mitigation.

b. Conclusion--First Sale

The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. The analysis indicates that the only substantial source of potential environmental justice-related effects on Native villages from the Northwest NPR-A Planning Area development under Alternative B would occur from long-term population and productivity effects on the Teshekpuk Lake herd (TLH) caribou from development in critical insect-relief habitat. Disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--all communities that harvest caribou from the TLH.

c. Multiple Sales

The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. The analysis indicates that the only substantial source of potential environmental justice-related effects on the Native villages from the Northwest NPR-A Planning Area development under Alternative B would occur from long-term population and productivity effects on TLH caribou from development in critical insect-relief habitats.

d. Conclusion--Multiple Sales

The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. The analysis indicates that the only substantial source of potential environmental justice-related effects on the Native villages from the Northwest NPR-A Planning Area development under Alternative B would occur from long-term population and productivity effects on the TLH from development in critical insect-relief habitat. Disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--all communities that harvest caribou from the TLH.

17. Coastal Zone Management

For Alternative B, the proposed Kasegaluk Lagoon Special Area would not be available for leasing and no permanent oil and gas facilities would be allowed either in the Special Area or--excepting two right-of-way sites to be designated at Peard Bay and near Wainwright--in the coastal bays and lagoons (including islands in those bays and lagoons) identified on Maps 16 and 17. Stipulations and ROP's (Section II.C.6) would place further restrictions on the siting of permanent oil and gas facilities around lakes, rivers, and important habitat. Offshore exploratory drilling would only be allowed in winter in the coastal bays and lagoons from bottom-fast ice pads, natural islands, and human-made gravel islands. Protective measures include: 1) applying relevant stipulations and ROP's (Section II.C.6); 2) recommending that the Kasegaluk Lagoon area be designated a Special Area; 3) limiting recreational OHV use in portions of the Planning Area; 4) restricting use of airboats; and 5) identifying VRM areas. Additional protection may be introduced following future site-specific NEPA analysis.

The NPR-A Federal lands are excluded from the coastal zone, as noted in the introductory section of the No Action Alternative Sec. IV.B.17. However, Section 307(c)(3)(B) of the Federal Coastal Zone Management Act requires that applicants for Federal permits include as part of their application a certification that activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone will be conducted consistent with the State's coastal management program. The State may concur or object to an applicant's certification. The following analysis is based on the hypothetical scenarios developed for proposed oil and gas activities in the NPR-A and for the non-oil and gas activities that might occur. At the time that future site-specific plans are submitted for any activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone, the applicant would be required to submit a consistency certification to the State.

a. Effects of Non-Oil and Gas Activities

Under Alternative B, the type of non-oil and gas activities would be the same as they are for the No Action Alternative; only the level of activity and duration would change. Effects related to coastal zone management remain the same as those for the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

The types of activities and related disturbances for Alternative B are the same as they are for Alternative A. Only the number of activities would change. It is projected for this alternative that the drilling of 5 to 12 exploration wells and 2 to 18 delineation wells could occur. These could require up to 6 production pads and up to 205 mi of pipeline if exploration resulted in development and production.

Kasegaluk Lagoon and the adjacent onshore area would be unavailable for leasing, several areas would have restricted uses with no permanent facilities allowed, and issue- and area-based stipulations would apply to several of the marine and most of the estuarine and riverine coastal areas (Map 16). Although under this alternative a portion of the Planning Area would be unavailable for oil and gas leasing and additional stipulations would apply to specified areas, all proposed activities would still be subject to the ACMP standards and the district enforceable policies if they have reasonably foreseeable effects on the coastal resources and uses of the coastal zone. All activities in this category would be reviewed by the State for consistency with the ACMP standards and the enforceable policies of the NSB CMP. The analysis for Alternative A remains relevant for Alternative B. No permit can be issued for activities having reasonably foreseeable effects on coastal resources or uses of the coastal zone until the State concurs or the Secretary of Commerce overrides the State's objection.

(2) Effects of Spills

The analysis in Alternative A for "Effects of Spills" (Section IV.C.17.b.2) is also relevant to Alternative B. The number of spills hypothesized for Alternative B is proportionately smaller, but the potential for effects to coastal zone management remain the same. The effects of small spills are expected to be minor and localized. Given the mitigating measures addressing prevention and response, no conflicts with any of the statewide standards or district enforceable policies are anticipated. A large spill would be accidental and very unlikely.

c. Effectiveness of Stipulations and Required Operating Procedures

The discussion of the "Effectiveness of Stipulations and Required Operating Procedures" for Alternative A (Section IV.C.17.c) is relevant to Alternative B. However, Alternative B includes an additional stipulation over those listed for Alternative A. Stipulation E-1 identifies specific areas important for subsistence, wildlife habitat, cultural/paleontological, and traditional/cultural land uses (Map 84) and the possible imposition of additional restriction in these areas based on further investigation of the specific area identified in a plan. This stipulation provides additional protections to the listed uses and resources and further reduces any potential for conflict with the ACMP.

d. Conclusion--First Sale

There are no inherent conflicts with the ACMP standards or the enforceable policies of the NSB CMP. With mitigating measures and regulatory oversight, it would be possible to comply with all of the standards and policies relevant to oil and gas activities that have reasonably foreseeable effects on the coastal resources or uses of the coastal zone. Applicable policies would be more precisely addressed when specific proposals are brought forward by lessees. All plans that may have reasonably foreseeable effects must be accompanied by a consistency certification for State review and concurrence. No permit would be issued for activities having reasonably foreseeable effects unless the State concurs or the Secretary of Commerce overrides the State's objection.

e. Multiple Sales

Although the duration and extent of activities would increase, the type of activities would remain the same. For multiple sales, it is projected that from 15 to 36 exploration wells and 6 to 36 delineation wells would be drilled, and up to 12 production pads and up to 685 mi of pipeline might be required. The level of activities does not change the applicability of the relevant policies of the ACMP and the district program; they remain the same whether one or more sales are held. Applicable policies would be addressed at the time specific proposals are submitted to BLM for approval. No permit would be issued for activities having any reasonably foreseeable effect on coastal uses or resources of the coastal zone unless the State concurs or the Secretary of Commerce overrides the State's objection.

f. Conclusion--Multiple Sales

The potential for conflict with the statewide standards of the ACMP and the enforceable policies of the North Slope Borough Coastal Management Program are the same as those for a single sale. No conflicts are anticipated.

18. Recreation Resources and Wilderness

a. Effects of Non-Oil and Gas Activities

The nature of impacts from non-oil and gas activities under Alternative B would be the same as under the No Action Alternative. However, certain activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature, as described under the No Action Alternative, but the total area impacted could increase to 1,000 acres (one additional camp) from 500 acres in No Action Alternative.

Although the amount of supplies and material transported by winter overland moves may increase under this Alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails (see Visual Resources) is expected to noticeably increase from the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

The types of oil and gas exploration activities that occur under Alternative B would be similar to those under Alternative A. However, the level of some of these exploration activities would decrease as compared to

Alternative A (i.e., there would be one less seismic-survey operation under this Alternative than under Alternative A), the number of exploration/delineation wells drilled would decrease from 8 to 7 (5 exploration and 2 delineation) with oil at $18/bbl and 40 to 30 (12 exploration and 18 delineation) with oil at $30/bbl. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under the No Action Alternative to 1,000 acres affected under Alternative B. However, this represents a decrease of 500 acres from Alternative A. The area that could be impacted during drilling operations (winter only) would decrease from approximately 64,000 acres under Alterative A to 56,000 acres under Alternative B with oil at $18/bbl or from 320,000 acres to 240,000 acres with oil at $30/bbl. Accumulating summer season impacts to the area's naturalness from the greening caused by ice pads, roads, and airstrips would decrease from about 400 acres (under Alternative A) to 350 acres (under Alternative B), with oil at $18/bbl and from 2,000 acres (under Alternative A) to 1,500 acres (under Alternative B) with oil at $30/bbl. Linear green trails also would be visible from the air as a result of seismic operations; the number of miles visible would decrease from Alternative A in direct relationship to decrease in seismic operations (see Visual Resources Sec. IV.D.20).

(b) Development

The types of oil and gas development activities that would occur under Alternative B are the same as described under Alternative A, however the level of development would be less. Assuming oil prices up to $30 (gas prices up to $4.27), as many as 6 production pads, a pump station, up to 205 mi of pipeline, and 2 staging areas could be constructed. Accordingly, there could be a long-term loss of solitude, naturalness, or primitive/unconfined recreation over an area of up to approximately 203,200 acres ([8,000 acres/pad x 6 pads] + [8,000 acres/staging area x 2 staging areas] + [8,000 acres/pump station] + [640 acres/mi x 205 mi of pipeline]).

(2) Effects of Spills

The effects of spills would be the same as described for Alternative A.

(3) Effects to Wilderness Values

Impacts to wilderness values of naturalness and outstanding opportunities for primitive recreation or solitude would be as described above and in the Visual Resources section. Under this alternative, no area would be protected by wilderness designation.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-2 and A-3 under Waste Prevention, Handling, and Disposal and Spills would greatly increase the protection of wilderness and recreation resources. These stipulations would help reduce, if not eliminate, the possibilities of larger fuel spills in pristine areas, or areas that can ill afford any type of fuel spill. These two stipulations would not unduly restrict recreationists from using the area resources for their endeavors and yet would adequately protect these same resources from being impacted from fuel spills. In addition to the above stipulations, ROP's A-1 and A-2, dealing with the handling of garbage, would help protect the area's recreation/wilderness resources as well as the users.

Other stipulations and ROP's that would benefit the recreation/wilderness resources and users of the area are stipulations C-1 (benefit for wilderness values only) and ROP's A-5 and A-8 (benefit for both recreation and wilderness values) and E-8 and F-1 (benefit for wilderness values only).

d. Conclusion--First Sale

As compared to the No Action Alternative, there would be an increase of approximately 1,000 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative A, short-term impacts from ongoing oil and gas exploration activities would decrease from approximately 64,000 acres to 56,000 acres with oil at $18/bbl and from 320,000 acres to 240,000 with oil at $30/bbl.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation over very few acres with oil at $18/bbl; however, if oil should go to $30/bbl, the long-term loss would be an area of approximately 203,200 acres (or 2.2% of the Planning Area) for the life of production fields and pipelines, as compared to 235,200 acres under Alternative A.

e. Multiple Sales

It is assumed that additional lease sales under Alternative B would result in additional 0 to 4 oil/gas fields developed; exploratory well numbers would increase, as would delineation wells. An additional 480 mi of pipeline in and east of the Planning Area to the Kuparuk oil field would be added. Total pipeline mileage for new oil, gas, and service lines could reach 685 mi, of which 340 mi would be new oil and gas pipelines in the Northwest NPR-A (Table IV-29).

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. At $18/bbl for oil, there would be no production pads, no pipeline miles, and no staging areas and therefore, no real facility increase over that needed for a single sale. However, if oil were to reach $30/bbl, the affected area would total up to approximately 273,600 acres ([8,000 x 6 pads] + [8,000 x 1 staging area] + [640 acres x 340 mi of new oil and gas pipeline]). Some of the pipeline would be outside the Planning Area. The length of pipeline within the Planning Area is projected to be 340 mi, the length outside the Planning Area is projected to be 345 mi (Table IV-29).

f. Conclusion--Multiple Sales

Long-term impacts would be about the same as those of the first sale. Should oil sell for $30/bbl (2002$), long-term impacts would accumulate and increase about 41 percent over those for the first sale and affect a total of 494,400 acres. Approximately 273,000 would be within the Planning area, about 3.4 percent of the Planning Area.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are considerably reduced by restricting these activities to winter months. Few recreationists visit the area during winter months. On a relative scale, few recreationists visit the area summer or winter.

19. Wild and Scenic Rivers

a. Effects of Non-Oil and Gas Activities

The infrastructure and economic development in the Planning Area and local communities are expected to lead to some additional vehicular use under non-oil and gas activities, which might in turn lead to some additional erosion of stream banks, particularly at subsistence-use sites. An increase in the number of subsistence cabins would be expected. Some decline in the time spent on subsistence activities would be expected if significant numbers of local residents were to obtain employment under this alternative.

The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not noticeably impacted by non-oil and gas activities, although they are used for subsistence. This situation is likely to continue because of the area's distance from local communities and difficulties of access.

Much of the area would be classified as "limited" or "closed" to off-highway vehicle use. OHV use would be expected to expand as vehicular technology improves and more cash comes into the economy, so limits on their use would mitigate potential negative impacts on river values including fish, wildlife, cultural, and fossil resources.

The Colville River riparian area is managed by the State of Alaska and the Arctic Slope Regional Corporation. These entities could authorize improvements such as airstrips, lodges, cabin sites, or storage facilities in the riparian area that would impact the scenic quality and primitive roadless nature of the river.

Under Alternative B, the impacts of non-oil and gas activities to river values would be similar to those identified under the No Action Alternative. Impacts from recreational OHV use would be largely avoided because of increased restrictions on their use in comparison with Alternative A.

b. Effects of Oil and Gas Activities

(1) Seismic activity compared to No Action Alternative

The effects of seismic activity on river values under Alternative B would be similar to those described under the No Action Alternative.

(2) Effects of Disturbances

The effects of disturbances related to oil and gas development on river values would be reduced in comparison with Alternative A, largely because of the restrictions of stipulation E-1, which could limit disturbances in many river, lake, and coastal areas. The exception to this, of course, is the Colville River, where BLM does not have management authority. The impacts to the Colville River, adjacent to the Planning Area, would be the same as those under Alternative A because the riparian area likely to be developed is not under BLM management.

(3) Effects of Spills

The effects of spills under Alternative B on water quality, subsistence, fish, and wildlife values are described elsewhere in this Section. The effects would be greater than those expected under the No Action Alternative, and somewhat less than those anticipated under Alternative A because of the reduction in leased area.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, A-3, C-1, and C-2 would all limit the impacts that oil and gas exploration and development would have on river values. Without these stipulations, greater impacts from spills, and damage to stream banks at river crossings would be expected.

Stipulation B-1 would be somewhat effective in preserving instream flows in eligible rivers, and in protecting overwintering habitat for fish. There is some risk entailed by this stipulation, because it allows for withdrawal of stream water so long as resident fish populations are not endangered. This could be taken to allow complete dewatering of streams during periods when fish are not present, which would negatively impact instream flows.

Stipulation D-1 and ROP E-6 contribute to the conclusion regarding the impacts of development on fish, wildlife, and instream flows. The stipulation and ROP would entail some risk to riparian areas and water quality because of somewhat subjective language with regard to acceptable impacts to fish wildlife, vegetation, and hydrologic condition.

Stipulation E-1 could prove effective in limiting impacts of oil and gas development on river values, provided effective site-specific analysis and ongoing monitoring studies are sufficient to improve the effectiveness of stipulations and operating procedures.

ROP's A-1, A-2, A-3, and A-4 contribute to the conclusion that this alternative would have little effect on water quality. Without these procedures, adverse impacts to water quality would be expected to increase.

ROP C-1 would reduce the likelihood of impacts to the free flow of streams by reducing the likelihood of additional freezedown and unnatural breakup of rivers. ROP C-1 also provides protection from rutting and changes in drainage patterns for riparian areas.

ROP E-8 could be effective in limiting impacts to river values, particularly fisheries and subsistence activities.

ROP's F-1 and I-1, along with stipulations G-1, H-1, and J-1, would help to limit negative impacts to river values.

d. Conclusion--First Sale

Under Alternative B, the impacts of the first sale on Wild and Scenic River values would be limited in scope. Impacts are expected to be less than under Alternative A because of additional restrictions that protect stream banks, and limit potential withdrawals of water. The Colville River would likely see the greatest negative impact to river values because it is not under BLM management, and would probably be crossed by access trails, ice roads, and pipelines. The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not impacted by oil and gas activities and this situation is likely to continue because of low potential for development.

e. Multiple Sales

Multiple sales would have little additional impact on river values.

f. Conclusion--Multiple Sales

Multiple sales would have little additional impact on river values.

20. Visual Resources

Under Alternative B, the Kasegaluk Lagoon Special Area would be a Visual Resource Management (VRM) Class II area. The Colville River, identified estuarine areas, the four rivers in the Special Area (see Table II-01), and an area extending 1 mi back from the banks of these waterbodies also would be VRM Class II areas. The remaining 17 rivers identified as eligible for designation as wild and scenic rivers and an area extending from the banks of these rivers would be assigned VRM Class III. The rest of the Planning Area would be assigned VRM Class III or IV (a change from Alternative A) (Map 22). Implementation of VRM prescriptions would take place in an individual environmental analysis of each proposed activity.

a. Effects of Non-oil and Gas Activities

The kinds of activities other than oil and gas expected under Alternative B would be the same as under Alternative A. The impacts from the camps would be the same as under the No Action Alternative and Alternative A.

Although the amount of supplies and materials transported by winter overland moves could decrease under this alternative, these moves generally follow the same routes. Therefore, neither the length nor number of green trails would be expected to differ noticeably from the No Action Alternative and Alternative A.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Under this alternative, seismic survey work would continue but would increase from one operation (under the No Action Alternative) to two operations each winter season. Assuming two crews working per season, ongoing seismic operations would be expected to affect 1,000 acres annually, or about 500 acres more than under the No Action Alternative. Green trails (see the No Action Alternative) resulting from these operations could increase from the No Action Alternative with approximately 200 mi of intermittent green trails visible from the air during any one summer season (up from 100 mi under the No Action Alternative).

For the first sale, between 7 and 30 exploration or delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than three wells would be anticipated to be drilled at any one time. These impacts would be expected to be greatest within a 1/2-mi to 2-mi radius of each drill site, an area of approximately 4,000 acres per well site. Accordingly, under the first sale in this alternative, there would be a temporary loss of visual quality over an area of approximately 12,000 acres.

In addition to the short-term impacts that would result from ongoing exploratory drilling operations, summer season visual concern would exist as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails-- the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years of longer. There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 1,500 acres (30 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe, expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Under the first sale, a total of as many as six production pads and 205 mi of pipeline would be anticipated under this alternative. Although with the cessation of construction activities and closure of material sites the intensity of impacts likely would be reduced from the development phase to the production phase, remaining structures and associated activities would have adverse impacts on visual quality. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts would be expected to be greatest within ½ mi to 2 mi of the pad sites (an area of about 4,000 acres per site). Pipelines would be expected to be elevated about 5 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond about a half-mile. This equates to about 640 acres per mile of pipeline. Under this alternative, production pads would impact up to 24,000 acres while pipelines would impact up to 131,200 acres.

Under this alternative, one to two staging bases and one pumping station would also be expected. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities, or about 4,000 acres per staging base. Accordingly, under this alternative there would be long-term loss of visual resources over an area of approximately 4,000 acres to 8,000 acres from the staging bases and approximately 3,500 acres from the pumping station, the same as for Alternative A.

(2) Effects of Spills

The effects of spills would be the same as those analyzed for Alternative A.

c. Effectiveness of Stipulations and Required Operating Procedures

The Kasegaluk Lagoon Special Area, the four rivers in the Special Area (Avak, Nokotkek, Ongoravik, and Tunalik), the Colville River, and identified estuarine areas would be designated VRM Class II under this alternative (Map 22). As Class II, the level of change to the landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the landscape. The 17 rivers outside the Kasegaluk Lagoon area that have been identified as eligible for designation as Wild and Scenic Rivers and the estuarine areas would be designated VRM Class III. As Class III, the level of change to the characteristic landscape should be moderate. Management activities may attract the attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the landscape. The rest of the Planning Area would be assigned VRM Class III and IV. As Class IV, the level of change to the characteristic landscape can be moderate. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeatition of the basic elements found in the predominant natural features of the landscape.

d. Conclusion--First Sale

As compared with the No Action Alternative, there would not be an increase in adverse, short-term impacts to visual resources from activities other than oil and gas exploration and development.

Short-term impacts from ongoing seismic activities would affect approximately 1,000 acres. The greening and ring effect of vegetation resulting from ice pads, roads, airstrips and compacted snow would impact up to 1,500 acres. Short-term impacts from exploratory drilling would encompass approximately 12,000 acres.

Oil and gas development would result in the long-term loss of visual resources of approximately 166,700 acres (2% of the Planning Area) for the life of production fields and pipelines.

e. Multiple Sales

For multiple sales, between 21 to 72 exploration and delineation wells would be anticipated under this alternative. However, because of the limited number of drill rigs available, no more than three wells would be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs, bermed drill materials, equipment and housing), vehicles, aircraft, human presence and associated activities all would have adverse, short-term impacts on visual quality during the winter season. These impacts would be expected to be greatest within a 1/2-mi radius of each drill site (50 acres)--a total area of approximately 4,000 acres impacted per well site. Accordingly, under this alternative there would be a temporary loss of visual quality over an area of approximately 12,000 acres for the three wells being drilled at any one time.

In addition to the short-term impacts that would result from ongoing exploratory drilling operations, summer season visual concern would exist as a result of the greening of vegetation under vacated ice pads, airstrips, and roads (as described above). There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 3,600 acres (72 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe, expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Under multiple sales, a total of as many as 12 production pads and 685 mi of pipeline would be anticipated under this alternative. Although with the cessation of construction activities and closure of material sites, the intensity of impacts likely would be reduced from the development phase to the production phase, remaining structures, and associated activities would have adverse impacts on visual quality. Because production could last for 30 years, impacts would be long term. These long-term, adverse impacts would be expected to be greatest within a 1/2 mi of the pad sites (about 4,000 acres for each pad site). Pipelines would be expected to be elevated about 5 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond about a half-mile. This equates to about 640 acres/mi of pipeline. Under this alternative, production pads would impact up to 48,000 acres while pipelines would impact up to 438,400 acres.

Under this alternative, three staging bases and one pumping station would be expected to be built. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities--about 4,000 acres per staging base. Accordingly, under this alternative there would be long-term loss of visual resources over an area of approximately 12,000 acres for the staging bases and approximately 3,500 acres from the pumping station.

f. Conclusion--Multiple Sales

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and pads, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent that such facilities would be necessary to support exploration and production. It is anticipated that such facilities would impact about 6 percent of the Planning Area and would affect a total of approximately 505,500 acres.

21. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared comprehensive impact analyses on those resources within Northwest NPR-A Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section IV.D.7)

Effects of First Sale: Impacts from activities other than oil and gas exploration and development would be slightly less than for Alternative A.

The impacts of oil and gas exploration and development would be the same types as for Alternative A, but would cover fewer acres and may be shifted away from marsh and riparian wetland habitats. Seismic surveys could affect 0.2% to 4% (22,500 to 366,000 acres) of the Planning Area per year. Construction of ice roads and ice pads would annually impact <420 acres and <170 acres, respectively. Development could involve destruction of vegetation on <650 acres and the alteration in plant species composition of <1950 acres. Unless these impacts occurred to a rare plant species, these impacts would not likely adversely affect any plant species or community. Oil spills would affect <4.3 acres of vegetation within the Planning Area.

Effects of Multiple Sales: There would be a small increase in the amount of disturbance from seismic activities that would be evident at any one time compared to that described for the first sale. Up to 1,940 acres around and under ice pads and roads could be disturbed. Development activities from all lease sales would cause the destruction of vegetation on <1,260 acres and the alteration in plant species composition of <4,050 acres. Oil spills would affect <8.6 acres of vegetation within the Planning Area.

Soils (Section IV.D.1)

Effects of First Sale: Impacts from activities other than oil exploration and development would be negligible. Impacts from seismic surveys and winter exploration would be minor to negligible. Development activities would cause loss or disturbance of up to 650 acres of soils. The duration of these impacts would be permanent. Oil spills would be cleaned up immediately causing minimal contamination to soils.

Effects of Multiple Sales: Impacts to soils from exploration activities would be small to negligible, while development could permanently destroy soils on up to 1,260 acres.

Water Resources (Section IV.D.3)

Effects of First Sale: Seismic activities may have short-term impacts on 15 to 60 acres annually and long-term (several years to several decades) on 2 to 6 acres annually. The potential short-term impacts, from exploration and delineation drilling would be water removal from up to 90 lakes and riverine pools, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 2,000 acres. Long-term impacts from development of gravel roads, pads and pits, could impact up to 1,000 acres.

Effects of Multiple Sales: Annual impacts from seismic activities would be the same as for the first sale. Although shared infrastructure could reduce impacts, overall impacts from other oil and gas activities could be double that for the first sale.

Freshwater Quality (Section IV.D.4)

Effects of First Sale: The short-term, localized impacts from seismic and exploratory activity would be reduced approximately one third and one quarter, respectively, compared to Alternative A. Long-term impacts from seismic would be slightly less than for Alternative A. Impacts from impoundment of water would be one quarter less than for Alternative A. Oil spills could degrade water quality along short stretches of some rivers for a few weeks, and cause about 6 ponds or small lakes to become toxic to sensitive species for about 7 years.

Effects of Multiple Sales: Long-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about 8 ponds or small lakes remaining toxic to sensitive species for about 7 years.

Estuarine Water Quality (Section IV.D.5)

Effects of First Sale: The effects of regulated discharges and of disturbance due to permitted construction would be similar to those under Alternative A, except in Kasegaluk Lagoon, which would be excluded from leasing so there would be no effects. Winter spill effects on estuarine water quality would be similar to those under Alternative A, but open-water spill effects would be much lower than with Alternative A.

Effects of Multiple Sales: The effects of multiple sales on estuarine water quality would probably be slightly less than twice that for the first sale.

E. Alternative C

The most likely scenarios for oil and gas development under each alternative are presented in Section IV.A.1.b . Given: 1) the marginal economics involved with development in the Northwest NPR-A Planning Area; 2) that some of the most promising areas for leasing would not be offered under Alternative C; and 3) the protections afforded surface resources under Alternative C, the BLM does not project any oil and gas development under this alternative unless exceptions were to be granted to the stipulations and ROP's. Consequently, this analysis of impacts from oil and gas activities under Alternative C generally will indicate that BLM does not anticipate oil and gas development activities or any associated impacts.

Nevertheless, Alternative C would allow leasing. Unforeseen discoveries, advances in technology, or changes in oil field economics or in market conditions could lead to development of those leases. The activities associated with that development would generally be the same types as those described in Alternatives A and B.

1. Soils

a. Effects of Non-Oil and Gas Activities

The types of activities and associated impacts that could affect soils under Alternative C include those analyzed under the No Action Alternative. Effects would be similar to those evaluated under vegetation.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Those areas subject to oil and gas exploration activities would see effects similar to those described under Alternative A. The number of wells might be reduced to a range of 2 to 6 with total of up to 1 acre of soil lost or disturbed from well cellars.

Under Alternative C, development is considered unlikely. Effects from gravel pads, pump stations, material sites, and pipelines would not exist. However, if development were to occur, the effects would be similar to the evaluation under Alternative A, with a reduction in the number of activities. The fixed size of development areas would likely remain the same. Acreages are not calculated, as no development is foreseen under this alternative.

(2) Effects of Spills

As there is no development assumed to occur under Alternative C, the likelihood of oil spill impacts to soils would be limited to those occurring from seismic exploration and exploratory drilling. No small, refined-oil spills are projected to occur from activities under Alternative C. If a fuel spill were to occur, soils would be affected if the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup however, is more likely to damage soils.

c. Effectiveness of Stipulations and Required Operating Procedures

The effectiveness of Stipulations and ROP's is the same as described under the No Action Alternative and the exploration portions of Alternative A.

d. Conclusion--First Sale

Impacts to vegetation from activities other than oil exploration and development under Alternative C would be unlikely to cause loss of soils and any impacts would be expected to be negligible.

Impacts from exploration that requires winter operations again would be unlikely to cause loss of soils. Any impacts would be expected to be minor to negligible, the single measurable impact being that of well cellars.

Development is assumed to not occur with this alternative. The area of soils impacted by any spills would be similar to the area of vegetation affected. Spills would be cleaned up immediately, causing minimal contamination to soils.

e. Multiple Sales

It is assumed that additional lease sales could occur under Alternative C, but again, no development is projected. The annual level of seismic operations is assumed to stay the same. The total number of exploratory and delineation wells would increase to 5 to 16 wells drilled from ice pads, resulting in up to 1 acre of soils lost or disturbed from well cellars.

f. Conclusion--Multiple Sales

Generally, under Alternative C impacts would be similar in nature to those under Alternative A without the development phase. Impacts to soils from exploration activities would be small to negligible, while development impacts would remain small to moderate. The duration of these impacts would range from several years if the vegetation were disturbed up to several decades if the soils were destroyed. The overall impact to soils of the Northwest NPR-A Planning Area would be negligible (with seismic) to moderate (with development).

2. Paleontological Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative C, the type of non-oil and gas activities would be the same as they are in the No Action Alternative; however the level of activity and duration could be expected to increase somewhat. Despite this increase in activity the impacts on paleontological resources, which are usually relatively deeply buried, would still be minimal.

b. Effects of Oil and Gas Activities

Under Alternative C, which provides the highest level of environmental protection for the Northwest NPR-A Planning Area, the level of seismic activity would be expected to increase slightly beyond that of the No Action Alternative. While much of the Planning Area would be open for oil and gas exploration, a substantial amount of the high oil and gas potential area would have significant stipulated environmental constraints in place. Still, there would be an increase in the lessees' need for additional seismic data. While the types of potential impacts to paleontological resources would be the same in Alternative C as those described in the No Action Alternative, the heightened level of seismic activity would increase the possibility that impacts could occur. While the level of seismic activity for Alternative C would be expected to be somewhat less than it would be for Alternative A, the levels of other oil and gas activities would be considerably reduced, because Alternative C is much more environmentally restrictive than Alternative A, particularly near areas with high oil and gas potential. In the areas open to exploration under this alternative, the deeply buried context of most paleontological remains generally precludes any significant impact to the resource and in the areas where paleontological remains are known to occur on the surface, protective stipulations are in place.

Paleontological resources are not ubiquitous in the Planning Area, as are habitat and wildlife. As a result, it is quite possible that oil and gas exploration or development activities would have no impact on paleontological resources simply because oil and gas activities would occur where no paleontological resources are present.

(1) Effects of Disturbances

Under Alternative C, the level of oil and gas activity in the Planning Area would be significantly reduced from that of Alternative A. Because most of the activity that would be carried out would occur during the winter months, the potential for impact to buried paleontological resources would be relatively low. The likelihood of impacting surface paleontological materials would also be low because of their isolated and rare occurrence and because of stipulations governing oil and gas exploration activities in the areas in which they are most likely to occur.

The drilling of as many as four exploration wells and two delineation wells could occur under Alternative C. Although six wells could be drilled in a single winter season, it is anticipated the work would be conducted over more than one season. As always, drill pads, camp pads, roads, and airstrips would be made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed (requiring no gravel or rock) no significant disturbance of the ground would occur and buried paleontological resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of the drilling would be the creation of the drill hole itself. It is possible that drilling the borehole could impact significant accessible paleontological material, but the likelihood of that occurrence is minuscule.

Under Alternative C, it is assumed there would be no development because of the restrictiveness of the stipulations, therefore, no subsequent environmental impacts. However, if development were to occur, the effects of the assumed disturbance (i.e. the construction of several production pads connected by roads, one airstrip, one pump station, one staging base and approximately 130 mi of pipeline) could possibly occur under Alternative C. Surface disturbance resulting from this work would impact approximately 140 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to paleontological resources would result from the excavation of material for construction of the permanent facilities. If the source of materials for pads, roads, and airstrip was terrestrial, then extraction of material could impact paleontological resources. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of VSM's. Depending on the depth at which the VSM's were set, it is possible (though highly unlikely), that buried paleontological resources would be impacted. If buried pipelines were to be used, disturbance and impacts to paleontological resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline. The potential for impacts to surface paleontological resources under this alternative have been previously discussed.

(2) Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that any spills would occur on an ice pad, ice road, or during winter conditions, where cleanup would be less invasive than with a summertime terrestrial spill. In any case, paleontological resources usually are so deeply buried that they would not be affected by either a spill or subsequent spill cleanup. If present, surface paleontological remains could be impacted in the same manner as surface cultural material. However, since the occurrence of significant surface paleontological remains is far less common than cultural remains, the probability of any impact would be remote.

c. Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, stipulations E-1a, f, g, i, l, and s, and ROP C-1 c apply to paleontological resources. However, stipulation E-1 applies to only a very few specific locales within the Northwest NPR-A Planning Area, and ROP C-1 applies only in an ancillary sense. There is no general stipulation or ROP specific to cultural/paleontological resources. The NHPA requires that an archaeological/paleontological resource survey be completed before any undertaking occurs on Federal lands. Ground disturbing activities, such as the construction of buried pipelines, are considered undertakings. If paleontological resources were to be identified during the survey, Federal law requires that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

d. Conclusion--First Sale

Under Alternative C, impacts to paleontological resources from management activities other than oil and gas exploration would be as previously stated. Impacts would include displacement and/or destruction of resources and would be anticipated to be minimal regardless of the level of seismic activity. Under Alternative C, the potential impacts to paleontological resources from first sale oil and gas exploration would be significantly reduced from those in Alternative A because of increased environmental constraints and the resultant reduction of exploration activities.

e. Multiple Sales

Under Alternative C, the potential for impacts to paleontological resources would be minimal. While the scattered nature of paleontological deposits and the fact that the locations of most deposits remain unknown (making it somewhat difficult to assess the likelihood and severity of potential impacts), the environmental constraints present in Alternative C would be expected to further reduce potential impacts.

f. Conclusion--Multiple Sales

Under Alternative C, potential impacts to paleontological resources from management activities other than oil and gas exploration would be as previously described. At the same time, the probability of the occurrence of such impacts should decrease slightly from those assumed under Alternative A. Under Alternative C, the potential impacts to paleontological resources from oil and gas exploration would be minimal.

3. Water Resources

a. Effects of Non-Oil and Gas Activities

Non-oil and gas management actions within the Planning Area that could affect water resources under Alternative C would be similar to those in the No Action Alternative, except that the number and frequency of camps and moves would decrease somewhat. The amount of decrease would depend on management actions in land, water, and resource monitoring as related to leasing activities. Alternative C protects all areas identified as special resources, including those areas adjacent to streams and lakes identified as critical aquatic habitat. Therefore, most (if not all) of the additional camps and moves likely would be at some distance from these critical aquatic habitat areas. Because surface-disturbing activities--as defined by events of such magnitude, extent, and duration to create the effects discussed in Sec. IV.C.3--would not be expected, there probably would be no significant long-term effect on water resources. However, there could be some sites that require remediation from earlier exploration or military activities, which are discussed under Hazardous Materials (Sec III.A.1.f).

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Exploration and development activities within the Planning Area that could affect water resources under Alternative C would be similar to those under Alternative A, except that the number and frequency of these activities would decrease significantly (Table IV-05 and Table IV-07). The decrease would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. Seismic activities probably would decrease relative to Alternative A (Section IV.A.1.a.3), but still would occur. While observations by BLM personnel and others (National Research Council, 2003) indicate that short-term impacts (such as diversions of shallow water tracks and limited ponding) are estimated at about one per cent of the proposed seismic lines per season (Section IV.A.1.b), newer, low-ground-pressure equipment could reduce this significantly, to about four acres. Long-term impacts due to thermokarst erosion, such as diversions of shallow water tracks and limited ponding, are estimated at less than a tenth of an acre. Where disturbance does occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987).

The estimated total winter water pumpage for the levels of activities (Section IV.A.1.b.4) under Alternative C could be more than 121 million gallons, or the equivalent of 371 acre/ft. As noted in Section IV.C.3.b, a typical large tundra lake used as a winter water source could have from less than 10 to over 100 acre/ft of water available for pumping. This estimate assumes the drawdown limitation of 15 percent of the under-ice water volume required by stipulation B-1 for all winter water usage. Water withdrawal from riverine pools would not be permitted under Alternative C. Depending on the areas leased and number of exploratory wells drilled, annual water usage for exploration under Alternative C could require pumping water from as few as 4 to as many as 40 or more lakes during a winter's exploration season. Since all of the areas adjacent to streams and lakes identified as critical aquatic habitat would be unavailable to leasing, little (if any) exploration and development would likely be near these critical aquatic habitat areas. Limiting the exploration and development activities to only those areas not in active floodplains or on stream and lake shores would decrease the risk of disturbing stream banks and shorelines, disrupting drainage patterns, causing erosion and sedimentation, and dewatering riverine pools and lakes.

While development is not projected under Alternative C, future development in the western portion of Northeast NPR-A Planning Area or near Barrow could provide infrastructure and stimulate development in the Northwest NPR-A Planning Area. For a limited, single-field development, gravel construction of pads, roads, and an airstrip would cover about a 100-acre footprint under Alternative C. In the coastal plain of the North Slope--where low surface gradients limit flow and permafrost is ubiquitous--gravel construction can create significant water impoundments and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 200 acres in the case of Alternative C. Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 acres per site, or from 50 acres total under Alternative C. Unlike the ice roads and pads, gravel structures and pits would create long- term impacts over the life of the field(s).

If oil pipelines were to result from any development under Alternative C, they could range up to 50 mi in length and affect up to 100 acres of water resources, primarily through temporary impoundments, diversions and sedimentation during construction. If gas pipelines were also constructed, impacts could double--up to 200 acres.

(2) Effects of Spills

Under Alternative C, the projected number and volume of oil spills is zero (Sec. IV.A.2 and Table App 9-09). Because Alternative C would protect more areas of special aquatic resources from any spills--including those areas adjacent to streams and lakes identified as critical aquatic habitat--adverse effects on water resources should be much less than under Alternatives A or B.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations that protect water resources under Alternative C are similar to those under Alternative A. Additional stipulations in Alternative C are noted in Section IV.C.3.c and IV.C.3.e. There would be no requirement to preserve natural drainage patterns when constructing gravel roads, airstrips, and pads under Alternative C.

d. Conclusion--First Sale

The impacts of activities other than oil and gas exploration and development under Alternative C would be expected to be significantly less than those under Alternative A. The potential short-term impacts from exploration and development would be water withdrawals from up to 40 lakes, and--during construction--increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 350 acres. Long-term impacts from development of gravel roads, pads and pits (such as melting of permafrost and disrupting drainage patterns) could impact up to 200 acres. Roads would pose the single most significant impact because of the diversions, impoundments, and increased sediments runoff associated with them, so limiting the length of the roads would cause the greatest reduction in impacts to the water resources. While any surface-disturbing activity could affect water resources, Alternative C would protect more areas of special aquatic resources, including those areas adjacent to streams and lakes identified as critical aquatic habitat. The potential adverse effects of Alternative C on water resources should be very much less than Alternative A.

e. Multiple Sales

While the effects of oil and gas exploration from multiple lease sales could be up to three times greater than the first sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation from channel alteration or gravel removal might not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources. Even where infrastructure was shared, both long and short-term impacts, as noted above (as well as recovery times), could increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. Roads would pose the single most significant impact because of associated diversions, impoundments, and increased sediments runoff, so limiting the length of the roads would cause the greatest reduction in impacts to the water resources. While difficult to quantify, multiple sales could result in short-term impacts--from exploration and delineation well drilling--of water removal from up to 80 lakes, and increased water impoundments, diversions, thermokarst erosion and sedimentation of more than 700 acres. Long-term impacts from development of gravel roads, pads and pits could impact more than 350 acres of water resources from water impoundments, diversions, and thermokarst erosion.

f. Conclusion--Multiple Sales

Adverse impacts from multiple lease sales could be up to 3 times greater than a single sale, while indirect impacts might take years to develop. While shared infrastructure could reduce the adverse effects to water resources of multiple sales, both long- and short-term impacts (as noted above), as well as recovery times, could increase somewhat, depending on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity.

4. Freshwater Quality

a. Effects of Non-Oil and Gas Activities

Ground-impacting actions other than seismic operations would not affect water quality.

b. Effects of Oil and Gas Activities:

(1) Effects of Disturbances

Exploration activities (such as 2-D and 3-D seismic activity and ice-road and pad construction) that could affect water quality under Alternative C would be less than those described under Alternative A. Total acres with damage to vegetation caused by seismic trails would be an order of magnitude less than that for Alternative A. Water quality could be degraded over less than an acre. Annual ice pad and road construction (330- to 440-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

Development activities within the Planning Area that could affect water quality under Alternative A are ice-road and-ice pad construction and oil spills.

During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet per year for each field, requiring about 5 to 20 acres of lake for water supply. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a total of 100 to 400 acres under Alternative C. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel (200 to 800 acres in this case). Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not be within the area unavailable for leasing under Alternative C.

(2) Effects of Spills

Spills would be another impacting agent on water quality. No crude spills or fuel spills are projected to occur under Alternative C. Development would not be expected to occur under this Alternative, but if development were to occur and spills were to occur, the effects would be essentially the same as those described in Section IV.C.4.b. Potential spill locations would not be within the areas unavailable for leasing under Alternative C.

If a spill were to occur and reach a lake or stream, the effects would be similar to those described for Alternative A, in Section IV.C.4.b. At the level of activity estimated in Alternative C, it would be unlikely (though possible) for a spill to enter the marine environment. Major crude-oil spills generally result in peak dissolved-hydrocarbon concentrations that are locally and marginally at toxic levels. A spill $\geq$ 1,000 bbl could temporarily (for about a month) contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm acute toxic criterion could occur over a few tens of square miles during the first several days of such a spill.

Such a spill would be unlikely under this alternative and water quality is not anticipated to be affected by spillage of crude oil produced as a result of this alternative.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROP's that decrease the potential for a crude oil or fuel spill to enter a water body would reduce potential effects and benefit water quality. Stipulations A-1, A-2, A-3, D-1, E-1, E-3, E-5, and G-1, and ROP's A-3, A-4, A-6, A-8, and B-1 would provide protection to water quality by reducing the potential for oil and gas activities to adversely affect nearby lakes, streams, and rivers.

d. Conclusion--First Sale

Effects under Alternative C would be less than those described for Alternative A. Effects for activities other than oil and gas would be similar to those for Alternative A. Water quality up to 2,000 acres could be affected by construction or placement of ice or gravel roads and other structures. If an oil spill were to occur, it could result in water of ponds or small lakes remaining toxic to sensitive species for about 7 years.

e. Multiple Sales

Seismic trail activities would be similar to those for a single sale. During exploration, annual ice pad and road construction (390- to 620-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 230 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water equivalent to 4 to 8 acres of lake. Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 200- to 600-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

If development were to result from multiple sales, spills could degrade water quality of some ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of a river from an oil spill. The spreading of a similar-sized spill over a larger lake for a few weeks could be considered an effect on water quality.

For multiple sales under Alternative C, an oil spill could individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

f. Conclusion--Multiple Sales

Long-term (decade-or-more) effects of multiple sales would be slightly greater than those for a single sale. Although no spills are projected under Alternative C, a spill could contaminate the water in ponds or small lakes, remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks from an oil spill along a short stretch of nearby rivers.

5. Estuarine Water Quality

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities under Alternative C would be similar to those that would be expected to occur under Alternatives A and B.

b. Effects of Oil and Gas Activities

The NPR-A coastal bays and lagoons would be unavailable for leasing under Alternative C. Low levels of seismic surveying and exploration are projected. Although no spills are projected under Alternative C, there would still be a slight chance of spills from fuel transported across the bays for onshore exploration.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's concerning fuel transport and storage would be as effective as with Alternatives A and B.

d. Conclusion--First Sale

The coastal waters would not be available for leasing, therefore no drilling--and thus no discharges or platform construction--would occur in NPR-A coastal waters. There would be a greatly reduced risk of spills, but still a slight chance spills from fuel transported across the bays for onshore exploration.

e. Multiple Sales

It is assumed that additional lease sales could occur under Alternative C, but there would be no offshore leasing and therefore no offshore exploratory or development drilling. The annual level of seismic operations for future leasing and exploration is assumed to be lower that for Alternative B.

f. Conclusion--Multiple Sales

There would be a very low level of effect on estuarine water quality resulting from the first lease sale with Alternative C, so subsequent lease sales with Alternative C would have a similar, very low level of effect.

6. Air Quality

Impacts to air quality would result from emissions. Disturbances and noise do not cause air-quality impacts. Supporting materials and discussions are presented in Sec. III.A.3.b (description of existing air quality on the North Slope of Alaska).

a. Effects of Non-Oil and Gas Activities

The potential impacts on air quality from non-oil and gas activities under Alternative C would be negligible. Air pollutants are discussed under the No Action Alternative (Sec. IV.B.6).

b. Effects of Oil and Gas Activities

Impacts to air quality from air emissions, oil spills, oil-spill cleanup, accidental emissions, and other factors would be less than those discussed under Alternative A (Section IV.C.6) and B (Section IV.D.6). Effects to air quality in the areas unavailable for leasing would not occur.

Effects on air quality from air emissions would be only a very small percent of the maximum allowable Prevention of Significant Deterioration (PSD) Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards. Principally because of the atmospheric dispersion of emissions, the other effects of air-pollutant concentrations from exploration and development and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires.

The Alaska Department of Environmental Conservation (ADEC) has jurisdiction for regulating and permitting air-quality emissions within the Northwest NPR-A Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including the need to obtain construction and operating permits. Construction air-quality permits include PSD requirements.

c. Effectiveness of Stipulations and Required Operating Procedures

Mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control discharges. None of the stipulations and ROP's is applicable to air-quality impacts.

d. Conclusion--First Sale

The air-quality analysis is based on the specific emission controls and emission limitations that the operators would apply to meet the appropriate State regulations and permit requirements for any development and production activities. The effects of all these activities would cause only small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and NAAQS. Therefore, effects from Alternative C would be low.

e. Multiple Sales

Impacts to air quality from air emissions, oil spills, oil-spill cleanup, accidental emissions, and other factors would be less than those discussed under Alternatives A (Sec. IV.C.6) and B (Sec. IV.D.6), because less area would be available for leasing and no development activities are projected to occur. No air-quality effects would occur in the areas not available for leasing.

f. Conclusion--Multiple Sales

The air-quality effects of all activities under all sales would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and NAAQS. Therefore, effects of Alternative C from multiple sales would be low.

7. Vegetation

Ground-impacting management actions within the Northwest NPR-A Planning Area that could affect vegetation under Alternative C include those analyzed under the No Action Alternative and those resulting from exploratory drilling for oil and gas resources (analyzed under Alternative A).

a. Effects of Non-Oil and Gas Activities

The impacts of management actions under Alternative C would be similar to those described under the No Action Alternative except that the total areal extent of archaeological/paleontological excavations could increase to 2 acres per year from the 1 acre per year under the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

If it is assumed that impacts to vegetation from any of the disturbance factors below would occur to different land-cover classes in proportion to their occurrence in the Planning Area (Table III-06) (with the exception of the three water classes), then these impacts, whether or not quantified as to area involved, would occur among the land-cover classes as presented in Table IV-23. However, this assumption would be invalid under either of the two following potential scenarios.

As discussed in Section III, Description of the Affected Environment, over 95 percent of the Planning Area can be classified as "wetland" by some definitions. There are, however, some general differences between the northern and southern portions of the Planning Area. The northern portion lies in the coastal plain and has a higher frequency of "marsh wetlands" (aquatic, flooded tundra, and wet tundra land-cover classes, (Table IV-23), whereas the southern portion lies in the foothills and has a higher frequency of "tussock wetlands" (tussock tundra and dwarf shrub land-cover classes, Table IV-23). If it is assumed that exploration or development activity would more likely be concentrated in the northern portion of the Planning Area, then the "marsh wetland" cover types would be affected in greater proportion than suggested in Table IV-23 and the "tussock wetland" cover types would be affected less. The comparative value of these two generalized wetland types depends upon the context in which they are being evaluated. For instance, the "marsh wetlands" are generally of greater importance to waterbirds, whereas the "tussock wetlands" are generally of greater importance to some shorebirds and songbirds, and to caribou.

Secondly, if development were to be proposed at a location addressed by stipulations E-1, E-3, E-4, or J-1 (see below), the location of the development could be shifted to some extent to avoid (as much as possible) the vegetation types considered of greater importance in that local area for the protection of specific resources. In this case, these would most likely be of either the "marsh wetland" type, or riparian shrubs (low or tall shrub, Table IV-23).

(a) Exploration

Under Alternative C, it is assumed that one seismic survey, either 2-D or 3-D, would occur in the Planning Area during alternate winter seasons. This is the same level of activity assumed under the No Action Alternative, which fully describes the characteristics and areal extent of subsequent impacts. Overall, depending on the survey type and the number of line-miles actually accomplished per survey, the range of areas impacted by all seismic operations would be 11,000 to 183,000 acres about every other year.

Impacts of exploratory and delineation drilling under Alternative C would be of the same type as described under Alternative A, but there might be 2 to 6 wells drilled under Alternative C (rather than 8 to 40 projected under Alternative A), for a total of <35 acres affected under ice pads. If one of these ice pads were to be maintained over a summer, vegetation would likely die around its perimeter, affecting <0.05 acres total. Under Alternative C, it is assumed that at most one ice road would be built per year rather than the 0 to 3 under Alternative A, affecting

210 acres per year. Well cellars around the 2 to 6 wells would replace <0.01 acres of tundra.

(b) Development

Under Alternative C, it is assumed that development of any oil/gas fields would be unlikely (in contrast to up to 5 fields for Alternative A). If Alternative C were to be implemented, there would be none of the impacts associated with gravel pads, pump stations, material sites, or pipelines as described under Alternative A. However, development would still be permissible under Alternative C, and unforeseen economic circumstances might make future development feasible. In this case, the impacts to vegetation would be of the same types as those analyzed under Alternative A. They are not quantified here because of the assumption of a no-development scenario for this alternative.

(2) Effects of Spills

Under Alternative C, it is assumed there would be no development. If development were to occur, then spills associated with development could occur. Those spills are not quantified here because of the assumption of a no-development scenario for this alternative. Even though no spills are projected to occur under the no-development scenario, some small spills of refined oils, and perhaps crude oil, could still occur during seismic exploration and exploratory drilling. Since the level of seismic exploration and drilling would be reduced, and since most spills occur during the development phase, there would be much less area affected by spills under Alternative C than the 5 acres affected under Alternative A.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's that would reduce the acreage of impacts to vegetation under Alternative C are those that reduce the areal extent of gravel cover or alterations to tundra during exploration or development (stipulations D-2 and E-2, and ROP's E-2 and I-1) and those that would reduce the probability of oil spills reaching the tundra or spreading further once they reach the tundra (stipulations A-1 and A-2; ROP's A-3, A-4b and c, A-6, A-7, A-8, E-1, and I-1). Stipulations E-1, E-3, E-4, and J-1 would not reduce the acreage of vegetation impacted by an action, but might shift the impacts from more valuable wetland or riparian vegetation types to habitats perceived as lesser in value. Stipulations and ROP's that would reduce the level of impacts to vegetation--but not the areal extent of impacts--are stipulation A-1 and ROP's A-6 and A-7 (by providing better cleanup of spills), and stipulation C-1b and ROP's C-1c, d, and e, and I-1 (by reducing impacts of off-road vehicles). Stipulations E-4 and G-1 could increase the probability that altered vegetation would eventually be returned to a natural, or at least more productive, state. These stipulations would be effective in reducing impacts to vegetation.

d. Conclusion--First Sale

Impacts to vegetation from activities other than oil exploration and development under Alternative C would involve either disturbance or destruction, and would affect a negligible fraction of the Planning Area. The impacts of oil exploration would be of the same types as for Alternative A, but would cover fewer acres because of the reduced level of activity by the oil/gas industry. Exploration activities would include: vegetation disturbance on 11,000 to 183,000 acres every other year from seismic surveys; construction of ice roads on <210 acres per year and ice pads on <35 acres; and permanent, minor vegetation destruction and alteration from the construction of exploration well cellars. It is assumed that no development would occur under Alternative C, so none of the impacts of development as described under Alternative A would occur. Although none are projected, spills could occur during seismic surveys and exploratory drilling; any spills would affect much less than the 5 acres for Alternative A.

e. Multiple Sales

It is assumed that additional lease sales under Alternative C would result in additional exploration activities, but that there would still be no oil/gas fields developed. The annual level of seismic operations would be assumed to stay the same as for the first lease, and it would be expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells would be assumed to increase to 3 to 12 for multiple sales from 1 to 4 for a single sale, and delineation wells to 2 to 4 from 1 to 2, for a total for all lease sales of 5 to 16 wells drilled from ice pads. Vegetation destruction from well cellars would still affect <0.01 acres, and vegetation death around ice pad perimeters would increase to <0.1 acres. Tundra would recover from the latter in one to a few years. The total acres of tundra affected under ice pads would increase to <90 acres, but there would probably be no increase in the number of ice roads built to accommodate these pads.

With the assumption that no oil/gas fields would be developed following multiple lease sales under Alternative C, impacts from development would remain at zero as for the first lease sale. The likelihood of refined oil spills from seismic surveys would remain the same as for the first sale.

f. Conclusion--Multiple Sales

The impacts of oil exploration following multiple lease sales under Alternative C would include about double the vegetation disturbance from seismic work as under a single-sale scenario for Alternative C, and about one-sixth the level of multiple sales under Alternative A. The extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time between the first sale and subsequent sales. Exploration activities also would result in <0.01 acres of permanent vegetation destruction around well cellars and alteration, per year, of <250 acres around and under ice pads and roads. These levels are slightly more, on a per year basis, than those of a single sale under Alternative C and roughly 10 percent of the levels of multiple sales under Alternative A. Development activities, and subsequent impacts to vegetation, are assumed not to occur under Alternative C. The likelihood of refined oil spills from seismic activities following multiple sales under Alternative C would remain at the same level as for the first sale.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Actions within the Planning Area that could affect fish under Alternative C include those analyzed under the No Action Alternative and those resulting from exploratory drilling for oil and gas resources analyzed under Alternative A.

(1) Effects of Non-Oil and Gas Activities

Actions and impacts associated with Alternative C which could cause disturbance to fish are similar to those described under the No Action Alternative.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbance

Under Alternative C, it is assumed that one seismic operation would occur every other year in the Planning Area. This is the same level of activity as discussed in the No Action Alternative, which details potential impacts. As a result, seismic surveys associated with Alternative C would be expected to have the same overall effect on fish as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations). Although no fuel spills are projected to occur under Alternative C, any fuel spills would be expected to have the same overall effect on fish populations as discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations).

Construction-related activities that could affect arctic fish include water withdrawal related to the construction of drill pads, roads, and airstrips.

Under Alternative C, it is projected that 1 to 4 exploration wells and 1 to 2 delineation wells (Table IV-05) would be drilled in the Planning Area as a result of the first lease sale, for a total of 2 to 6 wells on ice pads. Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), water needs would equate to approximately 2 million gallons for each drill pad, for a total of 4 to 12 million gallons of water. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that 0 to 1 ice roads, 25 to 50 mi long, would be built each season for a maximum annual water need of 75 million gallons. Water needed for one drilling rig, associated camps and airstrips, and maintenance of roads, pads, and airstrips would add approximately another 34 million gallons to the annual water use budget. Total annual maximum water need is estimated at 121 million gallons. Decreased exploration activity under Alternative C (as compared with activity under Alternative A) represents a 71 percent decreased water budget. Assuming that a typical large tundra lake (1 mi long and >6 ft deep) has approximately 20 to 40 million gallons available for pumping (USDOI, BLM 1998), the decreased water need would equate to about 10 fewer lakes being pumped.

Potential impacts to fish in relation to water withdrawal are reduced under Alternative C when compared with Alternative A. Water withdrawal from rivers would be prohibited under Alternative C and water withdrawal in lakes would be limited to 15 percent of the under ice water volume in any fish-bearing lake, while Alternative A would allow water withdrawals from rivers and lakes if the proponent could demonstrate that fish populations were not endangered. Water pumping could still adversely affect arctic fish, depending on the location of the withdrawal and the quantity of freshwater withdrawn. Limits on withdrawal and monitoring of water quality should minimize concerns. The reader is referred to the discussion of water withdrawal in the Fish section of Alternative A for further details on impacts. Water withdrawals conducted under Alternative C would be monitored through a sampling program that ensures that water-quality standards are met.

Assuming that the Authorized Officer would follow the above common practices when approving water withdrawals, lake water withdrawal associated with Alternative C would not be expected to have a measurable effect on arctic fish populations in the Planning Area. Exploratory drilling on lakebeds and in streams would be prohibited under Alternative C.

Alternative C would make 47 percent of the BLM-administered lands in the Planning Area available for oil and gas leasing (Map 19). Large portions of the headwaters of the Meade, Titaluk, and Ikpikpuk river drainages and most of the Chipp River and the lower portions of the Meade, Ikpikpuk, Inaru, and Topagoruk river drainages would not be available for leasing. These river drainages (especially the Chipp and the downstream sections) are suspected to provide important habitat (overwintering/rearing) for fish. Excluding these areas from potential development would greatly reduce the risk to fish populations and habitat. Given this scenario (whereby 53 percent of the acreage would not be available for leasing), it is assumed that no oil/gas fields would be developed under Alternative C (in comparison with up to five fields projected under Alternative A). As a result, impacts in Alternative C related to development--such as excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways, and water withdrawals--would be eliminated.

(b) Effects of Spills

Given that there would be no development and less seismic activity under Alternative C, the estimated number of spills of refined and crude oil is zero. No measurable effects on arctic fish populations in the Planning Area would be expected.

(3) Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, A-3, and C-2, and ROP's A-6, A-7, and A-8 would provide increased protection to fish and fish habitat during fuel use, handling, and storage. Stipulation B-1 would provide adequate protection for water withdrawals from rivers and lakes. Stipulation B-2 and ROP C-1 would protect rivers and lakes from additional freezedown. Stipulations that would reduce impacts during oil and gas exploratory drilling include stipulations D-1 and D-2. ROP E-2 and stipulations E-3, E-4, and E-5 would be beneficial to fish habitat and fish.

(4) Conclusion--First Sale

Construction of pads, roads, and airstrips, as well as fuel spills associated with activities under Alternative C, might be expected to kill a small number of individual fish, but would not be expected to have a measurable effect on arctic fish populations. Potential mortality from water withdrawals in lakes would also be possible, although limits on withdrawal and monitoring of water quality should minimize concerns. Decreased projected exploration activity under Alternative C (as compared with Alternative A) represents a 71 percent decreased water budget. This would also lessen the potential for fish kill in lakes. Seismic surveys and non-oil and gas activity under Alternative C would not be expected to have a measurable effect on arctic fish populations in the Planning Area over the production life of the field. These last conclusions are the same as found for Alternative A.

(5) Multiple Sales

It is assumed that additional lease sales under Alternative C would result in additional exploration activity even though there still would be no oil/gas field development projected. The number of exploratory wells would increase from 1 to 4 for a single sale to 3 to 12 for multiple sales, and delineation wells would increase from 1 to 2 to a projected 2 to 4 (Tables IV-05 and IV-07). Water withdrawals would increase in proportion to the activity level. Given the large quantity of lakes in the area likely to be developed, increased water use would not be expected to impact fish more severely than under a single sale. Regardless of the amount of water pumped, withdrawals should be monitored through a sampling program that ensures water quality standards are met. The level of seismic activity would not be expected to change from a single sale to multiple sales, although it could be extended over a longer period. Assuming that there would be no development following a multiple lease sale means that impacts from development would remain the same (zero) as the first lease sale.

(6) Conclusion--Multiple Sales

Seismic surveys and water withdrawals associated with multiple sales would be expected to have the same overall effect on arctic fish populations as the first sale. Mortality from water withdrawals in lakes could be possible, although limits on withdrawal and monitoring of water quality should minimize concerns. The impacts under multiple sales in Alternative C would be reduced when compared with those in Alternative A.

b. Marine Fish

Under Alternative C, lagoons and estuaries along the coast of the Planning Area, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, the Kuk River system (Wainwright Inlet) and Dease Inlet/Admiralty Bay area, and Elson Lagoon, would be unavailable for oil and gas leasing. Oil and gas exploration and development activities in the northern portion of the Planning Area adjacent to Dease Inlet/Admiralty Bay area and Elson Lagoon would be subject to issue/area-based stipulations. Under Alternative C, the activities and events most likely to have some effect on marine fishes would be those of seismic surveys, and oil or fuel spills.

(1) Effects of Non-Oil and Gas Activities

Activities not related to oil and gas exploration and development would not be likely to have a measurable effect on marine fishes.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

Seismic surveys would likely have no measurable effect on marine fishes (same as for Alternative A).

(b) Effects of Spills

As there is no oil and gas development projected in coastal areas under Alternative C, the probability that a spill associated with Alternative C would adversely affect marine fish is extremely low. No spills are estimated to occur under Alternative C.

(3) Effectiveness of Stipulations and Required Operating Procedures

Waste prevention, handling, and disposal and spills stipulations (A-1 through A-3) and ROP's (A-3 through A-8). would reduce the potential for contamination of marine waters and effects on marine fish.

(4) Conclusion--First Sale

Alternative C would not be expected to have a measurable effect on marine fish populations.

(5) Multiple Sales

Additional NPR-A lease sales would increase seismic surveys above the level projected for the first sale and thereby increase the likelihood of seismic activity occurring above overwintering habitat. However, such events would likely be infrequent. Seismic surveys associated with multiple sales in Alternative C would be expected to have the same overall effect on marine fish as discussed for the first sale. If several lease sales were to be held under Alternative C, more exploration activity would be expected to occur in the Planning Area. The number of spills estimated for multiple sales under Alternative C is zero.

(6) Conclusion--Multiple Sales

Seismic surveys would likely have a slightly greater overall effect on marine fish fro multiple sales than that for the first sale under Alternative C. Insufficient recovery time between activities resulting from sales and/or greater levels of activity from multiple sales could result in greater effects than estimated for a single sale.

c. Essential Fish Habitat

As discussed in the No Action Alternative, "Essential Fish Habitat" (EFH) is unlikely to be affected. The potential impacts to the few salmon that are present in the Northwest NPR-A Planning Area would be much the same as those for all other fish species. Consequently, impacts on salmon, as part of EFH, are evaluated in the general fisheries analysis for this alternative.

9. Birds

This section discusses potentially adverse effects of management actions on nonendangered birds within the Northwest NPR-A Planning Area under Alternative C. Such actions--including only exploration activity in winter--could potentially result in: 1) altered distribution, abundance and/or behavior resulting from disturbance of species present during the winter period; 2) minor alteration of habitats; and 3) effects resulting from pollution of the environment by refined products, wastewater, and solid/liquid wastes of various toxicity. This analysis assumes stipulations in Table II-02 are in place. Nearly all of the approximately 70 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northwest NPR-A portion of the Arctic Coastal Plain (ACP). Principal bird groups considered include loons and waterfowl, shorebirds, raptors, passerines, and seabirds. Generally, only three species are year-round residents.

a. Effects of Non-Oil and Gas Activities

Effects from management actions other than oil and gas exploration under Alternative C would likely be about the same as those discussed under Alternative A (Sec. IV.C.9) because the anticipated level of activities in all categories (except the area disturbed by excavation and collection--4 acres under Alternative A versus 2 acres under Alternative C) would be the same (Table IV-28).

b. Effects of Oil and Gas Activities

Under Alternative C, oil and gas leasing and exploration would be allowed in the Planning Area except in the Kasegaluk Lagoon Special Area, Kasegaluk Lagoon, Kuk River/Wainwright Inlet, Peard Bay, the northern and northeastern Planning Area to south of Smith Bay including Elson Lagoon and Dease Inlet/Admiralty Bay, a large proportion of the southern Planning Area, areas along major rivers, and numerous lakes and buffers throughout the area (Map 19). No oil and gas exploration activities in the southern area and along major rivers could provide some protection from disturbance for gyrfalcons if they overwinter in the areas where nest sites were occupied in summer (Ritchie and Wildman, 2000). In addition, some benefit could result from stipulations applied to all areas remaining available for leasing. These restrictions would provide substantial environmental protection. Exploration activity for the first sale could vary substantially depending on the price per barrel of oil (Table IV-05). Thus, the number of exploration/delineation wells could range from 1/1 to 4/2, and the number of drilling rigs would likely be one. The number of staging bases, production pads, and pipeline miles is estimated at none because commercial development is not projected to occur with most areas of high oil and gas potential unavailable for leasing. If exploration were to occur, it would be expected to take place over a period of 7 years.

(1) Effects of Disturbance

(a) Seismic Exploration

One seismic operation would be expected to occur in alternate winters under Alternative C, compared with three surveys each winter expected under Alternative A. It is likely that this decreased frequency would result in lower effects than those discussed under Alternative A. Although camps and survey areas are occupied for only brief periods and wintering bird species (gyrfalcon, ptarmigan, and snowy owl) are present at low densities, birds could be displaced by survey operations, potentially causing a minor effect on species with small or declining populations.

(b) Oil and Gas Development

The levels of most routine oil and gas exploration activities under Alternative C would be about one-quarter (or less) of those projected for Alternative A. Thus, it is likely that local disturbance effects would be considerably lower. During exploratory drilling in winter, displacement of the three species from the local area would be expected to occur. Duration of the displacement could range up to several months, but only a limited area would be affected; thus, the effect on overwintering species in a given area would likely be negligible. Overall effect of such routine oil and gas activities at the regional population level also would likely be negligible. Effects of air and vehicle traffic would likely be somewhat more widespread along approach corridors, but still would involve displacement only from the immediate area (and a few 100 m on each side of routes) for relatively short periods. Overall effect of air and vehicle traffic would likely be negligible. No gravel mining would be anticipated during exploration activities.

(2) Effects of Spills

Because commercial development would not be feasible under the restrictions applied to oil and gas activities under Alternative C, only exploration would be likely to occur, and no crude-oil spills would be expected (Table IV-19). Thus, none of the spill-related effects discussed under Alternative A would apply. Estimated number of small refined-oil spills under Alternative C also would be zero, and any that were to occur would likely be contained and cleaned up under winter conditions.

c. Effectiveness of Stipulations and Required Operating Procedures

Although no oil and gas development would be likely to occur under Alternative C, if development did occur, impacts on birds could be mitigated through restrictions placed on operators by the appended stipulations and ROP's. These could mitigate effects of four types of problems for birds that could result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, contamination of waterbodies occupied by birds, and mortality of fish that are prey for fish-eating birds.

Stipulation C-2 would mitigate disturbance of nesting raptors and other birds occupying surrounding areas by requiring that motorized ground-vehicle use be minimized within 1 mi of any known raptor nest site during the nesting season April 15 through August 15 (gyrfalcon nest sites beginning March 15), and prohibiting such use within 1/2 mi of active raptor nests.

Stipulation D-2, by prohibiting construction of permanent oil and gas facilities such as roads and airstrips during exploration, could mitigate disturbance of birds occupying surrounding areas by vehicle and aircraft noise and activity on roads and airstrips during breeding and post-breeding seasons.

Stipulation E-1 could minimize disturbance of resources of significant concern--such as raptors and other birds occupying surrounding areas--as determined through site-specific investigations, which may require additional design features or mitigation (including up to 1-mi setbacks for projects).

Stipulation E-2, by prohibiting construction of permanent roads (with possible exceptions for roads connecting separate fields), disturbance of birds occupying surrounding areas by vehicle noise and activity could be mitigated.

Stipulation E-3 could mitigate disturbance of breeding waterfowl (and shorebirds in particular) by restricting approval of permanent oil and gas facilities (which could include vehicle and aircraft noise and activity on roads and airstrips) to those that are likely to cause minimal effects within 500 ft of various waterbodies and their floodplains.

ROP F-1 could mitigate aircraft disturbance of raptors and other birds occupying surrounding areas by requiring aircraft to maintain an altitude of at least 1,500 ft above ground level (AGL) when within 1/2 mi of cliffs identified as raptor nesting sites from April 15 through August 5 (beginning March 15 for gyrfalcon nest sites), and requiring permittees to obtain information from BLM for planning flight routes near gyrfalcon nests.

Stipulation F-1, by requiring aircraft to maintain an altitude of at least 1,000 ft AGL over caribou winter ranges from October 1 through May 15, could mitigate disturbance of ptarmigan and ravens in these areas.

Stipulation F-2, by requiring aircraft to maintain an altitude of at least 2,000 ft AGL over the caribou insect-relief area from June 20 through July 31, could mitigate disturbance of breeding and post-breeding birds in this area.

Stipulation J-1 could mitigate disturbance of raptors and other birds occupying surrounding areas in the Colville River Special Area by requiring that all reasonable efforts be made to place permanent oil and gas facilities--which could include vehicle and aircraft noise and activity on roads and airstrips--as far from raptor nests as feasible.

Stipulation D-2, by prohibiting construction of permanent oil and gas facilities such as roads and airstrips during exploration, could mitigate loss of habitats occupied by breeding and post-breeding birds and any effect this might have on their breeding success.

Stipulation E-1, by establishing up to 1 mi setbacks prohibiting permanent oil and gas facilities (including roads and airstrips) in and adjacent to the active floodplain of selected waterbodies, could mitigate loss of habitats occupied by breeding and post-breeding birds and foraging raptors, and any effect this might have on their breeding success.

Stipulation E-2, by prohibiting construction of permanent roads (except between pads that create minimal environmental impacts in remote fields, and also with possible exceptions for roads connecting separate fields), would avoid loss of habitat occupied by some bird species.

Stipulation E-3 could reduce the loss (through burial) of wetland habitats, important for breeding waterfowl (and shorebirds in particular) by prohibiting permanent oil and gas facilities (including roads and airstrips) within 500 ft of the active floodplains of waterbodies not listed in stipulation E-1.

Stipulation E-4, by prohibiting gravel mine sites within the active floodplain of a waterbody, would avoid loss of habitat occupied by some bird species during breeding and post-breeding periods.

Stipulation E-5, by prohibiting causeways, artificial gravel islands, and bottom-founded structures in river mouths or deltas, would prevent burial of waterbird bottom-foraging habitat and blockage of free nearshore passage of fishes that may be prey for fish-eating waterbirds. Additional mitigation would be required if fish passage objectives (determined by required monitoring) were not being achieved.

Stipulation J-1 could reduce impacts on important habitats of raptors and other birds occupying surrounding areas in the Colville River Special Area by prohibiting alteration of high-quality raptor foraging habitat within 15 mi of nest sites, particularly in wetland and riparian habitats.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where waterbirds (and nesting or brood-rearing birds occupying adjacent habitats) could become contaminated and die, by requiring storage and fueling to take place in diked and impermeably lined areas at least 500 ft from the active floodplain of any waterbody.

Stipulation A-3 may prevent spilled fuel from entering waterbodies where waterbirds (and nesting or brood-rearing birds occupying adjacent habitats) could become contaminated and die, by prohibiting the refueling of equipment within 500 ft of the active floodplain of any waterbody.

Stipulation C-2 could prevent spilled fuel from entering waterbodies where waterbirds (and nesting or brood-rearing birds occupying adjacent habitats) could become contaminated and die, by prohibiting refueling of equipment within the active floodplain of any waterbody.

Stipulation E-1, by prohibiting location of pipelines within and adjacent to waterbodies according to prescribed setbacks--such as 1/2 mi from the Ikpikpuk River, except 1 mi in the raptor nesting area--could decrease the probability of any oil released from a leaking pipeline entering these waterbodies where it could contaminate breeding or post-breeding waterbirds.

Stipulation E-3 could prevent spilled fuel or leaking pipeline oil from entering waterbodies where waterbirds (and nesting or brood-rearing birds occupying adjacent habitats) could become contaminated and die, by prohibiting pipelines within 500 ft of the active floodplain of the waterbodies not listed in stipulation E-1.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species) by requiring storage and fueling to take place in diked and impermeably lined areas at least 500 ft from the active floodplain of any waterbody.

Stipulation A-3 could prevent spilled fuel from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species) by prohibiting the refueling of equipment within 500 ft of the active floodplain of any waterbody.

Stipulation B-1 could prevent winter die-off of fish prey of fish-eating birds (e.g., loons, mergansers, terns)--which could adversely affect the breeding success of these waterbird species--by prohibiting water withdrawal in winter from shallow lakes that are connected to a fish-bearing stream.

Stipulation B-2, by prohibiting compaction or removal of snow from fish-bearing waterbodies could prevent winter die-off of fish prey of fish-eating birds (e.g., loons, mergansers, terns), which could adversely affect the breeding success of these waterbird species.

Stipulation C-2 could prevent spilled fuel from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species) by prohibiting equipment refueling within the active floodplain of any waterbody.

Stipulation E-1 could prevent spilled fuel or leaking pipeline oil from entering waterbodies where fish prey of fish-eating birds (e.g., loons, mergansers, terns) could become contaminated and die (adversely affecting the breeding success of these waterbird species) by prohibiting pipelines within the prescribed distances of listed waterbodies.

Stipulation E-3 could prevent spilled fuel or leaking pipeline oil from entering waterbodies where fish prey of fish-eating waterbirds could become contaminated and die (which could adversely affect the breeding success of these waterbird species) by prohibiting permanent oil and gas facilities within 500 ft of the active floodplain of waterbodies not listed in stipulation E-1.

Stipulation E-4, by prohibiting gravel mine sites within the active floodplain of most waterbodies, so that the fish prey of fish-eating waterbirds would not be adversely affected, thereby adversely impacting the breeding success of these waterbird species.

These stipulations and ROP's would minimize disturbance of most bird species from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where waterbirds or fish prey of fish-eating birds could become contaminated, or from contaminating surrounding nesting and brood-rearing habitats. Except for some raptor nesting areas, the measures do not specifically establish minimum aircraft altitudes for routine flights over areas of high bird density. Also, the lack of a specific stipulation for summer use of ground vehicles in high bird density areas, except in the vicinity of raptor nest sites, could result in lowered nest success in local areas. In most cases, the stipulations and ROP's would likely affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a given species' regional population.

These mitigating measures would provide additional protection from disturbance, and habitat contamination and degradation for birds by protecting important habitats and providing buffers between raptors and late winter exploration activities.

d. Conclusion--First Sale

Under Alternative C, disturbance effects from non-oil and gas activities and routine oil and gas winter exploration activities would likely be negligible, as under Alternative A. However, effects of more numerous winter seismic surveys could be elevated to minor for species with small populations or that are declining. Effects of air traffic associated with exploration would likely be negligible under Alternative C.

e. Multiple Sales

If multiple sales were to occur under Alternative C, disturbance of any overwintering species by exploration activity would not be concentrated in the northern portion of the Planning Area (which would be unavailable for leasing under this alternative) as it would under Alternative A. Disturbance associated with multiple sales could result in increased local effects--over those expected from the first sale--especially if leases and activities were to be concentrated in limited portions of the remaining Planning Area. However, the overall effect of routine oil and gas activities at the regional population level would likely be negligible because there would still be a relatively low level of activity projected and most species' populations would be scattered over a large area. Effects of air traffic with multiple sales (particularly if exploration is concentrated in limited portions of the Planning Area) could be elevated to a minor level, especially for species with limited habitat preferences and small and/or declining populations (e.g., gyrfalcon, snowy owl).

f. Conclusion--Multiple Sales

Because the projected level of activity would be substantially less under Alternative C than under Alternative A and would be likely to involve only winter exploration in the portion of the Planning Area available to leasing (marine, western and southern and northeastern portions or the Planning Area would be unavailable for leasing), Alternative C would be likely to result in a negligible level of disturbance by most activities among affected overwintering species, and potentially minor effects from air traffic. This represents a substantial reduction in overall effect compared to Alternative A. However, effects of more winter seismic surveys could be elevated to minor for species with small populations or with populations that are declining. Effects of multiple sales over a longer period in remaining areas could elevate the overall probability of disturbance in those areas, thereby increasing the potential for disturbing overwintering birds well above that of the first sale.

10. Mammals

a. Terrestrial Mammals

(1) Effects of Non-Oil and Gas Activities

Under Alternative C, approximately 53 percent of the Northwest NPR-A Planning Area would be unavailable to leasing and the maximum number of special management designations would be made. The Kasegaluk Lagoon, Foothills, and Mountain WSA's would be established. Twenty-two rivers would be recommended for designation under the Wild and Scenic Rivers Act. The entire Planning Area would be designated as limited for OHV use. Under this alternative, the proposed WSA's and Wild and Scenic Rivers are unavailable to leasing and development, but would be open to seismic exploration. Over the short term, adding additional layers of protection in the form of management designations would have no practical impact on wildlife. If these areas were designated as wilderness, they would be protected from development for the long term, conferring a positive benefit to mammals. Limiting recreational OHV use in the summer would have no impact on terrestrial mammals as virtually no recreational OHV use occurs. However, over the long term, if recreational OHV use were to become more prevalent on the North Slope, negative impacts could be prevented or reduced.

Air traffic, excavation, and the presence of resource inventory survey camps are expected to increase somewhat under Alternative C as compared with the No Action Alternative. Impacts would be similar to those under the No Action Alternative, but could be more frequent, greater in extent, or longer in duration. Impacts from recreation and overland moves would be the same as those under the No Action Alternative. Current management practices and stipulations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities to terrestrial mammals as discussed under the No Action Alternative.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbance

1) Seismic

The effects of seismic operations on terrestrial mammals would be the same as those described under the No Action Alternative.

2) Exploratory Drilling

Under this alternative, no leasing or development would be allowed in numerous areas associated with important surface physical, cultural, or biological resources including virtually all of the moderate or high oil resource potential areas (Map 19). Under Alternative C, 1 to 4 exploration and 1 to 2 delineation wells are projected to be drilled. Impacts of drilling would be similar to those discussed under Alternative A, though much less in extent and duration. Impacts to caribou would be minimal. Important use areas for the TLH--including core mosquito and oestrid fly relief habitats (Map 50 and Map 49)--would be closed to leasing. A portion of the WAH summer range would be closed to leasing. Impacts to caribou would be limited to short-term disturbance of wintering TLH, and possibly WAH, animals. Impacts to moose, muskoxen, and grizzly bear would be lower than under Alternative A as the higher density habitats for these species would be closed to leasing.

3) Development

According to the scenarios, no oil or gas development would occur under this alternative. Therefore, there would be no impacts on terrestrial mammals from development. If development should occur, impacts from development would be similar to those discussed under Alternative A, but much less in extent as 53 percent of the Planning Area would be closed to leasing (Map 16). In particular, most of the moose winter habitat, currently occupied muskoxen habitat and higher density bear habitat would be closed. Much of the TLH insect-relief habitat (Maps 49 and 50) would also be closed to leasing (Map 19). In addition, permanent oil and gas facilities would be prohibited in portions of the insect-relief habitat that overlap with sensitive areas identified in Stipulation E-1, greatly reducing the potential for impacts to caribou.

(b) Effects of Spills

There would be no impacts on terrestrial mammals from spills as no spills are projected to occur. If, however, development did occur and spills resulted, the type of impacts would be similar to those discussed under Alternative A, though less in extent and frequency. Potential impacts to bears would be reduced as most of the higher density bear habitat and much of the coastal area would be closed to leasing.

(c) Summary

Among the terrestrial mammals that could be affected by management actions under Alternative C are caribou, grizzly bears, arctic fox, and small mammals. Terrestrial mammals could be temporarily disturbed or displaced by human activities associated with resource inventories, seismic operations, and exploratory drilling, although such exposure would not be expected to have any effects at the population level.

(3) Effectiveness of Stipulations and Required Operating Procedures

Much of the protection for terrestrial mammals and their habitat under this alternative is the result of land use allocations. Approximately 53 percent of the Planning Area would be unavailable to leasing. Oil and gas development would not be anticipated on the lands that would be made available for leasing. Stipulation A-1, ROP A-1 and ROP's A-2, A-3, A-4, A-6, A-7, C-1, E-1, E-2, E-4, and I-1 are the same under Alternative C as under Alternative A and would have a similar level of effect. Some of these stipulations and ROP's apply to development and although development is not anticipated under Alternative C, if it should occur, these measures would be at least as effective as described under Alternative A. The effectiveness of stipulations A-2, A-3, D-1, D-2, E-1, and E-2, and ROP's E-5, E-6, E-7, F-1, F-2, and J-2 are described in Appendix 12. In general, these stipulations would have positive effects on terrestrial wildlife, although some would only apply if oil and gas development were to occur.

(4) Conclusion--First Sale

The effects of seismic operations and non-oil and gas activities on terrestrial mammals would be similar to (though somewhat greater in extent than) those discussed under the No Action Alternative. The effects of exploratory drilling would be similar to those discussed under Alternative A, but with a lower level of impact. Assuming that no development were to occur, there would be no impacts from oil and gas development. If development should occur, the type of impacts would be similar to those under Alternative A, though much smaller in magnitude because many of the sensitive habitats would be closed to leasing.

(5) Multiple Sales

Impacts to terrestrial mammals from multiple sales would be slightly more intensive or widespread than under the first sale as more exploration (and possible development) would occur.

(6) Conclusion--Multiple Sales

Assuming no development was to occur, no southern pipeline route would be constructed, so there would be no impacts to CAH caribou, no spills would occur, no gas pipeline would be constructed to Prudhoe Bay, and no oil field would be developed in TLH insect-relief habitat; thus many of the impacts to caribou would be eliminated. Impacts to moose, muskox, and grizzly bear would also be reduced.

b. Marine Mammals

Under Alternative C, the northern and western coasts of the Planning Area (extending from the Dease Inlet to west of Barrow and the Kasegaluk Lagoon), Peard Bay, the Kuk River system (Wainwright Inlet), Dease Inlet/Admiralty Bay area, and Elson Lagoon would be unavailable for oil and gas leasing. Seven species of nonendangered marine mammals--ringed, spotted, and bearded seals; walruses; polar bears; and beluga and gray whales--commonly occur year round or seasonally in coastal habitats adjacent to the Planning Area. Under Alternative C, some individual polar bears and maybe spotted seals could be exposed to effects from activities in the Northwest NPR-A Planning Area.

(1) Effects of Non-Oil and Gas Activities

Ground-impacting management actions along the coast within the Planning Area that could affect nonendangered marine mammals under Alternative C include aerial surveys (including surveys of wildlife); ground activities (such as resource inventories), paleontological excavations, research and recreational camps (hunting and river floating), seismic exploration, and overland moves. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. The other activities take place in summer and early fall (June-September). The primary potential causes of disturbance of marine mammals are helicopter traffic (1 to 2 round trips/day for 3 to 6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities, if they were to occur along the coast of the Planning Area, could cause short-term (<1 hour) displacement or harassment of hauled-out seals and polar bears. Recreational camps in some cases could attract bears, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves would be expected to be minor or insignificant to the bear population, but would contribute to cumulative adverse effects.

No fuel spills are projected to occur in association with resource inventories and surveys, recreational activities, and overland moves. If any were to occur, spills would likely involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly with only local effect on vegetation. Under current BLM requirements, fuel spills must be cleaned up immediately, if possible. Such events would not be expected to have any significant effects on marine mammals in the Planning Area.

Under Alternative C, the effects of activities other than oil and gas exploration and development on marine mammals (seals, polar bears, and whales) would be local and short term, with no significant adverse effects to the populations.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

It is assumed that geophysical surveys would use 60 persons and would collect 5 to 10 line-miles of 3-D seismic data/day and would be conducted entirely in winter (early December to mid-April) using ice roads. Under Alternative C, seismic surveys conducted near the coast could expose a few denning polar bears to seismic activity noise and associated disturbances. Although seismic surveys would be prohibited near known polar bear den sites in the Planning Area, such activities could result in the displacement of a few maternal polar bears and their cubs, leading to the abandonment of the den site and possible loss of a small number of cubs. Few polar bears would be expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the Planning Area (Map 51).

Onshore seismic activity would not be expected to have any effects on other marine mammals. Ringed seals den during the winter; however, denning ringed seals would not be expected to be exposed to the noise and activity associated with onshore seismic operations because their denning habitat is located in the floating fast-ice zone generally some distance offshore.

Overland moves typically occur each winter, travel from Prudhoe Bay or Oliktok Point to Barrow, follow an offshore route over stable sea ice, and include (in one season) 20 to 100 trains of 1 to 6 vehicles and attached sleds. These moves could be a disturbance to denning ringed seals if the routes were to cross floating fast-ice areas, and could temporarily displace seals within a short distance of the traffic route. Polar bears also could be temporarily disturbed within about 1 mi of this traffic. Seismic effects under Alternative C would be local and short term, with no significant adverse effects to the populations as a whole.

(b) Effects of Spills

No spills are assumed to occur under Alternative C.

(3) Effectiveness of Stipulations and Required Operating Procedures

Handling of food and garbage under stipulations A-1 and A-2 (waste prevention, handling, and disposal) would prevent the attraction of polar bears to campsites--encounters that could result in the taking of polar bears in human/bear interactions. Under stipulation C-1 (overland moves), operators planning winter activities (October 30 through April 15) must consult with FWS to prevent disturbance of denning polar bears. Activities would be prohibited within 1 mi of known polar bear dens. This consultation is expected to prevent most disturbances of denning polar bears under Alternative C. ROP F-1 (aircraft traffic) would reduce the number of aircraft disturbances of marine mammals and other wildlife.

Under the Marine Mammal Protection Act (MMPA), harassment or "taking" of marine mammals is prohibited unless the lessees have a Letter of Authorization (LOA) that would allow them to unintentionally harass marine mammals during their operations. To limit and avoid excessive harassment or taking of non-endangered marine mammals, the MMPA requires lessees to have an LOA to conduct activities that may harass or take marine mammals. This requirement is expected to limit any disturbance of marine mammals associated with seismic activities in the Northwest NPR-A Planning Area.

(4) Conclusion--First Sale

Effects under Alternative C would be similar to those for the No Action Alternative--local and short term, with no significant adverse effects to the populations as a whole.

(5) Multiple Sales

The effect of oil and gas activities with multiple sales under Alternative C would be expected to be about the same as for the single sale--local and short term, with no significant adverse effects to marine mammal populations--but the duration and extent of activities would occur over a longer period of time, as would potential disturbance effects.

(6) Conclusion--Multiple Sales

Effects under Alternative C would be similar to those for the No Action Alternative--local and short term, with no significant adverse effects to the populations as a whole.

11. Endangered and Threatened Species

This section discusses potentially adverse effects of management actions, including oil and gas exploration and development, on endangered and threatened species affected by projected activities within the Northwest NPR-A Planning Area under Alternative C. Effects on bowhead whales would result primarily from disturbance during their semiannual migration past the Planning Area. Effects on spectacled eider and Steller's eider exposed to such activities would be: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, staging, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by crude- and refined-oil products, wastewater, and solid-liquid wastes of various toxicity. This analysis assumes stipulations in Table II-02 would be in place.

a. Consultation Assumptions

In accordance with the ESA Section 7 regulations governing interagency cooperation, the early consultation process was initiated when BLM requested notification from the U.S. Fish and Wildlife Service (FWS) (memorandum dated June 10, 2002) and the National Marine Fisheries Service (NOAA Fisheries) (letter dated June 10, 2002) of the listed and proposed species and critical habitat to be referenced in the memorandum and letter to follow requesting initiation of formal consultation for this project. The FWS responded (memorandum, dated July 24, 2002), specifying the threatened spectacled and Steller's eiders as the species to be included in the IAP/EIS for the Planning Area; and NOAA Fisheries responded (letter, dated July 26, 2002), specifying the endangered bowhead whale as the species to be included. These letters are reproduced in Appendix 10. No critical habitat is located within the Northwest NPR-A Planning Area.

The endangered bowhead whale may occur seasonally adjacent to or in the Planning Area, and the threatened spectacled and Steller's eiders occur seasonally in the Planning Area; each of these species may be exposed to activities associated with the Northwest NPR-A management plan. Sections 4(d) and 9 of the Endangered Species Act (ESA), as amended, prohibit taking of listed species of fish and wildlife without a special exemption. "Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harass" is further defined as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behaviors that include, but are not limited to, breeding, feeding, or sheltering. "Harm" is further defined as an act that may include significant habitat modification or degradation to the point at which it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NOAA Fisheries agreed that the proposed project was unlikely to adversely affect the bowhead whale and found that formal consultation was not required, as noted in their July 26, 2002 letter (Appendix 10). Section 7 consultation with FWS was reinitiated in September 2003 to address the BLM's Preferred Alternative developed for the Final IAP/EIS. Additional and updated information and analysis on the potential impacts of selected factors on spectacled and Steller's eiders can be in the *Biological Assessment for Threatened and Endangered Species with Respect to the Proposed Northwest National Petroleum Reserve-Alaska Integrated Activity Plan* (USDOI, BLM, 2003) prepared for the reinitiation of the Section 7 consultation with FWS.

b. Effects of Non-Oil and Gas Activities

Effects of management actions within the Planning Area on bowhead whales and spectacled and Steller's eiders under Alternative C might include altered distribution, abundance, and/or behavior resulting from disturbance (aircraft, human presence and activity) during breeding, staging, or migration periods and alteration and pollution of eider habitats. Effects on eiders of non-oil and gas activities could be somewhat greater than those discussed under the No Action Alternative (Section IV.B.11), and somewhat less than those under Alternative B. Any increase over No Action would be because several categories of anticipated non-oil and gas activities--including duration of aerial surveys, duration of camp occupation, and area of ground disturbed--would increase under Alternative C (Table IV-28). The effect of these differences could be lessened if Kasegaluk Lagoon (potentially used by eiders) were to be designated a Special Area or Wilderness where activities likely to cause wildlife disturbance could be controlled.

(1) Effects on the Bowhead Whale

Bowhead whales may be present in the Beaufort Sea off the northern Planning Area boundary primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea (Map 64). They may be present in the Chukchi Sea off the western Planning Area in April to early June during their northward spring migration. Under Alternative C, only under exceptional circumstances--if whales were to be migrating near the coast coincident with the presence of barge traffic, or possibly air traffic--would it be likely that bowheads would be disturbed by activities associated with the management plan. For example, in fall of 2000, when median distance of migrating whales offshore was just 11 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance from underwater or airborne noise would have existed. Effects from such exposure would likely be negligible.

(2) Effects on Spectacled and Steller's Eiders

Spectacled eiders are widely distributed on lakes throughout much of the Planning Area in summer (Larned et al., 2001; Ritchie and King, 2002), and are essentially absent from the area from October to May. The highest densities occur in several areas from Dease Inlet west to the Chukchi coast and west of the community of Atqasuk to Peard Bay and Kuk River/Wainwright Inlet (Map 62). Steller's eiders are sparsely distributed in the Planning Area, particularly in the northwest portion between Dease Inlet/Admiralty Bay and the Chukchi coast, and nest attempts apparently are relatively infrequent (Map 62). They are absent from the area from late October to May. Effects of management actions on spectacled and Steller's eiders would likely be similar to those discussed for other waterfowl species in Section IV.B.9.

Most ground transport activities occur in winter and thus would not disturb eiders or affect their habitats. Eiders would be likely to be displaced from within 700 ft to 0.6 mi of large summer encampments, causing a local decline in nest attempts and success. Under Alternative C, occupation of large camps would be anticipated at 12 weeks (as under Alternative B) rather than 6 weeks, as under the No Action Alternative (Table IV-28). However, this difference would not be likely to alter the disturbance effects on birds significantly, because in the context of the short arctic breeding season, those that would be displaced when the camp was first occupied probably would not return to the area to renest after 6 weeks any more readily than after 12 weeks because of lack of mate availability and insufficient time remaining in either scenario to raise a brood at the end of either of these periods. Also, those individuals that would be tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks. Local eider populations could experience minor declines in breeding success from disturbance in summers when camps would be occupied, though this may not be as relevant to Steller's eiders, with their scattered distribution. While the effects of small, frequently moved camps would be likely to be negligible; those in place for 6 to 12 weeks could cause minor local loss of nest success and productivity. Overall habitat loss from non-oil and gas activities in Northwest NPR-A under Alternative C would be expected to be negligible in its effect on eiders. Predators attracted to camps could decrease breeding success of local eiders. Waste removal and fuel spill cleanup could disturb local nesting or brood-rearing birds for varying periods, resulting in nest failure for those directly involved. Small groups of travelers on the Colville and other rivers at the anticipated level would be expected to cause only minimal disturbance of eiders.

Effects of routine air traffic into large camps could range from causing avoidance of certain areas by eiders to abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights could pass over areas where eiders occur at higher density. Aerial survey flights for monitoring bird or caribou populations would have considerable potential for disturbance of eiders because they are flown at low altitude. However, in any given area they would be of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects would likely be minimal. Other aerial surveys would also be likely to cover only a small percentage of the Planning Area. Under Alternative C, duration of wildlife and other aerial surveys and camp occupation would be the same as for Alternative B (Table IV-28), so the resulting disturbance would likely be similar. Other aircraft activity would be lower and the area of habitat disturbed less under Alternative C. In isolated areas, aircraft effects would likely be negligible, though potentially minor effects could occur in the vicinity of large camps. Spills of refined-oil products would likely be contained and cleaned up before contacting eiders. Quantitative effects resulting from most factors would likely be difficult to separate from natural variation in population numbers.

c. Effects of Oil and Gas Activities

The proposed Kasegaluk Lagoon Wilderness Study Area (WSA), which may be used by eiders, would be unavailable for oil and gas leasing under Alternative C (Map 19; Table II-01). (The proposed Foothills and Mountain WSA's are little used by eiders.) The fact that the WSA's would be unavailable for oil and gas leasing, together with the generally lower level of oil and gas activity projected for Alternative C (see below), could result in somewhat lower effects than under Alternative B (though still a greater effect than for the No Action Alternative, under which the entire Planning Area would be unavailable for oil and gas leasing). Exploration and development/production activity for the first sale could vary depending on the price per barrel of oil (Table IV-05). The number of exploration/delineation wells could vary from 1/1 to 4/2. The number of projected exploration/delineation rigs would be 1, and the number of staging bases, production pads, and pipeline miles would be 0. If exploration were to occur, it would be expected to take place over a period of 7 years. If development were to occur, it would be expected to require 10 years. Production would be estimated to last 22 years.

(1) Effects of Disturbance

(a) Seismic Exploration

Seismic surveys occur during winter months (December-April) when eiders and nearly all bowhead whales are absent from the region. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early-arriving eiders could occur, causing negligible increases in energy use. Standardized mitigation requirements (Appendix 13) calls for removal from public lands and/or incineration of waste materials, which would include those generated by seismic crews, hence this activity would not be expected to enhance the survival of predatory arctic foxes.

(b) Oil and Gas Development

Disturbance of eiders can: 1) cause injury or death, 2) cause increased energy expenditures that affect physiological condition and rate of survival or reproduction, or 3) cause long-term changes in behavior, including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect on eiders from oil and gas development and production in Northwest NPR-A, although careful planning and scheduling could avoid most serious effects. Depending on location and season, oil and gas activities in areas where eiders occur potentially could cause increased disturbance from routine aircraft operations, gravel-mining operations, presence of gravel pads and facilities, and associated vehicle and foot traffic. Initial developments would be likely to occur in the extreme northern portion of the Planning Area, extending from the Dease Inlet/Admiralty Bay area to Smith Bay and the Chukchi coast. Substantial numbers of spectacled eiders (Map 62) could be affected to some extent by individual disturbance events (e.g., passage of aircraft), although most incidents would be expected to result in minor effects from which individuals would recover within hours to one day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially could adversely affect physiological condition, nest success, molt, and survival of individuals. Ultimately this could result in population level effects although these usually are difficult to separate from natural variation in population numbers. The presence of facilities and construction of gravel structures would result in displacement from favored habitats and associated energy costs that could result in short-term, negative effects during breeding, brood-rearing, or migration; however, the footprint of such structures is quite small, so effects would not likely be evident at the regional population level.

1) Bowhead Whale

The bowhead whale migration route typically is well offshore (median 32.2 km) of where any oil and gas development would be likely to occur (Treacy, 2002), so it would be unlikely that whales would experience intense or frequent enough disturbance from noise originating from Northwest NPR-A activities to modify normal behavior.

2) Bird Concentrations

Disturbance effects could be particularly serious in areas where higher densities of spectacled eiders occur. Such areas are: west of Dease Inlet; south of Barrow; the southwest-central portion of the Planning Area; the western Planning Area south of Peard Bay, east of Wainwright, and east of the Kuk River (Map 62). Steller's eiders usually are sparsely scattered across the northern Planning Area (Map 63), with a somewhat greater concentration south of Barrow. Making estuarine areas unavailable for oil and gas leasing under this alternative could decrease the potential for disturbance of postbreeding eiders by aircraft, vessel, and personnel operations in these areas.

3) Air traffic Effects

Air traffic would likely be the most important source of disturbance associated with oil and gas development, helicopters being the most disturbing type. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992), few comparable studies of effects on other species at other phases of the annual cycle, or long-term effects on populations, have been done. Also, it is not known whether eiders and brant are at all comparable in this regard.

Aircraft routinely flying over the areas of higher density in the Planning Area noted above would be likely to cause at least minor effects in the local eider populations. For example, disturbance associated with development in the northern area (where the first would be likely to occur) could adversely affect higher concentration areas of both eiders south of Barrow.

4) Structures

The presence of pads, short connecting roads, facilities, and drilling operations would be expected to displace local breeding individuals from the affected sites, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals could relocate in nearby comparable habitat, as suggested by studies at Prudhoe Bay (Troy and Carpenter, 1990). Such displacements would not be expected to cause long-term effects on population productivity because of the relatively small area likely to be involved at a given site (TERA, 1993; Troy and Carpenter, 1990), but would be a long-term or permanent local result. Overall effect, particularly at the regional level, is likely to be negligible. Permanent roads connecting to infrastructure to the east are very unlikely to be constructed.

5) Gravel

Gravel within the Planning Area is likely to be obtained from river drainages and be transported to a site on ice roads during winter. The result of this activity, habitat burial, would displace any nesting individuals to undisturbed habitats from the local area (up to 50 acres), with potential for lowered productivity. Depending on location and extent of the mine site, overall effects could range from negligible to minor where mining eliminates breeding habitat of the spectacled eider, declining at a non-significant rate.

6) Pipelines

The presence of an aboveground pipeline is not likely to represent a significant collision hazard since migrating eiders generally fly at much greater altitude, and much movement during the breeding season is by swimming.

(2) Effects of Spills

The estimated number of small crude-oil spills (less than 500 bbl) is zero under Alternative C. The estimated number of large crude-oil spills (500 or 900 bbl) is also zero. The number and volume of small refined-oil spills is zero.

If a spill were to occur from a pad onto tundra and then into local lakes or other inter-connected wetlands it could cause mortality of small numbers of eiders, especially during the brood-rearing period later in summer. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the water. It is likely the above effects would be negligible to minor with regard to the proportion of the regional population involved. Because of the oil-absorptive capacity of tundra habitats, even if a spill enters a river it is likely that only a small proportion would enter the marine environment.

Under Alternative C, much of the Northwest NPR-A coastline of potentially high eider use, Kasegaluk Lagoon and potentially other areas with important surface resources, would be unavailable for oil and gas leasing, suggesting that any oil spill reaching them would have to originate from farther inland. If a spill moved into a delta area, Elson Lagoon, Dease Inlet, or Chukchi Sea coastal waters, individuals staging before or during fall migration would be at risk, with the potential to elevate effects to a moderate level. Many spectacled eiders nesting in the western part of the Planning Area may migrate overland directly to Chukchi lagoons, avoiding spills into the Beaufort from the northern Planning Area, but increasing potential exposure in the latter area. As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of fewer than 20 individuals, but potentially tens of individuals could be killed by cumulative total mortality from many small spills. The effect of such losses may not be detectable above the natural fluctuations of the population.

Physiological effects of oil on individual birds would be the same as those described in the *Northeast National Petroleum Reserve-Alaska IAP/EIS* (1998). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interferes with the reproductive process. Flocks of staging eiders could contact oil in nearshore or offshore areas. The spectacled eider population has declined 50 percent in 20 years so substantial mortality could be significant.

d. Effectiveness of Stipulations and Required Operating Procedures

Although no oil and gas development is likely to occur under Alternative C, if development did occur, impacts on eiders could be mitigated through restrictions placed on operators by the appended stipulations and ROP's. These could mitigate effects on birds of three types of problems that may result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, and contamination of waterbodies occupied by eiders. No stipulations specifically apply to bowhead whales.

Stipulation D-2, by prohibiting construction of permanent oil and gas facilities such as roads and airstrips during exploration, could mitigate disturbance of eiders occupying surrounding areas by vehicle and aircraft noise and activity on roads and airstrips during breeding and post-breeding seasons.

Stipulation E-2, by prohibiting construction of permanent roads (with possible exceptions for roads connecting separate fields) disturbance of eiders occupying surrounding areas by vehicle noise and activity could be mitigated.

Stipulation E-3 could mitigate disturbance of breeding eiders by restricting approval of permanent oil and gas facilities, which could include vehicle and aircraft noise and activity on roads and airstrips, to those that are likely to cause minimal effects within 500 ft of various waterbodies and their floodplains.

Stipulation F-2, by requiring aircraft to maintain an altitude of at least 2,000 ft above ground level (AGL) over the caribou insect-relief area from June 20 through July 31, could also mitigate disturbance of breeding and post-breeding eiders in this area.

Stipulation D-2, by prohibiting construction of permanent oil and gas facilities such as roads and airstrips during exploration, could mitigate loss of habitats occupied by breeding and post-breeding eiders and any effect this might have on their breeding success.

Stipulation E-2, by prohibiting construction of permanent roads except between pads that create minimal environmental impacts in remote fields (with possible exceptions for roads connecting separate fields) would avoid loss of habitat potentially occupied by eiders.

Stipulation E-3 could reduce the loss (burial) of wetland habitats important for breeding eiders by prohibiting permanent oil and gas facilities, including roads and airstrips, within 500 ft of the active floodplains of waterbodies not listed in stipulation E-1.

Stipulation E-4, by prohibiting gravel mine sites within the active floodplain of a waterbody, would avoid loss of habitat occupied by some eiders during breeding and post-breeding periods.

Stipulation E-5, by prohibiting causeways, artificial gravel islands, and bottom-founded structures in river mouths or deltas, would avoid burial of eider bottom foraging habitat.

Stipulation A-2 could prevent spilled fuel, other petroleum products, and other liquid chemicals from entering waterbodies where eiders could become contaminated and die, and contamination of nesting or brood-rearing eiders occupying adjacent habitats, by requiring storage and fueling to take place in diked and impermeably lined areas at least 500 ft from the active floodplain of any waterbody.

Stipulation A-3 may prevent spilled fuel from entering waterbodies where eiders could become contaminated and die, and contaminating nesting or brood-rearing eiders occupying adjacent habitats, by prohibiting the refueling of equipment within 500 ft of the active floodplain of any waterbody.

Stipulation C-2 may prevent spilled fuel from entering waterbodies where eiders could become contaminated and die, and contamination of nesting or brood-rearing eiders occupying adjacent habitats, by prohibiting refueling of equipment within the active floodplain of any waterbody.

Stipulation E-3 may prevent spilled fuel or leaking pipeline oil from entering waterbodies where eiders could become contaminated and die, and contamination of nesting or brood-rearing eiders occupying adjacent habitats, by prohibiting pipelines within 500 ft of the active floodplain of waterbodies not listed in stipulation E-1.

These stipulations and required operating procedures would minimize disturbance of eiders from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where eiders could become contaminated, or contamination of surrounding nesting and brood-rearing habitats. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of an eider regional population.

e. Conclusion--First Sale

Under Alternative C, disturbance effects of small summer camps are likely to be negligible, and minor in the vicinity of large summer camps. Disturbance effects of routine oil and gas activities from overland transport of equipment, seismic surveys, and most gravel mining in winter would not occur since eiders are not present. Effects of air traffic to development sites in summer, and gravel mining that eliminates breeding habitat, is likely to be minor. Effects from crude-oil spills could range from minor, when confined to terrestrial and freshwater aquatic habitats where mortality is likely to be relatively low, to moderate if a spill enters a nearshore marine staging area.

f. Multiple Sales

If multiple sales occur under Alternative C, construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under a multiple-sale scenario, depending on the oil price, up to 2 times the number of exploration and delineation wells may be drilled (5 to 16 for multiple sales versus 2 to 6 for the first sale; Tables IV-05 and IV-07); however, the number of fields expected to be developed (0), production pads (0), and pipeline mileage (0) are the same (Tables IV-06 and IV-07), given the assumption that production is unlikely to occur. Effects from disturbance factors and habitat alteration or loss for each development are likely to be short-term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially is lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oilfield facilities associated with multiple sales are grouped in high-resource-interest areas; if these are located in higher concentration areas, as appears to be likely south of Barrow, greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such effects may alter the populations of these local areas substantially, and effects could extend to regional populations and involve long-term changes in distribution. Effects could be elevated to a moderate level with multiple developments concentrated in a limited region; however, this appears an unlikely scenario under Alternative C.

The estimated number of crude oil spills for multiple sales under Alternative C is zero (Table IV-19).

g. Conclusion--Multiple Sales

Displacement of eiders by disturbance and habitat alteration or loss is expected to increase substantially if development and production facilities are located in a limited region with higher resource potential (i.e., northern Planning Area). This also could occur in several portions of the Planning Area if multiple sales were to be, potentially altering local populations in these areas, and effects could extend to the regional population and involve long-term changes in distribution. Although most effects that are likely to occur throughout the Planning Area are expected to be short term and negligible or minor, moderate effects could occur if concentrations were to be involved. Although no development is projected to occur with multiple sales under Alternative C, overall effects could increase from that discussed for the first sale if development were to occur and were to be relatively concentrated in a limited area.

12. Economy

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities under Alternative C would be the same as those under Alternative A.

b. Effects of Oil and Gas Activities

The economic effects of the first sale under Alternative C are likely to be the same as those under the No Action Alternative because, according to Section IV.A.1.b, the regulatory burden is so extensive that it is doubtful that commercial development could occur without granting exceptions on a site-specific basis.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's do not affect the potential economic impacts of Alternative C.

d. Conclusion--First Sale

The economic effects of the first sale Alternative C are likely to be the same as those under the No Action Alternative because, according to Section IV.A.1.b, the regulatory burden is so extensive that it is doubtful that commercial development could occur without granting exceptions on a site-specific basis.

e. Multiple Sales

The economic effects of multiple sales under Alternative C are likely to be the same as those under the No Action Alternative because, according to Section IV.A.1.b, the regulatory burden is so extensive that it is doubtful that commercial development could occur without granting exceptions on a site-specific basis.

f. Conclusion--Multiple Sales

The economic effects of multiple sales under Alternative C are likely to be the same as those under the No Action Alternative because, according to Section IV.A.1.b, the regulatory burden is so extensive that it is doubtful that commercial development could occur without granting exceptions on a site-specific basis.

13. Cultural Resources

a. Effects of Non-Oil and Gas Activities

Under Alternative C, the types of non-oil and gas activities would be the same as those under the No Action Alternative; however, the level of activity and duration could slightly increase. This means there is a greater likelihood of impacts on cultural resources under this alternative than under the No Action Alternative, but impacts would still be minimal and less than those under Alternatives A or B.

b. Effects of Oil and Gas Activities

Under Alternative C, which provides the highest level of environmental protection for the Northwest NPR-A Planning Area, the level of seismic activity is expected to increase slightly beyond that of the No Action Alternative. While much of the Planning Area would be available for oil and gas exploration, a substantial amount of the high oil and gas potential area would be unavailable for lease or would have significant stipulated environmental constraints in place. Still, there would be an increase in the lessees' need for additional seismic data. While the types of potential impacts to cultural resources would be the same in Alternative C as those described under the No Action Alternative, the increased level of seismic activity would increase the possibility that impacts could occur. While the level of seismic activity for Alternative C is expected to be less than it would be for Alternative A, the levels of other oil and gas activities would be considerably reduced. In the areas available to exploration under this alternative, unknown buried cultural resources are reasonably secure from any significant impact. In the areas where cultural remains are known to occur, particularly on the surface, protective stipulations are in place.

Cultural resources are not ubiquitous in the Planning Area, as are wildlife and habitat. Although cultural resources--because of their near-surface and surface contexts as well as other factors--are more common than paleontological deposits, generally they are more easily recognized and therefore avoided. As a result, it is quite possible that oil and gas exploration activities would have limited impact on cultural resources simply because in most cases oil and gas activities could be conducted to avoid the locations of cultural resources.

(1) Effects of Disturbances

Under Alternative C, the level of oil and gas activity in the Planning Area is projected to be substantially reduced from that under Alternative A. As was previously mentioned, because most of the activity would occur during the winter months, the potential for impact to buried cultural resources would remain relatively low. The likelihood of impacting surface cultural materials, while higher, may not be significant because of their isolated and scattered occurrence and because of the more restrictive stipulations associated with Alternative C.

The drilling of as many as 4 exploration wells and 2 delineation wells could occur under Alternative C. Although 6 wells could be drilled in a single winter season it is anticipated the work would be conducted over more than one season. As always, drill pads, camp pads, roads, and airstrips would be made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no gravel or rock needed, no significant disturbance of the ground would occur, and buried cultural resources would not be in jeopardy. It is possible that drilling the hole could impact a small amount of material if a hole was drilled through a cultural resources site but the likelihood of that occurrence is minuscule and the resultant impacts to the site would probably be minimal.

Under Alternative C, it is assumed there would be no development because of the restrictiveness of the stipulations, and therefore, no subsequent environmental impacts. However, if development were to occur, the effects of the assumed disturbance (i.e., the construction of several production pads connected by roads, one airstrip, one pump station, one staging base and approximately 130 mi of pipeline) could possibly occur under Alternative C. Surface disturbance resulting from this work would impact approximately 140 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to cultural resources would result from the excavation of material for construction of the permanent facilities. If the pads/roads/airstrip material source is terrestrial, then extraction of material could impact cultural resources. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of VSM's. It is possible, but highly unlikely, that buried cultural resources would be impacted. If buried pipelines were to be used, disturbance and impacts to cultural resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline. The potential for impacts to surface cultural resources under this alternative have been previously discussed.

(2) Effects of Spills

No spills are projected to occur under Alternative C. An estimated 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. In the exploration stage, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions when cleanup is less invasive than in a summertime terrestrial spill. In such a case, a buried cultural resource site would probably not be affected by the spill or subsequent spill cleanup. On the other hand, a surface cultural resources site could be impacted by such a spill and/or the subsequent cleanup.

c. Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, stipulations E-1a, f, g, i, l, and s and ROP C-1c apply to cultural resources. Stipulation E-1 would apply to a very few specific locales within the Northwest NPR-A Planning Area and ROP C-1 would apply only in an ancillary sense. There is no general stipulation or ROP specific to cultural resources. The NHPA requires that an archaeological/paleontological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities such as the construction of buried pipelines would be considered undertakings. If paleontological resources were to be identified during the survey, Federal law requires that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

d. Conclusion--First Sale

Under Alternative C, impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously stated. Impacts would include displacement and/or destruction of resources and are anticipated to be minimal regardless of the level of seismic activity. Under Alternative C, the potential impacts to cultural resources from first sale oil and gas exploration would be significantly reduced from those in Alternative A because of increased environmental constraints.

e. Multiple Sales

Under Alternative C, the potential for impacts to cultural resources would be minimal. While the scattered nature of cultural deposits and the fact that the locations of most remain unknown (making it somewhat difficult to assess the likelihood and severity of potential impacts), the environmental constraints present in Alternative C are expected to further reduce potential impacts.

f. Conclusion--Multiple Sales

Under Alternative C, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously described. At the same time, the probability of the occurrence of such impacts should decrease from those assumed under Alternative A. Under Alternative C, the potential impacts to cultural resources from oil and gas exploration would be minimal.

14. Subsistence-Harvest Patterns

Under Alternative C, approximately 62 percent of the Planning Area would be unavailable for leasing and the greatest number of special management designations would be made. The Kasegaluk Lagoon, Foothills, and Mountain WSA's would be established. Twenty-one rivers would be recommended for scenic-river designation, one river would be recommended for wild-river designation, the entire Planning Area would be closed to recreational ORV use, and the use of airboats would be prohibited. Under this alternative, the proposed WSA's and Wild and Scenic Rivers would be unavailable to leasing, but would be open to seismic exploration.

Exploration and development/production activity for the first sale could vary depending on the per barrel price of oil. The number of exploration/delineation wells could vary from 1/1 to 4/2. The number of exploration/delineation rigs and staging bases projected is 1, the number of production pads and pipeline miles is 0. If only exploration occurs, it is expected to take place over a period of 7 years. If development occurs, it is expected to require 10 years. Production is estimated to last 22 years with any expected development involving relatively small, interconnected gravel structures.

a. Effects of Non-Oil and Gas Activities:

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbance activities and oil spills under Alternative C on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in this section (Sec. IV.E) above.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from oil and gas exploration and development activities under Alternative C on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) are analyzed in this section (Section IV.E) above.

(2) Effects of Oil Spills

No spills are projected to occur under Alternative C.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations that protect and mitigate impacts to subsistence resources would also mitigate potential impacts to subsistence-harvest patterns. Specifically for subsistence, Stipulation E-1 prohibits permanent oil and gas facilities within and adjacent to waterbodies with identified subsistence values; identified areas are on the Ikpikpuk, Alaktak, Chipp, Oumalik, Titaluk, Kigalik, Topagoruk, Meade, Inaru, Kugrua, Kuk, Alataktok, Ivasaruk, Kaolak, Ketik, Avalik, Kungok, and Colville Rivers, as well as Maybe Creek, fish-bearing deep-water lakes, and important habitat on productive bays and lagoons, particularly Kasegaluk Lagoon, the mouth of the Kuk River, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay. Stipulation H-1 would specify that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP H-1 would direct the lessee to develop and implement a plan, in consultation with the Research and Monitoring Team and the SAP, to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area. The program would be specifically designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel would be working with the intent of reducing any potential conflicts with subsistence.

d. Conclusion--First Sale

The overall effects of oil and gas activities under Alternative C on subsistence resources and harvest patterns are expected to be the same or less than those for Alternative A. Effects on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally <1 year), and to have no regional population effects.

Impacts to caribou would be minimal under Alternative C. Important use areas for the TLH, including core mosquito and oestrid fly relief habitats would be closed to leasing. A portion of the WAH summer range would be closed to leasing. Impacts to caribou would be limited to short-term disturbance of wintering TLH and possibly WAH animals. No oil and gas development is expected to occur under this alternative. If development were to occur, impacts would be similar to those discussed under Alternative A but would be much less in extent, as more of the Planning Area would be closed to leasing. In particular, the TLH insect-relief area would be unavailable to leasing, greatly reducing the potential for significant impacts to caribou. Additionally, most moose winter habitat, currently occupied muskoxen habitat, and higher density bear habitat would be unavailable to leasing.

Subsistence-harvest patterns effects are expected to be the same or somewhat less than those for Alternative A, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. With no development expected under Alternative C and many critical habitats and harvest areas closed to leasing, moderate to high effects expected on the productivity of TLH under Alternatives A and B would not occur.

e. Multiple Sales

For multiple sales under Alternative C most resources would see decreases in effects from no development activity; any effects on terrestrial mammals, freshwater fish, marine fish, birds, bowheads whales, beluga whales, and other marine mammals are expected to be local and short term (generally <1 year), and to have no regional population effects--the same effects levels expected for a single sale.

Based on the scenario for Alternative C, development is unlikely. With no development, there would be no southern pipeline route constructed and no impacts to CAH caribou. No spills are expected, no gas pipeline would be constructed to Prudhoe Bay, and no oil field would be developed in TLH insect-relief habitat, eliminating many of the impacts to caribou. Impacts to moose, muskox, and grizzly bear would also be reduced.

Although no development is projected for Alternative C, if development were to occur, impacts would be similar to, but less than, those discussed under Alternative A, because much of the Planning Area would be unavailable to leasing. The TLH insect-relief area would be unavailable to leasing, greatly reducing the potential for significant impacts to caribou, and most of the moose winter habitat, muskoxen habitat, and higher density bear habitat would be closed to leasing. Making the Kasegaluk Lagoon, Peard Bay, Dease Inlet, and Smith Bay and along all major river corridors unavailable to leasing would reduce any potential disturbance from exploration and potential development on subsistence practices in areas used by Point Lay, Wainwright, Atqasuk, and Barrow hunters. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would be expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions.

f. Conclusion--Multiple Sales

For the multiple sales under Alternative C, most resources would see decreases in effects from no development activity; any effects on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to be local and short term (generally <1 year), and to have no regional population effects--the same effects levels expected for a single sale. Based on the scenario for Alternative C, development is unlikely. With no development, there would be no southern pipeline route constructed and no impacts to CAH caribou. No spills are expected, no gas pipeline would be constructed to Prudhoe Bay, and no oil field would be developed in TLH insect-relief habitat, eliminating many of the impacts to caribou. Impacts to moose, muskox, and grizzly bear would also be reduced. Not allowing leasing in Kasegaluk Lagoon, Peard Bay, Dease Inlet, and Smith Bay and along all major river corridors would reduce any potential disturbance from exploration and potential development on subsistence practices in areas used by Point Lay, Wainwright, Atqasuk, and Barrow hunters. Effects to subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would be expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions.

15. Sociocultural Systems

Under Alternative C, approximately 62 percent of the Planning Area would be unavailable to leasing and the greatest number of special management designations would be made. The Kasegaluk Lagoon, Foothills, and Mountain WSA's would be established. Twenty-one rivers would be recommended for scenic-river designation, the entire Planning Area would be closed to recreational ORV use, and the use of airboats would be prohibited. Under this alternative, the proposed WSA's and wild and scenic rivers would be closed to leasing and development but would be open to seismic exploration.

The primary aspects of the sociocultural systems that could be impacted are: (1) social organization, (2) cultural values, and (3) social health as described in Section III.C.4. For a more in-depth discussion of the parameters for sociocultural-effects analysis, see the discussion for Alternative A (Sec.IV.C.15).

a. Effects of Non-Oil and Gas Activities

The effects on sociocultural patterns from non-oil and gas activities under Alternative C are expected to be essentially the same as those discussed under the No Action Alternative. The effects on sociocultural patterns result from effects on subsistence resources and subsistence-harvest patterns (see Subsistence-Harvest Patterns,Sec. IV.E.14. above).

b. Effects on Oil and Gas Activities

(1) Effects on Subsistence Resources and Subsistence-Harvest Patterns

The overall effects of oil and gas activities under Alternative C on subsistence resources and harvest patterns are expected to be less than those discussed under Alternative A. Effects on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally <1 year), and to have no regional population effects.

Impacts to caribou would be minimal under Alternative C. Important use areas for the TLH, including core mosquito and oestrid fly relief habitats would be unavailable to leasing. A portion of the WAH summer range would be unavailable to leasing. Impacts to caribou would be limited to short-term disturbance of wintering TLH and possibly WAH animals. No oil and gas development is expected to occur under this alternative. If development were to occur, impacts would be similar to those discussed under Alternative A but would be much less in extent, as more of the Planning Area would be unavailable to leasing. Particularly, the TLH insect- relief area would be unavailable to leasing, greatly reducing the potential for significant impacts to caribou. Additionally, most moose winter habitat, currently occupied muskoxen habitat, and higher density bear habitat would be unavailable to leasing.

Subsistence-harvest patterns' effects are expected to be the same or somewhat less than those under Alternative A, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. With no development expected under Alternative C and many critical habitats and harvest areas unavailable to leasing, moderate to high effects expected on the productivity of TLH under Alternatives A and B would not occur.

(2) Effects on Subsistence Communities

Making Kasegaluk Lagoon, Peard Bay, Dease Inlet, and Smith Bay and along all major river corridors unavailable for leasing would reduce any potential disturbance from exploration and potential development on subsistence practices in areas used by Point Lay, Wainwright, Atqasuk, and Barrow hunters. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would be expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experienci n g overall population reductions.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulation E-1 prohibits permanent oil and gas facilities within and adjacent to waterbodies with identified subsistence values; identified areas are on the Ikpikpuk, Alaktak, Chipp, Oumalik, Titaluk, Kigalik, Topagoruk, Meade, Inaru, Kugrua, Kuk, Alataktok, Ivasaruk, Kaolak, Ketik, Avalik, Kungok, and Colville rivers, as well as Maybe Creek, fish-bearing deep-water lakes, and important habitat on productive bays and lagoons, particularly Kasegaluk Lagoon, the mouth of the Kuk River, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay. Stipulation H-1 would specify that all operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. ROP E-5 would provide for pipeline elevation to ensure the passage of wildlife and subsistence hunters, and ROP H-1 directs the lessee to develop and implement a plan--in consultation with the Research and Monitoring Team and the SAP--to monitor the effects of oil activities on subsistence. ROP I-1 would require training and orientation of employees to inform them of specific social and cultural concerns that relate to the Planning Area; the program is specifically designed to increase the sensitivity and understanding of workers to local community values, customs, and lifestyles in areas where these personnel would be working with the intent of reducing any potential conflicts with subsistence.

d. Conclusion--First Sale

Effects would be less than those under Alternative A. As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects, as well. With no development expected under Alternative C and many critical habitats and harvest areas closed to leasing, moderate to high effects expected on the productivity of the TLH under Alternatives A and B would not occur. If development were to occur, impacts from development would be similar to those discussed under Alternative A but would be much less in extent, as much of the Planning Area would be unavailable to leasing.

Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and potential development activities, from changes in population and employment, and from periodic disturbance to subsistence-harvest patterns from oil activities. Although effects on subsistence resources periodically could disrupt harvest practices, they are not expected to displace ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. It is expected that any possible wilderness designation for the Kasegaluk Lagoon, Foothills, and Mountain WSA's and closing the Planning Area to ORV use would be resisted by local communities as potentially too restrictive on traditional travel and subsistence hunting practices.

e. Multiple Sales

For multiple sales under Alternative C, most resources would see decreases in effects (as compared to Alternatives A and B) from no development activity; any effects on terrestrial mammals, freshwater fish, marine fish, birds, bowheads whales, beluga whales, and other marine mammals are expected to be local and short term (generally <1 year), and to have no regional population effects--the same effects levels expected for a single sale.

Based on the scenario for Alternative C, development is unlikely. With no development, there would be no southern pipeline route constructed and no impacts to CAH caribou. No spills are expected, no gas pipeline would be constructed to Prudhoe Bay, and no oil field would be developed in TLH insect-relief habitat, eliminating many of the impacts to caribou. Impacts to moose, muskox, and grizzly bear would also be reduced.

If development were to occur, impacts would be similar to those discussed under Alternative A but to a lesser extent, as more of the Planning Area would be unavailable to leasing. The TLH insect-relief area would also be unavailable to leasing, greatly reducing the potential for significant impacts to caribou, and most of the moose winter habitat, muskoxen habitat, and higher density bear habitat would be unavailable to leasing. Making Kasegaluk Lagoon, Peard Bay, Dease Inlet, and Smith Bay and along all major river corridors unavailable to leasing would reduce any potential disturbance from exploration and potential development on subsistence practices in areas used by Point Lay, Wainwright, Atqasuk, and Barrow hunters. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would be expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions.

Minor subsistence effects could cause periodic disruption of sociocultural systems in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut, but ongoing traditional practices for the harvesting, sharing, and processing of subsistence resources would not be disrupted, and impacts would not be expected to displace existing institutions or ongoing social systems.

f. Conclusion--Multiple Sales

Minor subsistence effects could cause periodic disruption of sociocultural systems but ongoing traditional practices for the harvesting, sharing, and processing of subsistence resources would not be disrupted, and impacts would not be expected to displace existing institutions or ongoing social systems.

16. Environmental Justice

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by activities in the Northwest NPR-A Planning Area and Alternative C. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and potential effects may affect subsistence resources and harvest practices. Potential effects from noise, disturbance, and oil spills on subsistence resources and practices and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The Environmental Justice Executive Order includes consideration of potential effects on Alaska Native subsistence activities. For a detailed discussion of Environmental Justice effects, see Section IV.C.16 and the cumulative-effects analyses for subsistence-harvest patterns and sociocultural systems in Sec. IV.F.8.n and Sec. IV.F.8.o.

a. Effects of Non-Oil and Gas Activities

The Environmental Justice effects of non-oil and gas activities under Alternative C would be a reflection of effects on subsistence resources, subsistence-harvest patterns, and sociocultural patterns (see Subsistence-Harvest Patterns, Sec. IV.E.14, and Sociocultural Patterns, Sec. IV.E.15, above).

b. Effects on Oil and Gas Activities

The Environmental Justice effects of oil and gas activities under Alternative C would be a reflection of effects on subsistence resources, subsistence-harvest patterns, and sociocultural patterns (see Subsistence-Harvest Patterns, Sec. IV.E.14, and Sociocultural Patterns, Sec. IV.E.15, above).

c. Effectiveness of Stipulations and Required Operating Procedures

See Section IV.C.16 for a detailed discussion of Environmental Justice mitigation.

d. Conclusion--First Sale

The Environmental Justice Executive Order includes consideration of potential effects on Alaska Native subsistence activities. The analysis indicates that there are no substantial sources of potential environmental justice-related effects from the Northwest NPR-A Planning Area development under Alternative C to the affected Alaska Native villages. As development is considered unlikely under Alternative C, many critical habitats and harvest areas would be unavailable to leasing, and the moderate to high effects expected on the productivity of the TLH under Alternatives A and B would not occur. Therefore, disproportionate, high adverse effects are not expected for the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--communities that harvest caribou from the Teshekpuk Lake herd.

e. Multiple Sales

The Environmental Justice Executive Order includes consideration of potential effects on Alaska Native subsistence activities. The analysis indicates that the only substantial source of potential environmental justice-related effects on Native villages from the Northwest NPR-A Planning Area development under Alternative C could occur from long-term population and productivity effects on the Teshekpuk Lake Caribou herd from development in critical insect-relief areas.

f. Conclusion--Multiple Sales

The Environmental Justice Executive Order includes consideration of potential effects to Alaska Native subsistence activities. The analysis indicates that there are no substantial sources of potential environmental justice-related effects from the Northwest NPR-A Planning Area development under Alternative C on the Native villages. As development is considered unlikely under the scenario for Alternative C, many critical habitats and harvest areas would be unavailable to leasing, and the moderate to high effects expected on the productivity of the TLH under Alternatives A and B would not occur. Therefore, disproportionately high adverse effects are not expected for the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--communities that harvest caribou from the Teshekpuk Lake herd.

17. Coastal Zone Management

Under Alternative C, numerous areas would be unavailable for oil and gas leasing, including those with most of the high and moderate oil resource potential (Map 19). Leasing and exploration (winter seismic surveys and wells) may occur under this alternative. The protective and restrictive measures in the areas that remain available for oil and gas leasing may curtail commercial development. Given the relatively low hydrocarbon potential of the areas remaining available for oil and gas leasing and the long distances of these areas to existing infrastructure, this alternative greatly reduces industry interest in leasing.

The NPR-A Federal lands are excluded from the coastal zone, as noted in the introductory section of the No Action Alternative (Sec.IV.B.17). However, Section 307(c)(3)(B) of the Federal Coastal Zone Management Act requires that Federal applicants include as part of their application a certification that activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone would be conducted consistent with the State's coastal management program. The State may concur or object to an applicant's certification. The following analysis is based on the hypothetical scenarios developed for proposed oil and gas activities in the NPR-A and for the non-oil and gas activities that may occur. At the time future plans are submitted for any activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone the applicant would be required to submit a consistency certification to the State.

a. Effects of Non-Oil and Gas Activities

Under Alternative C, the type of non-oil and gas activities would be the same as they are for the No Action Alternative; only the level of activity and duration could increase. Effects related to coastal zone management remain the same as for the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

The types of activities and related disturbances for Alternative C are the same as they are for Alternative B. The areas available for oil and gas leasing would be further restricted and as a result the number of exploration activities could change. It is projected for this alternative that the drilling of 1 to 4 exploration wells and 1 to 2 delineation wells could occur. There would be no production pads or pipelines because no development is assumed for this alternative. However, all proposed activities would still be subject to the ACMP standards and the district enforceable policies if they have reasonably foreseeable effects on the coastal resources and uses of the coastal zone. All activities in this category would be reviewed by the State for consistency with the ACMP standards and the enforceable policies of the North Slope Borough Coastal Management Program.

The areas remaining subject to oil and gas leasing would have the same effects on coastal zone management as those described under Alternative A. No permit can be issued for activities having reasonably foreseeable effects on coastal resources or uses of the coastal zone until the State concurs or the Secretary of Commerce overrides the State's objection.

(2) Effects of Spills

The number of spills estimated to occur under Alternative C is zero. If any spills were to occur, the analysis in Alternative A for "Effects of Spills" would be relevant to Alternative C. The effects of any small spills would be minor and localized. Given the mitigating measures addressing prevention and response, no conflicts with any of the statewide standards or district enforceable policies are anticipated.

c. Effectiveness of Stipulations and Required Operating Procedures

The discussion of the "Effectiveness of Stipulations and Required Operating Procedures" for Alternatives A and B, are relevant to Alternative C. While the mitigating measures proposed for this alternative address concerns related to several of the ACMP standards and district policies, they do not necessarily reduce the potential for conflict related to coastal zone management. The previous analyses conclude there are no conflicts inherent in the various proposals/alternatives.

d. Conclusion--First Sale

There are no inherent conflicts with the ACMP standards or the enforceable policies of the North Slope Borough Coastal Management Program related to Alternative C. With mitigating measures and regulatory oversight, it would be possible to comply with all of the standards and policies relevant to oil and gas activities that have reasonably foreseeable effects on the coastal resources or uses of the coastal zone. Applicable policies would be more precisely addressed when specific proposals are brought forward by lessees. All plans that may have reasonably foreseeable effects must be accompanied by a consistency certification for State review and concurrence. No permit would be issued for activities having reasonably foreseeable effects unless the State concurs or the Secretary of Commerce overrides the State's objection.

e. Multiple Sales

Although multiple sales might occur under Alternative C, no development is assumed to occur. Additional sales would result only in additional exploratory wells being drilled. It is hypothesized that multiple sales under Alternative C could result in 3 to 12 exploration wells and 2 to 4 delineation wells being drilled. The level of activities does not change the applicability of the relevant policies of the ACMP and the district program; they remain the same whether one or more sales are held. Applicable policies would be addressed at the time specific proposal are submitted to BLM for approval. No permit would be issued for activities having reasonably foreseeable effects on coastal uses or resources of the coastal zone unless the State concurs or the Secretary of Commerce overrides the State's objection.

f. Conclusion--Multiple Sales

The potential for conflict with the statewide standards of the ACMP and the enforceable policies of the North Slope Borough Coastal Management Program are the same as those for a single sale. No conflicts are anticipated.

18. Recreation Resources and Wilderness

a. Effects of Non-Oil and Gas Activities

The kinds of activities--other than oil and gas exploration and development--expected under Alternative C are the same as under the No Action Alternative. However, certain of these activities would increase as a result of and in support of oil and gas development. For example, field activities associated with archeological site clearances, such as camps, excavations, and aircraft activity all likely would increase. The resulting impacts would be minimal and short term in nature as described under the No Action Alternative, but the total area impacted could increase to 1,000 acres (from 500 acres in the No Action Alternative).

Although the amount of supplies and material transported by winter overland moves may increase under Alternative C as compared with the No Action Alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails (see Section IV.E.20 Visual Resources) would be an increase from the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

The types of oil and gas activities that would occur under Alternative C are similar to those under Alternative A. However, the level of some of these exploration activities would decrease compared with Alterative A, i.e., fewer seismic survey operations are expected, the number of exploration/delineation wells drilled would decrease from 8 under Alternative A to 2 (1 exploration well and 1 delineation well) under Alternative C with oil at $18/bbl and from 40 to 6 (4 exploration wells and 2 delineation wells) with oil at $30/bbl. Consequently, short-term impacts from ongoing seismic activity would go from 1,500 acres (3 seismic camps) affected under Alternative A to 500 acres affected under Alterative C. The area that could be impacted during drilling operations would decrease from approximately 64,000 to 16,000 acres (with oil @ $18/bbl) and 320,000 to 48,000 acres (with oil @ $30/bbl) for winter-only seismic. Accumulating summer-season impacts to the area"s naturalness from the greening of ice pads, roads, and airstrips would decrease from 400 acres (under Alternative A) to 100 acres (with oil @ $18/bbl) and 2,000 acres (under Alternative A) to 300 acres (with oil @ $30/bbl). Linear green trails would be visible from the air as a result of seismic operations; the number of miles visible would decrease from Alterative A in direct relationship to decreased seismic operations (see Section IV.E.20 , Visual Resources).

(b) Development

No development is anticipated under Alternative C. If development were to occur, impacts would be similar to those described under Alternative B.

(2) Effects of Spills

The chances of oil spills would less under Alternative C than that of Alternative A or B simply because of less oil and gas drilling allowed. However, should a spill occur, the effects would be the same as analyzed for Alternative A and B.

(3) Effect on Wilderness Values

Under Alternative C, the Kasegaluk Lagoon, Mountain, and Foothill assessment units would be managed as wilderness areas, therefore wilderness values of naturalness, solitude, and primitive and unconfined recreation would not be impacted. These three areas constitute approximately 3,050,000 acres, or 36 percent of the Planning Area. Impacts to wilderness values within the remainder of the Planning Area would be as described under "(1) Exploration" above and under Visual Resources (Section IV.E.20).

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulation A-2 and A-3 under Waste Prevention, Handling, and Disposal and Spills would greatly increase the protection of Wilderness and Recreation resources. This stipulation would help reduce, if not eliminate, the possibilities of larger fuel spills in pristine areas, or areas that can ill afford any type of fuel spill. These two stipulations would not unduly restrict recreationists from using the area resources for their endeavors and yet would adequately protect these resources from being impacted from fuel spills. In addition to the above stipulations, ROP's A-1 and A-2 dealing with the handling of garbage would help protect the area's recreation/wilderness resources as well as the users.

Other stipulations and ROP's that would benefit the recreation/wilderness resources and users of the area are stipulations C-2 (for both recreation and wilderness) and C-1 and E-5 (for wilderness only), and ROP's A-5 and A-8 (for both recreation and wilderness).

d. Conclusion--First Sale

As compared to No Action Alternative, there would be an increase of approximately 500 acres to 1,500 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. Short-term impacts from ongoing oil and gas exploration activities would impact approximately 8,000 acres (with oil at $18/bbl) and 48,000 acres (with oil at $30/bbl).

No development is projected to occur under the first sale in Alternative C.

e. Multiple Sales

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts from noise, aircraft, and other ongoing activities would be greater than that in the first sale, however, as in the first sale they would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would not accumulate to any extent within Alternative C, as production facilities are not necessary given the scenarios under this Alternative.

f. Conclusion--Multiple Sales

Long-term impacts would not be appreciably greater than those of the first sale.

Also of importance is that short-term impacts to recreation values from exploratory oil and gas activities, as well as overland moves, are substantially mitigated by being restricted to winter months. Few recreationists visit the area at any time and especially in winter months.

19. Wild and Scenic Rivers

Under Alternative C, all the eligible rivers listed in Table III-38 would be found suitable for inclusion in the National Wild and Scenic Rivers System, and would be managed to protect and enhance the free-flowing nature, water quality, and outstandingly remarkable values. A summary of management responsibilities BLM would assume for designated rivers is found in Appendix 11.

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities under Alternative C on subsistence resources and use, fisheries, wildlife, and cultural resources are described elsewhere in Section IV.E.

With the exception of the Colville River riparian area, non-oil and gas activities would not affect river values under this alternative because such effects would be avoided by the mandate to protect and enhance such values.

The Colville River riparian area adjacent to the Planning Area is managed by the State of Alaska and the Arctic Slope Regional Corporation. These entities could authorize improvements such as airstrips, lodges, cabin sites, or storage facilities in the riparian area that would impact the scenic quality and primitive roadless nature of the river.

b. Effects of Oil and Gas Activities

(1) Seismic Activity Compared to No Action Alternative

The effects of seismic activity on river values under this alternative would be similar to those described under the No Action Alternative with the seismic option.

(2) Effects of Disturbances

The effects of disturbances related to oil and gas development on river values would be reduced in comparison to all other leasing alternatives, largely because of the restrictions on areas available for leasing, development of surface facilities, and water withdrawals.

(3) Effects of Spills

The number of spills estimated to occur under Alternative C is zero. The effects of any spills under Alternative C on water quality, subsistence, fish, and wildlife values are described elsewhere in this section. Effects under Alternative C would be somewhat greater than those expected under the No Action Alternative, and less than anticipated under Alternatives A and B.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations A-1, A-2, A-3, C-1, and C-2 limit the impacts that oil and gas exploration and development would have on river values. Without these stipulations greater impacts from spills and damage to stream banks at river crossings could be expected, although the restrictions on leasing areas reduce the projected impacts in comparison to all the other leasing alternatives.

Stipulation B-1 would be effective in preserving instream flows in eligible rivers, and in protecting overwintering habitat for fish because of the prohibition of winter water withdrawal from streams.

Stipulation B-2 would limit concerns about effects of unusual freezing/thawing processes caused by compaction or removal of snow cover.

Stipulation D-1 and ROP E-6 contribute to our conclusions regarding the impacts of development on fish, wildlife, and instream flows and limit anticipated adverse impacts in comparison to the other alternatives.

Stipulation E-1 could prove effective in limiting impacts of oil and gas development on river values in conjuction with site-specific analysis and ongoing monitoring studies to improve the effectiveness of stipulations and operating procedures.

Stipulation E-2 would limit road construction but would not protect the Colville River riparian zone since BLM lacks management authority there.

ROP's A-1, A-2, A-3, and A-4 contribute to the conclusion that this alternative would have little effect on water quality. Without these procedures, adverse impacts to water quality would be expected to increase. ROP C-1 would reduce the likelihood of impacts to the free flow of streams by reducing the likelihood of additional freezedown and unnatural breakup of rivers. ROP C-1 would also provide protection from rutting and changes in drainage patterns for riparian areas.

ROP E-8 could be effective in limiting impacts to river values, particularly fisheries and subsistence activities.

ROP's F-1 and I-1, along with stipulations G-1, H-1, and J-1, would help to limit negative impacts to river values.

d. Conclusion--First Sale

Under Alternative C, the impacts of the first sale on Wild and Scenic River values would be very limited. Impacts are expected to be less than under any of the other alternatives because of additional restrictions that protect stream banks and limit potential withdrawals of water. The Colville River adjacent to the Planning Area would likely see the greatest negative impact to river values because it is not under BLM management and would likely be crossed by access trails, ice roads, and pipelines.

e. Multiple Sales

Multiple sales would have little additional impact on river values.

f. Conclusion--Multiple Sales

Multiple sales would have little additional impact on river values.

20. Visual Resources

Under Alternative C, the Kasegaluk Lagoon, Foothills and Mountain assessment units and an area extending 5 mi from the bank of the Colville River area would become Visual Resource Management (VRM) Class I areas (a change from Alternative A). The 21 streams (other than the Colville River) recommended for designation as Wild and Scenic Rivers, the identified estuarine areas, and an area extending 5 mi from the banks of these water bodies would be VRM Class II areas (a change from Alternative A). The rest of the Planning Area would be VRM Class III areas (a change from Alternative A--see Map 24). Implementation of VRM prescriptions would take place in individual environmental analysis of each proposed activity.

a. Effects of Non-oil and Gas Activities

The kinds of activities other than oil and gas expected under Alternative C are the same as under Alternative A. The impacts from the camps would be the same as under the No Action Alternative and Alternative A.

Although the amount of supplies and materials transported by winter overland moves may decrease under this alternative, these moves generally follow the same routes. Therefore, neither the length nor number of green trails is expected to be noticeably different between the No Action Alternative and Alternative A.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

Under this alternative, seismic-survey work would continue at the same level as under the No Action Alternative. Green trails resulting from these operations would be the same as under the No Action Alternative.

For the first sale under this alternative, between 2 and 6 exploration or delineation wells are anticipated. However, because of the limited number of drill rigs available, no more than one well is anticipated to be drilled at any one time. These impacts are expected to be greatest within a 1/2-mi to 2-mi radius of each drill site or an area of approximately 4,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of visual quality over an area of approximately 4,000 acres.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails--the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years of longer. There is also a "ring effect" around ice pads, airstrips, and roads where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 300 acres (6 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

(b) Development Activities

Under the first sale for Alternative C, no development is projected. No production pads would be constructed, no pipelines are anticipated, and no staging base is expected.

(2) Effects of Spills

The number of spills projected under Alternative C is zero.

c. Effectiveness of Stipulations and Required Operating Procedures

The Kasegaluk Lagoon, Foothills and Mountain Wilderness Study Areas and the Colville River area would be designated Visual Resource Management (VRM) Class I. As such, the level of change to the landscape should be very low and must not attract attention. This class provides for natural ecological changes; however, it does not preclude very limited management activities. The objective is to preserve the existing character of the landscape. The 21 streams recommended for designation as Wild and Scenic Rivers and estuarine areas would be assigned Class II. As Class II, the level of change to the landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the landscape. The rest of the Planning Area would be assigned a VRM Class III. As Class III, the level of change to the characteristic landscape should be moderate. Management activities may attract the attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the landscape.

d. Conclusion--First Sale

As compared with the No Action Alternative, there would not be an increase in adverse, short-term impacts to visual resources from activities other than oil and gas exploration and development.

Short-term impacts from ongoing oil and gas exploration activities would impact approximately 4,000 acres. The greening and ring effect of vegetation resulting from ice pads, roads, airstrips and compacted snow would impact about 300 acres. Seismic operations would result in approximately one hundred miles of green trails.

Oil and gas development are not expected to take place under this alternative.

e. Multiple Sales

For multiple sales, between 5 and 16 exploration or delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than 2 wells are anticipated to be drilled at any one time. These impacts are expected to be greatest within a ½- to 2-mi radius of each drill site or an area of approximately 4,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of visual quality over an area of approximately 8,000 acres.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails--the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years of longer. There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 800 acres (16 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

Under the multiple sale scenario for Alternative C no production pads would be constructed, no pipelines are anticipated, and no staging base is expected.

f. Conclusion--Multiple Sales

The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and pads, and other ongoing activities would not accumulate. No long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would be built in support exploration and production. There would be no increase over those of the first sale and no additional acres would be impacted.

21. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared comprehensive impact analyses on those resources within Northwest NPR-A Planning Area that are considered tp have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section IV.E.7)

Effects of First Sale: Impacts from activities other than oil exploration and development would involve disturbance or destructive impacts to a small fraction of the Planning Area, and overall impacts would be minor to negligible.

Impacts from oil exploration would include vegetation disturbance on 22,500 to 366,000 acres per year from 2-D and 3-D seismic surveys over the entire exploration period (10 years). About 25 percent of the disturbance would be at a medium to high level, and, after 9 years, recovery would be about 90 percent. Ice road construction would have impacts on < 420 acres per year, and ice pads on < 170 acres. Exploration activities would cause permanent, minor vegetation destruction and alteration from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines, one pump station, and the excavation of material sites, would cause the destruction of vegetation on < 650 acres and the alteration in plant species composition on < 1,915 acres, affecting a total of over < 2,565 acres. These impacts would be permanent assuming that gravel pads would remain after production ends although some plant species would be able to grow on the pads (McKendrick, 2000).

Effects of Multiple Sales: Impacts from oil exploration would include about double the vegetation disturbance from seismic work expected for a single-sale. However, the extended period of time over which it would occur--coupled with the recovery time for disturbed areas--would result in a small increase in the amount of visible disturbance. Exploration activities also would cause < 0.03 acres of permanent vegetation destruction around well cellars and alteration of < 1,940 acres per year around and under ice pads and roads.

Development activities would also impact vegetation, and the combined effect of exploration and development activities over all lease sales would cause the destruction of vegetation on < 1,260 acres and the alteration in plant species composition on < 4,050 acres, for a total of < 5,310 acres. These impacts would be permanent, assuming that the gravel pads would remain after oil production ends; recovery, thus, would be moot. Impacted areas (3,920 acres) represent about 0.04 percent of the total land cover, and, as such, they would not be likely to adversely affect any plant species or community. If a development facility were to be placed over a rare plant population, the effects on that taxon could be severe. However, careful siting of facilities after site-specific environmental analysis is expected to avoid and protect rare plant species.

Soils (Section IV.E.1)

Effects of First Sale: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be minor to negligible. Impacts from winter exploration and well drilling would be expected to be minor to negligible. Development would cause loss or disturbance of up to 600 acres of soils. The duration of these impacts would be permanent. Oil spills would be cleaned up immediately, causing minimal disturbance to soils. Impacts from development activities to soils would be minor to low.

Effects of Multiple Sales: Little impact to soils is expected from exploration activities; impacts from development activities would disturb or result in the loss of small- to moderate-sized areas. The overall impact to soils would be negligible (with seismic) to moderate (with development).

Water Resources (Section IV.E.3)

Effects of First Sale: Seismic impacts are expected to be minimal. Impacts from oil and gas development activities on the water resources in the Planning Area are from gravel roads, pads, and structures. The potential short-term impacts from exploration and delineation would be water removal from up to 90 lakes, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 2,000 acres. Long-term impacts from development of gravel roads, pads and pits could impact up to 1,000 acres. Overall impacts would be about 3,000 acres of short-term impacts and 1,500 acres of long-term impacts.

Effects of Multiple Sales: Seismic impacts are expected to be minimal. Impacts from oil and gas activities could be several times greater than impacts from a single sale, while indirect impacts might take years to develop. Short-term impacts include water removal of up to 1,800 acre/ft from 180 lakes for exploration and delineation drilling, increased water impoundments, diversions, thermokarst erosion, and sedimentation of up to 4,000 acres for construction activities. Long-term impacts from development of gravel roads, pads, and pits could impact up to 2,000 acres from water impoundments, diversions, and thermokarst erosion. Shared infrastructure could reduce the adverse effects to water resources from multiple sales.

Freshwater Quality (Section IV.E.4)

Effects of First Sale: The short-term, localized impacts from seismic and exploratory activity would be reduced approximately one third and one quarter, respectively, compared to Alternative A. Long-term impacts from seismic would be less than Alternative B and equivalent with the No Action Alternative.

Effects of Multiple Sales: Long-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale.

Estuarine Water Quality (Section IV.E.5)

Effects of First Sale: There would be a greatly reduced risk of spills, but still a slight chance of them in NPR-A bays for two reasons — fuel might be transported across the bays for onshore exploration and there might be further State and Federal leasing of adjacent offshore waters.

Effects of Multiple Sales: Multiple sales would have a very low level of effects on estuarine water quality, similar to the effects from the first sale.

F. Effects of the Cumulative Case

1. Introduction

According to the National Environmental Policy Act (NEPA) (40 CFR 1508.7) and 1508.25(a)(2):

> "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

> To determine the scope of environmental impact statements, agencies shall consider...Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

A handbook issued by the Council on Environmental Quality (CEQ), *Considering Cumulative Effects Under the National Environmental Policy Act, January 1997*, suggests, among other things, that analyses "determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions...identify significant cumulative effects..." and "...focus on truly meaningful effects." As suggested by the CEQ handbook, this IAP/EIS considers the following basic types of effects that might occur:

- "additive" (total loss of sensitive resources from more than one incident);
- "countervailing" (adverse effects are compensated for by beneficial effects); and
- "synergistic" (total effect is greater than the sum of the effects taken independently).

Each section of this cumulative effects analysis indicates which types of impacts might occur for each resource. When evaluating effects to resources, the EIS analysts consider whether the effects are additive, synergistic, or countervailing. We have found that synergistic and countervailing effects are the exception, not the norm. In most cases, the effects are additive, and it would become redundant and very repetitive to state that the effects are additive every time an analyst presents an effect analysis, a summary statement, and/or a conclusion. In the analyses that follows, effects should be considered to be additive in nature, unless other noted by the analyst.

2. Structure of the Cumulative Analysis

For this IAP/EIS, the analysis of cumulative impacts is a five-step process:

1. Identify the potential effects of the proposed actions in the Northwest NPR-A Planning Area on the natural resources and human environment.
2. Analyze other past, present, and reasonably foreseeable future oil-development activity on the North Slope and its coastal and offshore waters for effects on the natural resources and human environment that are potentially affected by the proposed actions in the Northwest NPR-A.
3. Determine the effects from other actions (sport harvest, commercial fishing, subsistence hunting, and loss of overwintering range, etc.) on these same natural resources and human environment.
4. Estimate the potential extent of the total cumulative effects (number of animals and habitat affected, jobs and revenues created or lost, etc.) and how long the effects might last (population recovery time, duration of income flows, etc.).
5. Keep the cumulative analysis useful, manageable, and concentrated on the potential effects that are meaningful. Consider activities that are more certain to happen and that are geographically in or near the Northwest NPR-A, and activities of greatest concern as identified in scoping in more detail. Where possible, use guiding principles from existing standards (see the following), criteria, and policies that control management of the natural resources of concern to help focus the analysis. Where existing standards, criteria, and policies are not available, the resource experts use their best judgment on where and how to focus the analysis.

3. Guiding Principles of the Analysis

The Endangered Species Act (ESA) of 1973 and the Northwest NPR-A IAP/EIS scoping process are appropriate vehicles to identify species that are potentially at risk from the incremental cumulative effects of activities that may occur under the Northwest NPR-A IAP. Effects on listed species identified in the Northwest NPR-A by the National Marine Fisheries Service (NOAA Fisheries, formerly NMFS) and the Fish and Wildlife Service (FWS) under Section 7 of the ESA are covered by this cumulative analysis. The potential effects on each of the other species identified through scoping were also reviewed and included, as appropriate.

Cumulative effects are analyzed for those species listed as "endangered," "threatened," "proposed," or "candidate" on the North Slope, in the Beaufort Sea, and in the Chukchi Sea and which NOAA Fisheries and FWS indicated that this IAP/EIS should assess.

The management of seals by NOAA Fisheries and polar bears by the FWS under the Marine Mammal Protection Act (MMPA) of 1972 provides for monitoring these species' populations and managing/mitigating potential effects of development on these species. For example, FWS implements measures to protect polar bear den sites through a Letter of Authorization under the MMPA.

The Alaska Department of Fish and Game (ADF&G), monitors caribou by a census of caribou calving and caribou distribution. These monitoring efforts provide a means of determining whether significant cumulative effects on caribou have occurred or are occurring on the North Slope and help in developing measures to minimize effects.

Water quality on the North Slope is regulated and/or monitored through various permitting and regulatory programs administered by the EPA; the Alaska Departments of Natural Resources (DNR), Environmental Conservation (ADEC), and ADF&G; and the North Slope Borough. These programs have been established to protect against the significant degradation of water quality associated with specific human/development activities. In evaluating the cumulative effects to water quality, collective impacts associated with both permitted/regulated activities and nonregulated activities and/or naturally occurring events are considered.

Air quality is regulated under the Prevention of Significant Deterioration (PSD) permitting process. For sources located in the OCS, the PSD program is administered by the EPA. For sources located in State waters and onshore, the PSD program is administered by the ADEC. Although minor sources of air pollutants are not subject to PSD permitting requirements, the analysis of cumulative effects to air quality in this IAP/EIS considers the contribution of both major and minor sources of air pollution on the North Slope.

Wetlands impacts are mitigated through Stipulations, Required Operating Procedures (ROP's), Terms and Conditions of Permits and Approvals issued at the exploration and development stages, and through the Section 404 Regulatory Program under Section 404 of the Clean Water Act, administered by the U.S. Army Corps of Engineers (COE). Under a Memorandum of Agreement between EPA and COE, it is recognized that in areas such as the North Slope of Alaska (with its high proportion of wetlands) minimizing wetland losses is preferable to compensatory mitigation.

Executive Order 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* and an accompanying Presidential memorandum require each Federal Agency to make the consideration of environmental justice part of its mission. The existing demographics (race and income) and subsistence consumption of fish and game are discussed, disproportionate environmental and health effects on Alaska Natives are evaluated, and mitigating measures and their effects are presented.

Executive Order 13084 *Consultation and Coordination with Indian Tribal Governments* requires consultation with Native tribal governments on "Federal matters that significantly or uniquely affect their communities," so that an effective process is established that "permits elected officials and other representatives of Indian tribal governments to provide meaningful and timely input." Representatives of BLM have met with local tribal governments to discuss subsistence issues relating to the Northwest NPR-A IAP (Section VI.E) and have established a dialogue on environmental justice with these communities. Mitigation measures included in this Northwest NPR-A IAP/EIS evolved through negotiations between local, borough, and State and Federal Agency representatives. Inupiat Traditional Knowledge had a part in developing mitigation. Conflict avoidance agreements between the oil industry and Inupiat subsistence hunters are an important mechanism for overcoming conflicts.

4. Scope of the Analysis

Oil and gas activities considered in the analysis include past development and production, present development, reasonably foreseeable future development, and speculative development. Activities not associated with oil and gas also are considered. Some activities that would occur beyond the 15- to 20-year production life of the Northwest NPR-A IAP are considered too speculative at this time to include, while other such activities are included in this analysis. All reasonably foreseeable future activities that may contribute to cumulative effects are considered in this analysis. The information, models, and assumption used to analyze the effects of oil spills and the estimates of spills for the cumulative scenario are presented in Appendix 9 .

5. "Significance"

As directed by CEQ's NEPA regulations (40 CFR 1502.16), direct and indirect impacts (effects) and their significance to physical, biological, and human social resources are evaluated. In characterizing significance, the analysis considers the "context" and "intensity" of the impact as intended by CEQ (40 CFR 1508.27). The context aspect considers the setting of the proposed action, what the affected resource may be, and whether the effect on this resource is local or more regional in extent. The intensity aspect considers the severity of the impact, taking into account such factors as whether the impact is beneficial or adverse; the uniqueness of the resource (for example, threatened or endangered species); the cumulative aspects of the impact; and whether Federal, State, or local laws may be violated. When considering cumulative effects, the time frame is extended to include past, present, and reasonably foreseeable activities. The geographic area is extended for the cumulative analysis to include the area that could be affected by Northwest NPR-A activities and the area where activities that might affect Northwest NPR-A resources occur. The incremental contribution of the alternatives also is evaluated in the cumulative case (see Section IV.F.9).

6. Other Information about Cumulative Effects

Readily available abiotic standards are important in determining environmental quality. Abiotic measurements (for example, air and water quality) often provide a good indication of the quality of biological and cultural resources. As the analysis moves from the abiotic to the biotic to the human-cultural context, the variables increase, making it more difficult to determine cumulative effects on the quality of life. A similar increase in complexity occurs with the move from the terrestrial environment to the offshore environment. Migratory species present additional variables that reflect habitat and species condition outside the primary study areas. Humans introduce even more variables with their mobility and behavioral diversity. The effects of this characteristic cascade of complexity are traced in Figure IV-06.

The purpose of the analysis of cumulative effects in this IAP/EIS is to determine whether the effects are additive or synergistic or have some other relationship. Additive (or combined) effects on specific resources often are difficult to detect and do not necessarily add up in the strict sense of 1 plus 1 equals 2. It is much more likely that an additive or combined effect would be greater than 1 but less than 2. A synergistic effect, in theory, is a total effect that is greater than the sum of the additive effects on a resource. To arrive at a synergistic effect in this example (continuing with the numeric analogy) the total cumulative effect would need to end up greater than 2. In the highly variable arctic environment--where natural variations in population levels can exceed the impacts of human activity--such an effect would need to be much greater than the hypothetical 2 to be either measurable or noteworthy.

Note: While synergistic impacts have been demonstrated in the laboratory (for certain types of chemical reactions, for example), there is almost no evidence of such impacts occurring when dealing with biological resources in the arctic environment. Where synergistic impacts are not specifically accounted for in the analysis section, it is because there are neither studies nor information supporting the identification of such impacts.

Concern about the potential for cumulative effects should be weighed with the following information.

- More rigorous environmental standards and more environmentally prudent industry practices exist now than ever before, to include: smaller facility "footprints;" fewer roads; directional drilling from onshore; elimination of most discharges into the water; practices that avoid damage to the tundra; and better working relations with the local residents.
- Current industry practices and the environmental state of the North Slope/Beaufort Sea region are continually observed and assessed, and much of this information is available to the public. This information, along with the ongoing dialogue between all levels of government and the interested public about environmental issues should continue to increase environmental awareness and encourage environmentally sound practices that, in turn, help reduce the potential for environmental damage.
- A key element in the development of North Slope/Beaufort Sea oil is the means of transporting the oil--the Trans-Alaska Pipeline System (TAPS). The pipeline is 800 mi long, stretching from Pump Station 1 at Prudhoe Bay to the Valdez Marine Terminal and, assuming a corridor width of about 100 ft, it represents an area of about 16 mi^2. This pipeline is expected to continue to serve as existing infrastructure for all foreseeable future oil production, eliminating the need for the construction of new oil pipelines other than feeder pipelines.
- Following the *Exxon Valdez* oil spill, substantive improvements have been made in tanker safety to reduce the potential for oil spills from tanker accidents. These include a mandatory phase-in of double-hulled tankers, better navigational systems, and tanker escorts. In addition, oil spill response capabilities for tanker-related oil spills have been increased substantially through the addition of equipment, personnel, training, and exercises. These initiatives were developed specifically to reduce the potential for future tanker accidents and to lessen effects, should spills occur.
- If a major oil spill were to occur, there likely would be a slowdown in new development during which additional safeguards certainly would be put in place and new ideas of pipeline placement and design would be researched. Just as the additional safeguards resulted from the *Exxon Valdez* oil spill, the likelihood of an additional oil spill from the same causative factors and to the same resources would be reduced. This emphasis on preventing a similar incident would further ensure the full recovery of those resources from the initial spill.
- Actual activities and the size and location of future oil and gas developments on the North Slope and in the Beaufort Sea are uncertain. The actual effects on natural resources and the human environment that may result from such developments also are uncertain. Nevertheless, this IAP/EIS presents a best estimate of what those activities and effects might be. It is unlikely that actual activities and effects would exactly match the scenarios developed for this IAP/EIS. Past efforts to foresee future activities have predicted more activities than have come to pass in the projected scenario. Effective corrective measures have come out of ongoing monitoring by industry, government and environmental groups. Subsequent discoveries and developments and other changes not accounted for in this scenario may need to be reassessed as appropriate and as required by NEPA.

The activities and projects considered in this cumulative analysis include past development and production, present development, reasonably foreseeable future development, and speculative development. Some activities that might occur beyond 20 years from now are considered too speculative to address at this time. Activities other than oil and gas activities are considered. The assumptions and scenarios used by the resource specialists in the analyses of the alternatives are presented in Section IV.A.1.b . The assumptions and estimates related to the oil-spill scenario for the cumulative analysis are presented in Appendix 9 .

These four development categories represent all known and unknown oil and gas sources that potentially could be developed on the North Slope and Beaufort Sea. The analysts preparing this IAP/EIS focus on the first three oil and gas development categories and consider the fourth category (speculative) with respect to seismic and associated exploration activities associated with future State and Federal lease sales. Other activities and issues could be analyzed as they apply to particular resource topics. These areas of additional evaluation may include cumulative effects from activities related to development in migratory overwintering ranges, environmental contamination, subsistence harvest, sport harvest, commercial fishing, marine shipping, tourism, and recreational activities.

7. Major Factors Considered in the Cumulative Effects Analysis

This section deals with those oil and gas projects that are past and ongoing, and those that will foreseeably occur as a result of the Northwest NPR-A IAP/EIS process and decision. The cumulative analysis also considers potential effects on the sensitive resources of the Northwest NPR-A Planning Area from reasonably foreseeable activities in areas adjacent to the Planning Area (e.g., exploration and development in the Northeast NPR-A and activities in State and OCS waters). Alaska North Slope oil and gas discoveries, proposed transportation projects, future lease offering activities, and current infrastructure (as well as other issues appropriate to the cumulative analysis) are listed in Tables IV-08, IV-9, IV-10, IV-11, IV-12, and IV-13. The oil-spill scenario for the cumulative analysis is presented in Appendix 9 and Tables App 9-12, App 9-13, App 9-14, and App 9-15.

Oil and gas development is the main agent of industrial-related change on the North Slope. Oil and gas exploration and production activities have occurred in the Alaska North Slope/Beaufort Sea region for more than 50 years. Past industrial development that occurred in association with this history included the creation of an industry support community airfield at Deadhorse and an interconnected industrial infrastructure that includes roadways, pipelines, production and processing facilities, gravel mines, and docks. In 1977, TAPS began to transport North Slope crude oil to a year-round marine terminal in Valdez, Alaska. Today it continues to transport the North Slope's entire production, as it is projected to do for many years into the future.

For this analysis, oil and gas scenarios were developed based on estimates of future activities. The scenarios are conceptual views of the future, including the timing and extent of future petroleum activities in the Beaufort Sea and on the North Slope. Estimates of anticipated production consider many factors, including the economically recoverable resources of the area, past industry leasing and exploration efforts, and future economic conditions.

From a historical standpoint, in the Beaufort Sea, only 7 of 23 scheduled Federal sales were held, and only a small fraction of the offered tracts were leased (692 of the 10,280 tracts offered in the 7 sales, less than 7%). Few of those leases were actually tested by drilling (30 wells on 20 prospects). Most discoveries (11 wells determined to be producible) were too small or too costly to become viable fields (one field--Northstar--is producing; another--Liberty--recently suspended further development indefinitely). General oil industry wisdom is that, under optimum exploration conditions, the chance that a commercial field will be discovered is only 10 to 20 percent (i.e., 10 to 20 percent of the wells drilled would encounter economic quantities of oil and/or gas). On Alaska's North Slope, however, the success rate for finding new commercial fields is likely to be even lower. Consequently, anticipated production volumes (and the associated environmental effects) often turn out to be overstated.

The cumulative scenario focuses on the following factors:

- Oil and gas that will be discovered (as a result of oil and gas leasing) and that will likely be developed during the next 15 to 20 years.
- Exploration and development of additional undiscovered resources (onshore and offshore) that could occur during the next 15 to 20 years.
- Some exploration and development activities that could occur more than 15 to 20 years after the upcoming State and Federal lease sales.
- Transportation of oil via TAPS and tanker to western ports.
- Activities other than oil and gas, such as sport and subsistence hunting and fishing, commercial fishing, sport

harvest, tourism, and recreational activities.

Table III-01 and Table IV-08 list North Slope fields and discoveries. Tables IV-24 and IV-25 list the current and proposed transportation projects and future lease-sale activities considered in this cumulative analysis. Maps 25 and 26 show the location of fields and discoveries on Alaska's North Slope. A "field" is a geologic structure with proven reserves that has been developed and is producing crude oil. Fields can contain numerous reservoir pools produced through a common infrastructure. "Discovery" refers to a pool with potential reserves that has not been developed. Some discoveries require additional drilling to confirm that oil or gas is commercially recoverable. Poor test results in some discoveries may be referred to simply as "shows." The development timing of resources listed as prospects or shows is speculative and could occur after more than 20 years.

For this cumulative analysis, oil and gas discoveries were divided into the following categories (Tables IV-08, IV-10, and IV-12):

- Past Development/Production: 33 fields and satellites, with 23 of these fields located onshore and 8 located offshore.
- Present Development/Production: 3 discoveries that are expected to start up within the next few years, all of which are onshore.
- Reasonably Foreseeable Future Development: 16 discoveries that might see some development-related activities (site surveys, permitting, appraisal drilling, or construction) within the next 15 to 20 years. They are: Lookout/Spark, Pete's Wicked, Sikulik, Point Thompson, Mikkelson, and Sourdough on the North Slope, and Liberty and Yukon Gold located offshore. Additional onshore resources (estimated 2.30 billion barrels [Bbbl]) and offshore resources (estimated 1.38 Bbbl) currently are undiscovered.
- Speculative Development: Additional new discoveries could be made and developed beyond 20 years, with 13 past onshore discoveries. The chance for development is too uncertain for detailed analysis at this time. However, additional exploration activities (wells and seismic surveys) are likely to occur and have been factored into the analysis.

The main focus of this analysis is on the first three categories, with consideration given to exploration activities of the fourth category. While oil companies may eventually produce oil from pools in the speculative development category, insufficient information exists to estimate the development activities associated with such undiscovered pools. Some discoveries date back to 1946 without subsequent development. It is quite possible that oil companies would not develop some prospects in the reasonably foreseeable category. Total resource amount estimate for the speculative category is taken from industry and government reports.

These four development categories represent all known and unknown oil and gas sources that potentially could be developed on the North Slope and Beaufort Sea. The analysts preparing this IAP/EIS focus on the first three oil and gas development categories and consider the fourth category (speculative) with respect to seismic and associated exploration activities associated with future State and Federal lease sales. Other activities and issues could be analyzed as they apply to particular resource topics. These areas of additional evaluation may include cumulative effects from activities related to development in migratory overwintering ranges, environmental contamination, subsistence harvest, sport harvest, commercial fishing, marine shipping, tourism, and recreational activities.

a. Past Development/Production

This category includes producing fields on the North Slope and nearshore areas of the Beaufort Sea. Infrastructure, cumulative production, and remaining reserves are well defined. Individual oil pools can be developed together as fields that share common wells, production pads, and pipelines. Fields can be grouped into production units with common infrastructure, such as processing facilities. Impacts associated with development have occurred over the past three decades, and there are data from monitoring that accurately reflect some of the long-term effects.

This category contains 33 discoveries, all of which are now producing oil (see Table IV-08 which also lists production and reserve data) and Table IV-09 lists infrastructure and facilities for these producing fields. All of these fields, with the exception of Northstar, Endicott, Sag Delta North, and Eider are onshore on State leases. Endicott is an offshore State field that began production in 1987 and, through 2001, had produced 411 million barrels (MMbbl) of oil. The Niakuk, Point McIntyre, and Badami oil fields are located mainly offshore but are produced from onshore sites. Badami is of particular interest, because the proposed Point Thomson pipeline would tie into Badami's common-carrier pipeline. Northstar began producing on October 31, 2001.

During 1996, ARCO announced that the Alpine Prospect located in the Colville River Delta, was producible and contained an estimated 365 MMbbl of oil. More recent estimates of Alpine are over 500 MMbbl. It is the largest onshore discovery in the United States in more than a decade and is the closest developing oil field to the area under study. Alpine came on line in November 2000 and produces approximately 80,000 barrels of oil per day (bopd). Alpine resources are extracted from two drill pads connected by a 3-mi long road. Oil is transported via a 34-mi pipeline to Kuparuk oil field processing facility where Alpine production is commingled with Kuparuk output. The Alpine pipeline crosses under the Colville River channel. Horizontal drilling techniques now facilitate drilling under major river systems such as the Colville and are expected to be used for other river crossings. Ice roads and bridges support activities in the winter. There are no gravel roads connecting the Kuparuk infrastructure to Alpine. Termed "roadless" development, it is a concept that could be applied to future production activities in the Northwest NPR-A. Alpine's 40,000-acre field was developed on 94 surface acres--although development of the recent additional satellite discoveries--such as CD South (Nanuq) with its estimated 40 MMbbl and CD North (Fiord) with an estimated 50 MMbbl--would add to this surface acreage of activity. Alpine is a zero discharge facility; its waste is reused, recycled or otherwise disposed of.

The Meltwater discovery is estimated to contain about 50 MMbbl of oil. The West Sak field began production in 1997 and Tarn and Tabasco fields began production in 1998. The Meltwater discovery, about 10 mi south of Tarn, marks the furthest extension south for the Kuparuk infrastructure. Kuparuk began production in 1981 and is the second largest oil field in North America. Palm, an extension of the Kuparuk formation has about 35 MMbbl of recoverable oil. British Petroleum recently began offshore production at the Northstar Unit. They estimate that Northstar will produce 145 MMbbl of oil over a 15-year period. It is now producing 50,000 bopd and is one of the 10 largest producing fields in the United States. Production is expected to be over 65,000 bopd by mid-2002. BP has also started production at Aurora and Borealis, two of five Prudhoe Bay satellite fields that will increase North Slope production by as much as 70,000 bopd (Marshall, 2002).

b. Present Development/Production (Within the Next Few Years)

This category includes fields that are in planning stages for development but that have not yet begun production. Infrastructure components, scheduling, and reserve estimates are fairly well defined, although reserve volumes could be revised later. Because new developments are commonly tied into existing infrastructure, continued development depends on the continued operation of this infrastructure.

This category contains three discoveries presented in Table IV-10:

1. CD North (Fiord)
2. CD South (Nanuk/Nanuq)
3. Orion (NW Eileen)

Estimated reserves are displayed in Table IV-10 and the infrastructure the oil companies propose for these discoveries are identified in Table IV-11. All three discoveries are onshore on State leases.

Recent discoveries near the Alpine formation include CD South (Nunuq), which is estimated to contain about 40 MMbbl of oil. CD North (Fiord), also an Alpine satellite, is estimated to contain about 50 MMbbl of oil.

c. Reasonably Foreseeable Future Development/Production (Within the Next 15 to 20 Years)

The MMS and BLM developed the information about reasonably foreseeable future development and production and consider it the best available information. This category includes activities that are reasonably foreseeable within the next 15 to 20 years. It is reasonable to expect that these activities would begin with the development of discoveries in close proximity to existing (past and present) fields to share infrastructure. Probability ranking for listed prospects is based on resource size and proximity to existing infrastructure. Resource volumes are uncertain in this category. Drilling data used to define reserves and engineering studies to support development are generally inadequate; nor is it possible to predict the development timing for these future fields. Many of the listed discoveries were made decades ago and have remained noncommercial to this day. Development in these cases will depend largely on technology advancements and higher petroleum prices.

While the list of reasonably foreseeable future developments includes only the 16 discoveries, there could be significant amounts of oil produced by enhanced recovery technology from existing fields and from presently undiscovered satellite pools close to infrastructure areas. Enhanced recovery adds production from known reservoirs, effectively creating "reserve growth." For example, the Prudhoe Bay field was originally estimated to hold 9.6 Bbbl of reserves, and today it has reserves approaching 13 Bbbl. More than 3 Bbbl were added by factoring in enhanced recovery technologies. In addition, industry has indicated that they have a large number of prospects very close to existing infrastructure that may become future satellite pools. Although the extent of both of these new resources (reserve growth and satellites) is as yet undetermined, it is reasonable to assume that a significant portion would be brought into production in the next 20 years, or even sooner. Assuming, for analysis, that half of the 4 Bbbl estimated for enhanced recovery and satellite fields would be brought into production in the foreseeable future gives approximately 2 Bbbl. Because satellite fields would be developed largely from existing infrastructure, the incremental addition of new infrastructure would be minor.

The 16 discoveries that oil companies may begin to develop in the next 15 to 20 years are presented in Table IV-12 , which also lists the associated resource estimates. Offshore discoveries in this category are Liberty, Sandpiper, Flaxman Island, Kuvlum, Hammerhead, Thetis Island, and Stinson. Gwydyr Bay and Kalubik are offshore discoveries that are likely to be developed from onshore sites. Onshore discoveries include Sourdough, Mikkelsen, Yukon Gold, Point Thomson, and Pete's Wicked.

Note: Of the discoveries listed above, Liberty, Sandpiper, Hammerhead, and Kuvlum are the only ones on offshore Federal leases; all others are either on State leases or North Slope Borough lands.

Lookout/Spark is a recent discovery in the Northeastern NPR-A. Recent discoveries in the Northeast NPR-A targeted the Alpine producing horizon and all have encountered oil and gas condensate. These discoveries are located approximately 15 to 25 mi southwest of the Alpine site. Although appraisal wells have been drilled during the two winter seasons since the Spark/Rendezvous discovery in 2000, reserve estimates and a timetable for development have yet to be announced by the operator (Phillips Alaska, Inc.).

The discussion of the effects of reasonably foreseeable future development/production will include the effects of production decline from existing fields, the current proposals for new development, and estimates of potential development associated with recent and proposed lease sales.

The possible development infrastructure--should the 16 discoveries be commercially developed--is indicated in Table IV-13. Briefly, the possibilities are as follows:

- Oil from the Kalubik prospect and other small accumulations in the Colville Delta could feed into the Alpine pipeline system.
- Development of the Lookout/Spark discovery also could use the Alpine infrastructure.
- Oil produced from the Gwydyr Bay, Pete's Wicked, and Sandpiper discoveries could be transported through the Northstar pipeline.
- The Badami field trunk pipeline would provide transport for other discoveries in the eastern North Slope listed in Table IV-12.

An indication of the infrastructure that may be required if these discoveries are developed is listed in Table IV-13. Outlined on Map 26 are the geographic boundaries of the Alpine, Northstar, and Badami fields and the discoveries these fields may service.

It is important to recognize the distinction between exploration/development activities and production activities. The discussion of exploration/development activities is related primarily to disturbance effects, whereas the estimated production volumes relate directly to the chance of an oil spill occurring. Ranking of probabilities for commercial development of these discoveries from highest to lowest is found in Table III-01. The ranking also could be viewed as an approximate (and hypothetical) sequence for production startup. Discoveries near the top of the list are expected to begin production sooner and are considered more likely to actually be produced. Discoveries near the bottom of the list wouldn't see production until much later, with most of their oil production likely occurring after the 20-year mark.

Additional development could occur in Northeast NPR-A, though the amount, nature, and location of such development is unknown.

d. Speculative Development (Beyond 20 Years)

This category includes small discoveries and undiscovered resources that are very unlikely to be developed in the next 20 years. Some of the discoveries listed in Table IV-08 were made 50 years ago and remain noncommercial today because of their very remote locations, low production rates, and lack of a gas-transportation system (not likely to change in the foreseeable future). With respect to undiscovered resources, it is not reasonable to estimate new infrastructure or predict the effects of development for prospects that have not been located or leased to industry for exploration. Accurate predictions of the location, size, or development schedule are not possible at this time.

Government and industry groups do publish resource estimates that often vary widely for a given area. These groups tend to use very different methodologies and reporting criteria and it is difficult to discern how these speculative undiscovered resource estimates would translate in terms of future infrastructure and effects. Some of those estimates are shown in Table IV-18 and definitely qualify as speculative.

With respect to the speculative offshore resource estimates, the leasing history for the Beaufort Sea suggests that the majority of production would already have occurred before most offshore projects would ever get underway. Any new development or additional oil production of the speculative resources will probably take place in nearshore areas adjacent to existing infrastructure. Development of additional offshore resources in deeper waters of the Beaufort Sea will depend heavily on the success of nearshore exploration and development.

Speculative resources include both discovered (though uneconomic) and undiscovered (purely speculative) resources that may be developed more than 20 years from now (Table IV-18). This category also includes undiscovered oil resources that might be developed more than 20 years from now as a result of future State and Federal lease sales (Table IV-16). Future development depends on favorable economic conditions. Table IV-15 includes speculative production from three sources: 1) enhanced recovery and satellite onshore accumulations near existing onshore infrastructure (50% of the 3.59 Bbbl total); 2) another 0.3 and 0.37 Bbbl is assumed to be discovered and developed in the Northeast and Northwest NPR-A from additional lease sales; and 3) a portion of the undiscovered resource base for offshore. Because these resources are undiscovered, no specific location or potential field size can be provided. Although the individual resource volumes are not known, this category also includes 12 discoveries that may be developed after 20 years. All of these discoveries are located onshore.

Development of gas resources on the North Slope is included in the speculative category because gas has been uneconomic to produce for several decades and may continue to be uneconomic in the future. The largest gas accumulation on the North Slope is in the Prudhoe Bay field (of 46 trillion cubic feet [Tcf] originally in place, approximately 25 Tcf are available now for sale). Various plans have been studied to bring North Slope gas to market, but no plan has overcome the high project cost and marketing hurdles. Because known gas resources are uneconomic today, it is difficult to predict the timing or scale of future gas production projects. According to general consensus, gas sales from Prudhoe Bay could start as early as 2010. Ample amounts exist in the Prudhoe Bay field alone to supply a large-scale gas export project for at least 20 years. The surrounding oil fields also have available gas resources that could feed into a North Slope gas transportation system. What is unlikely is that development of remote, undiscovered, and higher cost gas resources would occur while there are adequate supplies of known, readily available reserves. The existing North Slope oil infrastructure is capable of handling large amounts of natural gas (45.2 Tcf have been cycled through its facilities through 2001).

e. Oil Production on the North Slope of Alaska

(1) Production Through 2001

Between the time that the first production well was drilled on the Prudhoe Bay structure and the end of 2001, North Slope developments produced 13.625 Bbbl of oil (Table IV-14). Production on the North Slope peaked in 1988 at 2.0 MMbbl of oil per day, declining to its current rate of approximately 0.95 MMbbl per day. Of the producing fields on the North Slope, the most productive (in order of productivity) are Prudhoe Bay, Kuparuk River, Point McIntyre, and Endicott. Map 25 and Map 26 show producing fields and potential development areas on the North Slope.

(2) Resource Estimates Used for this Cumulative-Effects Analysis

The reserve and resource estimates shown in Tables IV-15 and IV-16 were used for analyzing cumulative effects from production onshore of the North Slope and in the Beaufort Sea--low range of 5 Bbbl, mid-range of 11 Bbbl, high range of 15 Bbbl.

(a) The Low Range--Past and Present Production

At 5 Bbbl (rounded), the low end of the range for this cumulative analysis takes into consideration past and present production (Tables IV-15 and IV-16). This includes reserves (5.294 Bbbl) in currently producing fields (Table IV-08) and resources (0.138 Bbbl) in discoveries in the planning or development stage (Table IV-10). The Northwest NPR-A Planning Area represents approximately 7.4 percent by reserve volume of the past and present production volumes (Table IV-15).

(b) The Mid-Range - Past, Present, and Reasonably Foreseeable Future Production

The 11 Bbbl (rounded) midrange for the cumulative analysis is based on past, present, and reasonably foreseeable future production. This figure is composed of the 5 Bbbl (rounded) from the low range (discussed above) added to discoveries that may be developed in the next 20 years. Reasonably foreseeable future production (total 5.43 Bbbl; Table IV-16) consists of discoveries totaling 0.500 Bbbl onshore and 1.070 Bbbl offshore, along with undiscovered onshore resources of 2.300 Bbbl in satellite accumulations and new fields in the Northeast NPR-A, and 1.38 Bbbl from tracts expected to be leased on the OCS in the Beaufort Sea (Table IV-16).

The Northwest NPR-A represents about 3.4 to 4 percent by reserve volume of this midrange figure (Table IV-16). By inference, the projected oil and gas activities would contribute 3.5 to 4 percent to the cumulative disturbance and resource habitat effects from past, present and reasonably foreseeable future activities. Projected oil and gas activities are estimated to contribute about 4.5 to 5 percent of onshore oil spills in the cumulative case.

(c) The High Range - Past, Present, Reasonably Foreseeable Future, and Speculative Production

The high range for the cumulative analysis is 15 Bbbl (rounded), which includes existing, planned, possible, and speculative production. The number is derived from the 11 Bbbl from the mid-range figure (discussed above) added to speculative future production of 3.59 Bbbl (includes undiscovered resources that may be developed after 20 years). Speculative production includes an estimated 2.670 Bbbl in currently undiscovered onshore resources in satellite fields and enhanced oil recovery (2.000 Bbbl), plus the remaining half of the leased and undiscovered volume in the National Petroleum Reserve-Alaska (0.670 Bbbl) (Table IV-16). It also includes an estimated 0.92 Bbbl of undiscovered offshore resources that could be developed as a result of future federal offshore lease sales. Northwest NPR-A represents about 2.5 percent by reserve volume of the total of past, present, reasonably foreseeable future, and speculative production (Table IV-15).

f. State Lease Sales Considered in This Cumulative-Effects Analysis

Since December 1959, the State of Alaska has held 32 oil and gas lease sales involving North Slope and Beaufort Sea leases. More than 4.6 million acres have been leased; some areas have been leased more than once because some leases expired or were relinquished. Historically, only about half of the tracts offered in state oil and gas lease sales have been leased. Of the leased tracts, about 10 percent actually have been drilled and about 5 percent have been developed commercially. About 78 percent of the leased areas are onshore, and about 22 percent are offshore. From the early 1960's through 1997, 401 exploration wells were drilled in State onshore and offshore areas. During this period, the number of exploration wells drilled annually has ranged from 2 to 35. From 1990 through 1998, the number of exploration wells drilled annually has ranged from about 7 to 12; the average number is about 10. Fifty-three of the exploration wells have resulted in discoveries--a success ratio of about 5 percent.

The State develops and approves an oil and gas leasing plan for a 10-year period, reassesses the plan, and publishes a schedule every other year. Except for Northstar, all of the North Slope and Beaufort Sea's commercially producible crude oil is on 931 active State leases (as of December 2000) broken down as follows: 1.35 million acres onshore along the Slope; 498,000 acres offshore in the Beaufort Sea; and 456,000 acres of active leases that straddle onshore and offshore acreage. Production to date from State leases (with a small recent contribution from Federal leases at Northstar) totals 13.625 Bbbl. The latest State lease sales--North Slope Areawide and Beaufort Sea Areawide--were held in October 2002. Between 2002 and 2006, the State of Alaska is expected to hold the following annual areawide lease sales:

- Beaufort Sea from Barrow to the Canadian border;
- Onshore Arctic Slope, including unleased State lands between the Arctic National Wildlife Refuge and the National Petroleum Reserve-Alaska; and
- Foothills sale, extending into the foothills of the Brooks Range.

The State has not yet estimated oil and gas resources involved in these future lease sales (see Table IV-16), but Table IV-18 shows 4.0 Bbbl in undiscovered resources on State lands on the North Slope. These include both leased and unleased State properties. Most are expected to be producible only as satellites through future field infrastructure.

g. Federal Lease Sales Considered in This Cumulative-Effects Analysis

In this analysis, lease sales for Federal OCS, Northeast NPR-A, and Northwest NPR-A are considered. Although Northstar production from the Federal OCS is small (1,131,639 bbl to May 2002), possible future production from Sale 186 is estimated at 460 MMbbl. As indicated above, speculative future offshore production of 3.59 Bbbl of currently undiscovered resources (Table IV-16) is also estimated. Future speculative production from leases on the Northwest NPR-A is estimated at approximately 2.1 Bbbl (Table IV-01).

Since December 1979, the U.S. Department of the Interior (USDOI) has held seven lease sales in Federal waters of the Beaufort Sea. The latest, Sale 170, was held in August 1998. Overall, 660 leases have been issued in the Beaufort Sea totaling 2.8 million acres. About 30 wells have been drilled on federal leases, with 9 wells determined to be producible. All wells have been plugged and abandoned because field economics have not favored production. There are 54 active leases on Federal submerged lands in the Beaufort Sea. The Kuvlum and Hammerhead units are potentially producible although not currently leased (Map 25); but there are no estimates of available resources. The Northstar Unit comprises 2 Federal tracts. These tracts contain 20 to 25 percent of Northstar's estimated 158 MMbbl of oil reserves.

Existing OCS fields in the Beaufort Sea are estimated to contain 220 to 550 MMbbl of recoverable oil. The lower number represents potential development at $18/bbl. The higher number assumes a price of $30/bbl, at which industry is likely to develop discovered but noncommercial fields such as Kuvlum, which is no longer active. Tracts available for lease in Sale 170 but not yet explored may contain 210 to 450 MMbbl of oil.

The BLM held its most recent lease sale in the Northeast NPR-A in June 2002. Overall, 60 tracts received bids with the high bids totaling $63.8 million. Assuming multiple sales, a speculative estimate of Northeast NPR-A production ranges from 130 to 600 MMbbl of oil. ConocoPhillips has drilled 10 wells with announced discoveries of gas, oil, and condensate in 5 of 6 wells. BP has drilled 2 wells and Anadarko 1 well. Neither company has made any announcements regarding the producibility of the wells.

h. Classified Drilling

In addition to the discoveries mentioned above, a number of wells have been drilled that are "classified" (or "tight holes" in oil field jargon). If a well is termed classified, no information is released to the public.

i. Infrastructure and Transportation

Given the decline of resources in the fields surrounding Prudhoe Bay, the infrastructure and transportation system (including the TAPS pipeline) should be able to process and transport any oil that other small projects produce. New fields would use infrastructure at the edge of the core area. Infrastructure at the edge of the core area can be envisioned as: the western sector or Alpine Group, which would accommodate the NPR-A; the central or Northstar Group; and the eastern sector or Badami Group (Map 25; Table IV-12).

Currently, the TAPS terminal at Valdez handles about 999,202 bbl of crude daily. At peak production, Northwest NPR-A would produce from 5 to 38 MMbbl of crude oil annually. The daily production rate from Northwest NPR-A would be approximately 5 percent of the throughput the TAPS pipeline system now handles. Estimating future production on the North Slope (including offshore) at the high end of projections, oil tankers still could be moving this daily amount of oil (about 1.0 MMbbl) from Valdez in 2009.

(1) Tanker Traffic and Routes

Potential crude oil (and possibly liquefied natural gas) tankerage from Valdez to the Far East will join existing liquefied natural gas tanker traffic from the liquefied natural gas plant in Nikiski, Alaska. Every 10 days, the Nikiski plant loads a tanker with 80,000 cubic meters of liquefied natural gas for a round trip to Tokyo, which it has been doing since 1968 without significant spillage. Because liquefied gas boils off and disperses quickly when exposed to normal air temperatures and winds in the North Pacific, it is not a major environmental threat along the tanker route.

On November 28, 1995, President Clinton signed legislation (30 U.S.C. 185(s)) that authorizes the export of crude oil from Alaska's North Slope in U.S. flag tankers, unless the President finds exports are not in the national interest. Map 97 shows the probable route that tankers bound from Valdez to the Far East would travel. They could carry up to 1.8 MMbbl each; however, such estimates are highly speculative, because they depend on opportunities for short-term contracts. The routing shown in Map 97 would bring the tankers more than 200 mi offshore of the Aleutian Islands--a distance that should protect the biological resources of the Aleutian Chain from pollution.

(2) Trans-Alaska Gas-Transportation System

If the price per barrel of crude oil remains between $20 and $30, building a gas transportation system may eventually become viable. At present, such a project is considered speculative. One such proposed system would deliver natural gas from the North Slope at up to 2.3 billion cubic feet (Bcf) per day to a liquefaction plant in

Valdez. The natural gas would be moved through a 42-inch pipeline built next to TAPS oil pipeline. The proposed project would consist of a plant to liquefy about 2 Bcf of natural gas per day, 4 tanks to store 3,200,000 bbl of liquefied natural gas, a marine loading area, and a dock for loading cargo and personnel. The liquefied natural gas plant most likely would be in Anderson Bay, 3 mi east of the Valdez narrows on the south shore of Port Valdez (other options are being considered). The site is 3.5 mi west of the existing TAPS terminal and 5.5 mi from Valdez. When completed, it would occupy 390 acres of a 2,630-acre site owned by the State of Alaska. An anticipated fleet of 15 liquefied natural gas tankers would carry 125,000 cubic meters of liquefied gas per trip to destinations in Japan, Taiwan, and Korea. Full development would require 275 liquefied natural gas tanker loadings a year (Federal Energy Regulatory Committee, 1995). A final EIS was issued for the plant in March 1995, but no agreements exist with the resource holders.

In the past year, industry has been studying a Trans-Alaska Gas System including: 1) the over the top of Alaska and down the Mackenzie River through Canada proposal, and 2) the follow the Haul Road south to Delta Junction and then through Canada route. Although not as cost effective as the versions involving a Canadian route, to create jobs and provide gas to Alaskan communities along the way, the Alaska State Legislature has passed legislation requiring the gas pipeline route to follow the TAPS route through Alaska.

Please see Table IV-24 for more information on the Trans-Alaska Gas System and other projects that could move gas from the North Slope to market. Given the remote likelihood of construction of such a transportation system in the foreseeable future its potential effects are not considered in this cumulative analysis.

(3) Transportation for "Roadless" Development

The current Integrated Activity Plan for the Northeast NPR-A prohibits permanent roads connecting Northeast NPR-A facilities to outside infrastructure. Stipulation 48 for Northeast NPR-A states, "Permanent roads (i.e. gravel, sand) connecting to a road system or docks outside the planning area are prohibited, and no exceptions may be granted" (USDOI, BLM, 1998b). Similarly, ongoing and planned oil-development projects such as Badami, Alpine, Northstar, CD North, and CD South are not expected to have permanent gravel roads connecting to Prudhoe Bay. Transportation to these fields is assumed to be by aircraft and marine vessels; in winter, temporary ice roads also will be used. The potential for a possible (but unlikely) road across the Northeast NPR-A is discussed in Section IV.K.

(4) Dalton Highway to NPR-A/Nuiqsut Road

The State of Alaska's Industrial Roads Program (IRP), also known as "Roads to Resources," began in March 2003 as part of the Northwest Alaska Transportation Plan when transportation analyses showed that new North Slope oilfield roads would accelerate development and provide significant revenue/employment opportunities.

The Alaska Department of Transportation and Public Facilities' (DOT&PF) preferred route of the Dalton Highway to NPR-A/Nuiqsut Road is Route 'A.' Route 'A' is a 108-mi road from the Dalton Highway in the area of Pump Station No. 2 west through the Brooks Range foothills, then north parallel to the Colville River, and across the Colville River. The 3,300-ft bridge will cross the Colville River a few miles south of Nuiqsut.

The State is continuing to meet with oil and gas companies to refine Route 'A' to access oil and gas leases on State land between the Dalton Highway and the Colville River, and oil and gas leases on Federal land within Northeast NPR-A.

The final alignment of Route 'A' and the bridge-crossing site will determine the route of a 14- to 17-mi road from the Spine Road to the Colville River Bridge. This road would be about 32 ft wide at the top and 4 ft deep. As reported in *Petroleum News*, the road would be capable of handling all ordinary industrial loads, including drill rig moves (Nelson, 2003). The Route 'A' road would not preclude continued winter use of the Spine Road by Nuiqsut to access whaling camps and other local wintertime uses.

Route 'A' is likely to take three years to design/permit and two-three years to construct. The bridge project is likely to follow immediately on the heels of Route 'A' completion. Depending on BLM development timelines, a road into NPR-A could follow immediately on the heels of the bridge completion.

Section 118 (e) of the Transportation Enhancement Act – 21 (TEA-21) authorizes the expenditure of Federal funds for resource development road construction projects without regard to the traditional 'public funds equals public access' caveat. TEA-21 allows industrial use designation of these roads that precludes or limits public access even though state or federal funds are used. The ADOTPF is investigating the full implications of this statute on the North Slope roads development program currently underway. It is as yet unclear whether or not the Dalton Highway to NPR-A/Nuiqsut Road would be open to public use.

j. Use of Water and Gravel Resources

(1) Water Resources

The Arctic Coastal Plain (ACP) is the predominant feature of the North Slope. It is a mosaic of tundra wetlands with extremely low relief and poor drainage, giving rise to numerous shallow lakes, ponds, marshes, and slow-moving streams. Permafrost prevents water from entering the ground, and the low relief limits runoff. The ACP extends south approximately 30 mi into the coastal lowlands, which are in turn dominated by tundra vegetation, meandering streams, and thousands of shallow thaw lakes. Approximately 26 percent of the ACP is covered by waterbodies (USDOI, BLM, 1979a). The onset of snowmelt and subsequent runoff begins in late May or early June in the foothills and moves north as summer progresses. Snowmelt contributes the majority of the annual runoff and helps maintain a saturated layer of surface soils. Rainstorms can produce increases in stream flow but seldom are sufficient to cause flooding. Stream flow decreases rapidly after freezup in September, and generally is nonexistent in the winter.

On the North Slope, the oil industry uses about 1 billion gallons of water annually (Fay, 2001, pers. comm.). Fresh water is used for construction maintenance and on-tundra roads. There are numerous permitted water sources that may be used for ice-road construction and other water needs. These sources include existing and abandoned mine sites. Available permitted lakes range in size from approximately 0.1 to 0.5 mi^2 in surface area. Given that 1.0 acre-foot = 326,000 gallons, 120 million gallons of water would equal 368 acre-feet. This volume represents a water drawdown of 12 inches from a 368-acre lake or two 184-acre lakes during the summer. Two larger lakes, four smaller lakes, or some combination would accommodate a drawdown of 6 inches. However, during the winter, the lakes are frozen down to a depth of 6 ft or more and a greatly reduced volume of unfrozen water remains available under the ice. Many more lakes would likely be needed to provide the same volume of water during winter. A tundra ice road 50 ft wide, 6 inches thick, and 6 mi long would require about 4.3 million gallons of water. Two-thirds of the road thickness would be fresh water and one-third would be snow. Pressure from the weight of the snow and ice can cause compression and breaking off of the older tundra vegetation and result in a "green trail" from the freed-up, younger portions of the plant.

The importance of overwintering habitat for freshwater fishes and the way in which extensive ice cover limits the availability of dissolved oxygen for the duration of the extended winter seasons on the North Slope has long been understood. Lakes have been cataloged, and the inventorying and investigating of lakes that also can accommodate industrial use continues. When issuing a permit for industrial use for a lake within its authority, the Alaska Department of Fish and Game (ADF&G) takes drawdown and other criteria into account in relation to overwintering. If the waterbody is fish bearing, the ADF&G imposes a restriction: "no more than 15 percentage of the total volume of water source may be withdrawn." Ice is excluded from the total volume calculation; therefore, the "15 percent" is of the available unfrozen water.

Temporary water use permits are granted by the ADF&G for a period of 1 day to 5 years. This would cover an exploration activity. The permit will not specify a source of fresh water because the environmental conditions change and this could change the conditions of a permit. For its Trailblazer Project in the Petroleum Reserve, BPXA used 84.5 million gallons of water for ice-road and pad construction through April 2001 (Chambers, 2002). For the 1999-2000 and 2000-2001 drilling seasons, Phillips used 51 and 57 million gallons of water, respectively, from permitted sources in constructing roads and drill pads in the Petroleum Reserve. For longer term needs, such as a production site, a lessee can file for water rights to a specific waterbody.

Most NPR-A water resources have not been permitted for industrial use. Only those waterbodies in the proximity of a construction or production site have been permitted. Most of those permitted sites are not used after the completion of a construction project, which can take from a few months to 1 or 2 years. As development proceeds, additional water needs will be assessed on a project-specific basis. Some construction activities, such as gravel mining, have created new water resources and associated habitat for biota.

(2) Gravel Resources

Gravel in the area of Alaska north of the Brooks Range has been used for a variety of construction and maintenance purposes. These historical uses include construction of the following:

- Dalton Highway/Haul Road in support of the development of the North Slope oil fields and TAPS;
- pads for camps, exploration drilling, development and production drilling sites, and operations and maintenance facilities;
- airports in oil-field areas and in the communities of the North Slope Borough;
- roads in oil-field areas and in the communities of the North Slope Borough;
- manmade islands for offshore exploration drilling and for development and production facilities;
- docks and causeways; and
- beach nourishment in several of the North Slope Borough communities.

From 1974 to 1999, more than 205 million tons of gravel have been mined to meet the industrial and community construction and maintenance needs in the area that the Alaska DNR, Division of Geological and Geophysical Surveys, refers to as the Northern Region. This area is north of 67 ° N. latitude and includes the Brooks Range, the area north of the Brooks Range to the Beaufort Sea coast (the North Slope), the Chukchi Sea coast north of Cape Krusenstern, and the North Slope Borough communities. Most of the gravel has been mined from the floodplains of rivers. About 180 million tons of the gravel (88% of the total) was mined from 1974 to 1985. During this time the Haul Road/Dalton Highway and pads, roads, and airfields were constructed for the facilities to develop the Prudhoe Bay, Kuparuk River, Lisburne, Milne Point, and Endicott oil fields. From 1986 to 1999, the amount of gravel mined annually in the Northern Region has ranged from 4.5 to 0.56 million tons, about 14 percent of the State's total gravel usage during those years.

Gravel extraction requires permits. The ADF&G, Habitat and Restoration Division, has developed guidelines for siting, design, operation, and reclamation of North Slope gravel pits. The area disturbed by gravel mines and fill placement is a fraction of the area north of the Brooks Range. The ACP covers about 23,000,000 hectares and the area between the Colville and Canning rivers is about 71,000 km^2 (7,000,000 hectares) (Gilders and Cronin, 2000). The area disturbed by gravel mines and fill placement is about 8,793 hectares; this is about 0.04 percent of the 23,000,000 hectares of the ACP.

West of the Colville River, gravel sources become far more difficult to locate. Surface deposits within the NPR-A consist mostly of fine-grain clay, silt, and sand. Gravel is located along the slopes of the Brooks Range, the Colville riverbed and some scattered areas along the arctic coast. Long hauls are often required to bring in gravel, so gravel from existing work/drill sites is reused (U.S. Geological Survey, 1985). This lack of gravel will be a significant consideration in the development of permanent oil and gas facilities west of the Colville River. Although there are no specific proposals, there is ongoing discussion of the potential need for inter-community roads west of the Colville River. Such roads would also require significant amounts of gravel and sand resources.

In general, North Slope gravel usage for the oil fields has been declining. Large fields (such as Prudhoe Bay and Kuparuk) that require a large number of production facility pads, are no longer being discovered. There also is a trend toward consolidating facilities and using technological advances that minimize the surface area disturbed (Gilders and Cronin, 2000).

Other developments that have reduced the amount of gravel needed to develop or maintain oil and gas production facilities include:

- ice pads instead of gravel for exploratory well-drilling pads (onshore and offshore in shallow waters, where appropriate);
- use of mobile steel or concrete bottom-founded structures to drill exploratory wells in shallow waters;
- use of ice roads instead of gravel roads for pipeline construction;
- developing fields without a gravel road connection to Prudhoe Bay/Deadhorse area (Badami and Alpine);
- reducing the spacing distance between development wells, which reduces the size of the development pads (Alaska Department of Natural Resources (1991) estimates a 76% reduction in development pad size);
- use of extended-reach drilling, which reduces the amount of gravel needed to develop new reservoirs that lie near established facilities;
- recycling of gravel from roads, airfields, or pads that are no longer used; and
- use of clean drill cuttings in place of gravel.

k. Global Climate Change

In its *Draft Guidance Regarding Consideration of Global Climate Change in Environmental Documents Prepared Pursuant to the National Environmental Policy Act, October 8, 1997* , the CEQ recommends addressing this issue at the program level rather than at the project level.

Based on current scientific research, there is growing concern about the potential effects of primary greenhouse gases (carbon dioxide, methane, nitrous oxide, ozone, water vapor, and chlorofluorocarbons) on global climate. Through many complex interactions on a regional and global scale, the lower layers of the atmosphere experience a net warming effect. These trends could be caused by greenhouse warming or natural fluctuations in the climate. This is an ongoing scientific debate.

The assessment of the impacts of climate change is in its formative phase, and it is not yet possible to know with confidence the net impact of such change. The potential effects of a global climate change could alter water supply, food security, sea-level fluctuations, and natural variances in the ecosystem. Global climate change may affect surface resources in the Northwest NPR-A. Possible impacts of global climate change include negative effects on the ecology of the arctic tundra and changes in the permafrost depth. Reduction in sea ice as a result of global climate change would affect marine mammals (particularly polar bears), fish, and birds, with related implications for Native subsistence harvests. In addition, potential sea-level rise and increases in severe weather could have adverse effects on oil- and gas-related infrastructure.

Because climate change must be viewed from a global perspective, the magnitude of the emissions potentially contributed by oil and gas activities in the Northwest NPR-A needs to be viewed in that context. Activities associated with exploration, development, and production of oil and gas resources from the Northwest NPR-A planning area will produce some of the listed greenhouse gases, primarily as a result of power requirements and fuel consumption, activities that produce carbon dioxide. The incremental contribution of greenhouse gases from the proposed alternatives in the Northwest NPR-A would be negligible when compared to total greenhouse gas contributions.

For a discussion on Traditional Knowledge on global climate change see Section IV.F.8.n.1.e.

8. Analysis of Cumulative Effects by Resource

a. Soils

(1) Cumulative Analysis

Cumulative impacts to soils within the Planning Area would occur from non-oil and gas activities and oil and gas exploration and development activities. Activities outside the Northwest NPR-A Planning Area--i.e., NPR-A outside the Northwest Planning Area and outside NPR-A altogether--are also part of the cumulative case. The infrastructure for oil and gas development and transportation is the most important aspect of the cumulative analysis.

The analysis for cumulative impacts to soils is similar to the analysis for vegetation. All impact measures inside the Planning Area are evaluated in Alternative A; outside the Planning Area, impacts are associated with other oil and gas development, pipelines, and oil spills. The scenarios for Alternative A, Alternative B, and the Preferred Alternative assume the possibility of pipelines constructed for a total of 245 mi to the east of the Planning Area. The impact for soils would be similar to the impacts that VSM placement or burial would have on vegetation (Section IV.F.8.g). As would be the case for impacts to vegetation, impacts from Alaska's North Slope oil and gas exploration and development on soils are expected to be additive in nature. These effects--from gravel extraction and fill for the construction of pads, roads, pipelines and material sites--are estimated to be less than 1,400 acres in the Planning Area. Added to the current development acreage of Prudhoe Bay/Kuparak at 9,000 to 10,000 acres, the total impacts are expected to remain a small percentage of the entire Arctic Coastal Plain.

Oil spills may impact soils as the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils.

Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled and they minimize surface disturbance. The affected area is limited to that area immediately covered by and adjacent to the spill.

(2) Conclusion

Impacts to soils are similar to the impacts to vegetation and occur from activities associated with development. They include construction of gravel pads, roads and air strips, pipelines and pump stations, and the excavation of material sites. The duration of the impacts to soils would range from short term (1 to several years) if the vegetation is disturbed and up to several decades if the soils are destroyed.

b. Paleontological Resources

(1) Cumulative Analysis

While oil and gas exploration and development in the Northwest NPR-A (as described in Alternative A) are the primary contributing activities in terms of cumulative effects on paleontological resources on the North Slope, other contributing factors may be of greater magnitude. These include permitted activities such as non-oil and gas-related overland moves, scientific data gathering, recreational use by the public, and activities ancillary to the BLM's management of the area.

Paleontological resources are not ubiquitous across the North Slope. Because of their internment in the natural stratigraphy, the location of plant and animal fossils is predictable only to a limited degree and most of the locales where they are present remain unknown. This makes assessment of cumulative impacts difficult. Obviously, as oil and gas-related activities increase, more area is potentially impacted, and there is a greater chance of paleontological resources being impacted.

Perhaps a better approach to this analysis is to examine the resource from the standpoint of vulnerability. In many settings, paleontological resources are well protected by nature, in that they are so deeply buried and totally encased in sediments or rock that virtually nothing can impact them aside from excavation. In other instances they are located on or near the surface and are very susceptible to impacts. In most cases, surface or near-surface paleontological resources are more likely to be impacted as the result of exploration activities than by development. This is because most exploration-related operations occur in the low-light conditions of winter. Although snow cover may offer some protection, it also disguises surface manifestations, making them difficult to recognize and avoid. It would be advisable to conduct surveys of proposed activity areas and overland travel routes during the snow-free months preceding the initiation of winter exploration activities.

(a) Effects of Gravel Extraction

Probably the greatest single potential impacting factor to paleontological resources would be the excavation of gravel for the well pads, roads, and airstrips that would be associated with development. Most mammalian fossils are of Quaternary age, which is also the age and origin of most North Slope gravel sources. Therefore, the more gravel deposits that are excavated for development construction activities, the more chances there are that significant impacts to paleontological resources would occur.

(b) Effects of Natural Events

Most paleontological deposits are revealed as the result of natural erosion. Usually this is from the action of flowing water, but it can also occur as the result of wind, seasonal freezing and thawing (cryoturbation), thermokarsting, and solifluction. It is difficult to assess the results of acts of nature on paleontological resources because in most cases they are regarded as revealing rather than as negatively impacting the resource.

(c) Effects of a Large Oil Spill

The effects of a large terrestrial oil spill on a paleontological deposit would be directly related to the time of year and the context of the resource. If the spill were to occur during the non-snow/unfrozen surface months, then the potential level of impact would be significantly higher. In an unfrozen context, surface or near-surface paleontological resources could be easily impacted--primarily from contamination that would render radiocarbon and biomolecular assays valueless. This would pertain primarily to resources of Quaternary age. In this case, it is assumed that the majority of the impacts would occur as the result of the cleanup rather than the actual spill. During the frozen months, both a spill and the resulting cleanup would be considerably less impacting. In the case of deeply buried paleontological deposits, neither the spill nor the subsequent cleanup (regardless of the time of year) would have any effect on the resource.

(2) Conclusion

The cumulative activities--including oil and gas exploration and development--are expected to impact paleontological resources to some degree. However, because of the nature of paleontological deposits (specifically, their unpredictable location and context on surface, near-surface, or deeply buried), the magnitude of the impact is difficult to assess. If current procedures for survey and inventory prior to exploration and development activities continue, the impact to paleontological resources would be expected to be minimal. Paleontological resources, unlike most other resources in the NPR-A, are nonrenewable. Once they are impacted through displacement or contamination, their value may be greatly and irreversibly compromised. Effects across the North Slope of Alaska are expected to be additive in nature, though even cumulatively they are expected to be minor.

c. Water Resources

(1) Cumulative Analysis

The cumulative effects of oil and gas exploration and development across the North Slope on water resources would result from disturbance of stream banks or lake shorelines and subsequent melting of permafrost (thermokarst); blockages of natural channels and floodways that disrupt drainage patterns; increased erosion and sedimentation; and removal of gravel from riverine pools and lakes (as noted in Section IV.B.3). The cumulative case assumes exploration and development for all of the Planning Area. Thus, the effects on water resources may be several times greater than estimated for Alternative A, Alternative B, or the Preferred Alternative. Outside of the Planning Area, increased use of material sites, lakes as water source for ice roads, and dust created by additional traffic on existing roads could cause additional impacts to water resources.

The long-term effect of thermokarst on water resources would be subsidence of the ice-rich permafrost along the stream banks and lakeshores, especially in areas where the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost result in increased sediment erosion and changes to stream channel and bed morphology.

Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation, as well as potential thermokarst. Since roads pose the single most significant impacting factor (diversions, impoundments, and increased sediment runoff), limiting the length of the roads would provide the greatest reduction in impacts to the water resources.

Besides thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Long-term effects are changes in channel morphology and composition of lake and stream bottom materials.

Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. This could result in long-term changes in stream channel and lakeshore sand- and gravel-bar formation. Due to the inadequate gravel resources within the Planning Area (Section IV.A.1.b.4.b), new or expansion of existing material sites in the Colville Delta are likely. While these sites require permits from ADF&G, there exists the possibility for impedance and diversion of floodwaters, increased erosion and sedimentation, and increased thermokarst adjacent to the material sites.

(2) Conclusion

Cumulative effects on water resources across the North Slope would be several times greater than that estimated for Alternative A, Alternative B, or the Preferred Alternative. The majority of the impacts would result from oil and gas development activities with construction of roads being the single greatest contributor to overall cumulative impacts. Impacts from activities other than those associated with oil and gas development (including any oil and gas-related roads) would be minimal. Because of the abundance of water resources on the North Slope, the overall cumulative impact would be small in magnitude and most impacts would be local.

d. Freshwater Quality

(1) Cumulative Analysis

Discussed in this section are the cumulative effects on freshwater water quality of ongoing and future activities as a result of leasing in the Northwest NPR-A Planning Area as well as other oil and gas activities on the North Slope. Cumulative effects of North Slope activities on water quality, Section V.C.1 of the *Beaufort Sea Planning Area Sales 186, 195, and 202 EIS* (USDOI, MMS, Alaska OCS Region, 2002a), are incorporated here by reference and summarized below.

A summary of the cumulative effects to water quality, supplemented by additional material, as cited, follows.

If a large oil spill were to result from oil and gas development in the Beaufort Sea, the marine environment would be degraded through the release of petroleum hydrocarbons into the water column. The hydrocarbon concentration could exceed the 1.5-parts per million (ppm) acute-toxic criteria for about a day in the area of about 2 km^2 (0.8 mi^2). The 0.015-ppm chronic criteria also could be exceeded for 10 or more days in an area of about 12 to 45 km^2 (4.6 to 17.4 mi^2). Small spills could exceed the acute-toxic level (1.5 ppm) for less than a day and chronic criteria (0.015 ppm) could be exceeded for less than a month in an area of less than 100 km^2 (39 mi^2).

Tankering of known Beaufort Sea and North Slope oil resources other than from the Planning Area from the southern end of the TAPS could result in an unlikely, very large tanker spill and the oil could contact nearshore areas in Prince William Sound or the Gulf of Alaska in a relatively non-weathered state. Such a spill is estimated to affect up to 10 percent of the water quality within the affected area. Recovery is expected to take days to weeks in areas with high surf energy and longer in embayments.

The quality of freshwater within the Planning Area is not affected by any of the major projects considered in cumulative case. The effects of construction activities are expected to be short term, lasting as long as the individual activity, and have the greatest impact in the immediate vicinity of the activity. The construction activities are not expected to introduce or add any chemical contaminants.

In the Prudhoe Bay area, trace metal contamination has been raised as a concern (Woodward et al., 1988; Snyder-Conn et al., 1997). Based on very limited sampling, Snyder-Conn et al. (1997) suggested that elevated levels of nickel and mercury exist in snowpack near the ARCO (world's largest) gas-handling facility and that elevated levels of mercury, antimony, cadmium, copper, and lead exist near the NSB solid-waste incinerator. A single total-mercury sample was collected near each facility, and "additional sampling is needed before any conclusions [regarding mercury] are drawn." The total mercury concentration for this single snow sample near the gas-handling facility was 8.4 parts per trillion (ppt), a few-fold higher than the chronic water-quality standard of 1.2 ppt, but far below the acute-toxic standard of 2,400 ppt.

There are two caveats that lessen concern over the single high mercury value near the gas plant. First, the EPA has recommended that the states treat EPA-based metal standards as dissolved metal standards, not total metal standards as reported by Snyder-Conn et al. (1997). The concentration of dissolved mercury may not exceed the criterion. Second, the EPA-based standard is based on the assumption that all mercury present is methylmercury. The mercury in snow should be ionic and possibly metallic mercury, not methylmercury. A criterion based on ionic mercury rather than methylmercury would be much higher than the measured total mercury value.

(2) Conclusion

Oil spills from oil and gas development activities could degrade water quality through the release of petroleum hydrocarbons. The spills would increase the concentration of hydrocarbons in the water column. For a large crude-oil spill, hydrocarbon concentrations could exceed the 1.5-ppm acute-toxic criterion for about a day. The 0.015-ppm chronic criterion also could be exceeded for 10 or more days. Hydrocarbons from a large diesel-oil spill (900 bbl) during open water could exceed the acute-toxic criterion for about 7 days. Hydrocarbon concentrations could exceed the 1.5-ppm acute-toxic criterion for less than a day in a very small area for small spills. The 0.015-ppm chronic criterion also could be exceeded for less than a month for small spills.

A large crude- or refined-oil spill (greater than or equal to 500 bbl from a pipeline or 900 bbl from a facility) would affect water quality by increasing the concentration of hydrocarbons in the water column of nearby lakes and streams if such a spill were to occur and were to enter these environments (the chance of a large spill occurring is low). Also, regional (more than 1,000 km² [386 mi²]), long-term (more than 1 year) degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is very unlikely.

e. Estuarine Water Quality

(1) Cumulative Analysis

This cumulative assessment includes the probable effects of activities resulting from additional lease sales in the NPR-A, current and projected North Slope oil development projects, and effects from activities resulting from past Federal and State oil and gas lease sales. The activities associated with these actions would affect estuarine water quality in the same way as discussed for Alternative A and the Preferred Alternative (permitted discharges, permitted construction disturbance, and accidental oil spills) but to a slightly greater extent.

As a result of past Federal and State oil and gas lease sales, more than 40 exploration wells have been drilled in the Beaufort Sea. The nearshore facilities that have been constructed include a long dock, a long causeway, and many gravel islands (e.g., the Sag, Niakuk, Resolution, Duck, Goose, Endicott and NW Milne gravel islands).

The National Research Council (NRC) recently summarized the cumulative effects of oil and gas activities on the North Slope, including the effect of operations in the nearshore Beaufort Sea on the bowhead whale and other species (NRC, 2003). The summary chapter includes information on the cumulative effects of permitted construction and accidental oil spills, but does not describe any cumulative effects of permitted discharges. With respect to permitted construction, the summary chapter states that many facilities have been abandoned without complete removal, but the chapter does not describe any cumulative environmental effects of the nearshore facilities. With respect to accidental spills, the chapter explains that, although no large oil spills have occurred in the marine waters off the North Slopes, their potential is such a major concern that the committee recommends research into mitigation.

The following is some additional information on the probable cumulative effects of long causeways and oil spills. A long causeway still creates measurable changes in water quality (i.e., water temperature and salinity) a decade after construction and enlargement of the breeches (Fechhelm et al., 2001). However, no new long causeways or docks are proposed; only short docks and causeways are part of the scenarios for the NPR-A. None of the water-quality effects associated with the long causeway has been found to occur around short docks (such as East Dock, which was constructed about 3 decades ago). So, the cumulative effect of docks and causeways would be similar to the present level of effects.

More oil spills are estimated for the cumulative case than for Alternative A or the Preferred Alternative because the NPR-A estuaries could be affected by spills from oil and gas operations offshore of the reserve. For example, the EIS for three proposed oil and gas lease sales on the outer part of the continental shelf (USDOI, MMS, Alaska OCS Region, 2003) assessed the effects of a 1,500 bbl spill from a production facility and a 4,600 bbl spill from an offshore pipeline. However, the EIS added that "a large spill is unlikely to occur based on a mean spill number ranging from 0.08 to 0.11 for Alternative I for MMS Proposed OCS Lease Sales 186, 195, and 202."

(2) Conclusion

The cumulative level of effects of regulated discharges on estuarine water quality would be negligible.

f. Air Quality

(1) Cumulative Analysis

(a) Background

Despite considerable oil- and gas-related activity since 1969, the overall air quality on the North Slope of Alaska remains relatively pristine. See Section III.A.3 for a discussion of the existing air quality.

Prudhoe Bay and Kuparuk are the big oil producers (see Table IV-08), however, their production will continue to decline over the coming years. Air monitoring at a number of sites in the Kuparuk and Prudhoe Bay fields showed that concentrations of nitrogen dioxide, sulfur dioxide, and particulate matter 10 micrometers or less are well within the national ambient air-quality standards. BP's air-quality modeling for the Liberty Project indicated that emissions from the Prudhoe Bay and Kuparuk fields have very little effect on ambient concentrations elsewhere. The air-quality modeling for that project also indicated that maximum concentrations would occur within about 100 to 200 m from the facility boundary and would be considerably lower at 1 km from the facility. The BLM considers that these results representative of what could be expected from any development resulting from the current Northwest NPR-A multiple-sale proposal. Thus, there would be very little cumulative interaction between developments under this proposal and other oil-producing facilities.

Potential impacts from future lease sales on the outer continental shelf and on land are difficult to evaluate. However, one can expect that any development would be scattered over a rather large area. Modeling performed for the *Lease Sale 144 Final EIS* (USDOI, MMS, 1996a) showed that impacts from widely scattered emissions sources on the outer continental shelf are small and well within regulatory standards. The *Final 5-Year Program EIS for 2002-2007* (USDOI, MMS, 2002) discusses the cumulative effects of the OCS Program in all areas. The relevant major finding was that no major degradation of onshore air quality is predicted. Emissions associated with routine OCS Program activities could cause small increases in onshore concentrations of some air pollutants, although there is not expected to be any exceedance of national or State air-quality standards. In the unlikely event of a large oil spill, the accidental release could cause rapid (and perhaps dramatic) increases in volatile organic carbon concentrations near the spill, but the duration of these should be too short (generally a few days) to cause major impacts.

A more comprehensive discussion can be found in the "Impacts on Air Quality" sections in the *MMS Five-Year OCS Program EIS* (USDOI, MMS, 2002:Sec. 4.3.2.2 and 4.3.3.2); that discussion is incorporated here by reference. Section 4.3.2.2 (pertaining to the Gulf of Mexico) includes also a general discussion of ambient air-quality standards, the effects of pollutants, and the type and relative amounts of pollutants generated by offshore operations. Section 4.3.3.2 (specific to Alaska) discusses the most commonly emitted air pollutants associated with Alaska OCS oil and gas activities, including operations in areas affected by ice cover, the construction of ice islands and gravel islands, and the concentration of activities into short time frames. The conclusions drawn there are that the impacts from the 5-year OCS Program on the pollutant levels, the ozone levels, and visibility would all be minor or negligible. Section V.C.13 of the *Liberty Final Environmental Impact Statement* (USDOI, MMS, Alaska OCS Region, 2002) discusses the cumulative effects on air quality of all North Slope of Alaska oil and gas activity since 1969. It concludes that the cumulative effects of all projects affecting that area in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards. The Northstar and Liberty Projects and all other reasonably foreseeable North Slope projects would not change this situation. Also, Section IV.C.6.b.(2) of this EIS concludes that from small oil spills there would be a small, very localized increase in concentration of hydrocarbons. Concentrations of criteria pollutants would remain well within Federal air-quality standards. The overall effects on air quality would be very low.

Emissions from the hypothetical first commercial development in the Northwest NPR-A Planning Area would result from the installation of a maximum of 3 production pads, the drilling of a maximum of 150 production and service wells, and the installation of 135 mi of pipeline (Table IV-02). In the peak years, a projected maximum of 36 wells per year would be drilled from 2 rigs. Production emissions from the first commercial oil project are projected to peak 10 to 15 years after the lease sale, with production of about 38 million barrels (MMbbl) of oil per year. Peak production from up to 8 fields from multiple sales under the Preferred Alternative is projected to reach 50 MMbbl per year).

Very little cumulative interaction is expected to take place between emissions from developments resulting from the proposed Northwest NPR-A Planning Area multiple-sale proposal and any other existing, planned, or potential oil or gas development projects. For the North Slope area as a whole, the quality of the air in coming years could be expected to increase in those areas where oil production currently is the greatest and to decline in areas where future development is expected to take place. It is possible that new development would be relatively scattered, keeping regional impacts small except for higher, localized concentrations in the immediate vicinity of production facilities.

Arctic haze is a phenomenon resulting from elevated concentrations of fine particulate matter that are found over the Arctic, primarily in winter and spring. Scientists believe that most of these pollutants are attributable to combustion sources in Europe and Asia. It is not known to what extent local sources in Alaska contribute to arctic haze in the area of the Beaufort Sea. However, the arctic haze phenomenon was first observed in the 1950's, long before oil development started on the North Slope. The fact that emissions in the general area are expected to decrease (because of a downward trend in oil production) means that any possible contribution to arctic haze would be reduced. Emissions from development resulting from the proposed Northwest NPR-A Planning Area multiple-sale proposal would be small compared to the emissions from Prudhoe Bay and Kuparuk oil field production. For example, actual emissions reported for the Prudhoe Bay oil fields for the year 1994-1995 listed 56,000 tons of nitrogen oxide, 1,471 tons of sulfur dioxide, and 6,200 tons of particulate matter less than 10 micrograms in diameter (U.S. Army Corps of Engineers, 1999:Table 5.4-7). Projected emissions from the current proposal would be only a small percentage of those figures. Therefore, any contribution from Northwest NPR-A activities to arctic haze would be minor.

(b) Global Climate Change

The global climate change analysis performed for the Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007 (USDOI, MMS, 2002:Sec. 4.1.2 and Tables 4-7a and 4-7b; incorporated here by reference) estimated that the emission rate of greenhouse gases (carbon dioxide, methane, and nitrogen dioxide [NO_2]) from the cumulative OCS program activities for Alaska would be from 381 to 723 thousand metric tons of carbon equivalent per year for carbon dioxide and from 1.1 to 2.1 thousand metric tons of carbon equivalent per year for methane. Emissions of NO_2 were not calculated because of lack of information about emission factors. However, NO_2 emissions are expected to be much smaller than for the other greenhouse gases. The total estimated greenhouse gas emissions from the 3 Beaufort Sea Lease Sales (186, 195, and 202), including emissions from tanker transport to U.S. West Coast ports, were from 177 to 311 million metric tons of carbon equivalent (TCE). This is about 0.01 to 0.02 percent of current nationwide greenhouse gas emissions. The Northstar Environmental Impact Statement estimated that the greenhouse gas emissions from current North Slope oil production (including shipping, refining, end product transportation, and consumption) is about 1 percent of the global fossil fuel greenhouse gas emissions (U.S. Army Corps of Engineers, 1999). (Emissions from the actual combustion of oil produced are much greater than that from just the production activities.)

The cumulative analysis for the current Northwest NPR-A first sale proposal considers 3 ranges of onshore and offshore future production activity. The low range includes reserves in currently producing fields and resources and discoveries in the planning or development stage. The mid range consists of the low range figure plus any reasonably foreseeable future production. The high range is created by adding in potential speculative future production. Using the mid-range estimate (11 billion barrels of oil), and assuming that this entire amount would be produced over a 20-year period, an average production rate is obtained of about 1.4 MMbbl of oil per day. This is very close to the 1996 North Slope oil production rate. While it is difficult to estimate greenhouse gas emissions from future oil and gas production activities in Northern Alaska precisely, greenhouse gas emissions would continue to be proportional to the oil production rate at the same ratio as exists presently. Based on that assumption, the regional greenhouse gas emissions associated with future cumulative production would be about the same as the 1996 North Slope emission levels. This is about 30 percent higher than current levels (since the 1999 North Slope production rate was about 1.1 MMbbl of oil per day). Greenhouse gas emissions associated with production activities can be reduced by using more fuel-efficient power generators and minimizing flaring. Based on the Northstar analysis cited above, the cumulative future oil production in Northern Alaska would produce a relatively small (about 1%) contribution to global greenhouse gas emissions. The Northwest NPR-A first sale production estimate of 450 MMbbl over 22 years averages to about 20.5 MMbbl per year, or 56,000 bbl per day. This is about 3.7 percent of current North Slope production and greenhouse gas emissions of 0.037 percent of global fossil fuel greenhouse gas emissions. The maximum estimates of contributions of all Northwest NPR-A Lease Sales would represent about 12 percent of current North Slope production and greenhouse gas emissions. Nationwide and global greenhouse gas emissions can be reduced by energy conservation, improving energy efficiency, and developing alternative energy sources. The need for continued development of domestic new oil and gas resources will continue to exist regardless of any downward pressure on the growth of future oil consumption as a result of measures to reduce greenhouse gas emissions. If Alaska energy sources were not to be developed in the future, resources would have to be produced in other areas of the globe. The impacts on greenhouse gas emissions on the planet would be very similar, regardless of the location of the energy source.

(c) Effects on Air Quality of the Transportation of Oil

The transportation of crude oil to market by tankers would result in air emissions from the tankers' engines during loading operations, transit, and during unloading. These emissions would consist primarily of nitrogen oxides, sulfur dioxide, and particulate matter. Emissions of volatile organic compounds would also occur during tanker loading and unloading operations. Emissions of nitrogen oxides and volatile organic compounds would be of concern in ports located within ozone nonattainment areas because of their potential to contribute to tropospheric ozone levels. In these areas, local regulations commonly require the use of vapor balance systems to substantially reduce volatile organic compound emissions. For any particular port, the emissions would be intermittent, and nitrogen dioxide, sulfur dioxide, and particulate matter concentrations would be within ambient air-quality standards. Impacts from emissions during transit would be very small because emissions would be dispersed over a large area.

A major oil spill would result in a localized increase in ambient volatile organic compounds concentrations from evaporation of the spill. Details on the effects of an oil spill and impacts associated with in situ burning are provided in Section IX.B.3.m of the *Liberty Environmental Impact Statement* (USDOI, MMS, Alaska OCS Region, 2002b) and in Section IV.C.6.b(2) of this IAP/EIS. Overall air-quality impacts from transportation would be low.

(2) Conclusion

The cumulative effects of all projects affecting the North Slope of Alaska in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards. All reasonably foreseeable North Slope projects (see Table IV-13) would not change this situation.

g. Vegetation

(1) Cumulative Analysis

In addition to multiple sales under Alternative A as presented in this document (which represents the greatest scope of development among all alternatives), other activities associated with the cumulative case that may affect the vegetation of Alaska's North Slope include oil development in the remainder of the NPR-A (east and south of the Northwest NPR-A Planning Area), Federal and State offshore oil development (through the construction of supporting infrastructure onshore), State onshore oil development, oil transportation, and road construction. All of these projects affect vegetation through the construction of infrastructure (direct effects of vegetation burial and indirect effects of vegetation change caused by dust, flooding, snow drifting, etc.) and through oil spills. In terms of acres affected, construction causes more than 99 percent of the impacts, with spills having a very minor role.

Most current onshore development on Alaska's North Slope is concentrated within the Arctic Coastal Plain physiographic province, which covers about 13 million acres. It is expected that the total development for all lease sales within the Planning Area would impact vegetation on less than 4,200 acres, with less than 1,400 acres of that total being direct affects from gravel extraction and fill (assuming 1 to 5 developments to recover up to 2.1 Bbbl of oil). Most development that might result from Alternative A or B or the Preferred Alternative would occur on the Arctic Coastal Plain. Potential development in the remainder of the Planning Area (for which there are lower petroleum resource estimates) may impact up to 40 percent of that 4,200-acre total. Although the current development in the Prudhoe Bay/Kuparuk areas directly impacts about 17,000 acres (through gravel extraction and fill; National Research Council, 2003), and affects an additional 10,000-11,000 acres of vegetation indirectly (Walker et al., 1986, 1987; National Research Council, 2003), the total impacted acreage remains a small proportion of the Arctic Coastal Plain.

No additions to the infrastructure outside the Planning Area, other than pipelines for transport of NPR-A oil and gas, are expected to be required as a result of any oil/gas development within the Planning Area (but see discussion of roads, below). Impacts to vegetation outside the Planning Area as a result of this plan would be caused by those pipelines, off-road travel by seismic crews accessing and departing the Planning Area, and oil spills. Under Alternatives A and B and the Preferred Alternative, both crude oil and gas pipelines might be built on both northern and southern routes to carry production east out of the Planning Area. Both oil pipelines combined would traverse about 245 mi of Federal and State lands east of the Planning Area. Impacts from pipeline construction are described under Alternative A and the Preferred Alternative. The VSM's for pipeline support would displace less than 8 acres of vegetation and the effects of ice roads or off-road vehicles used in conjunction with pipeline construction would impact less than 900 acres. Both gas pipelines combined would traverse about 270 mi of Federal and State lands east of the Planning Area. Burial of these pipelines would impact less than 490 acres.

Although not part of the development scenario for the Planning Area, and not technically required for oil/gas development in the Planning Area, it is reasonably foreseeable that the State of Alaska may build a new highway connecting the village of Nuiqsut and the NPR-A to the Dalton Highway farther east. Assuming the length of that road as 110 mi and assuming the same impacts as for other gravel roads and pads as presented in Alternative A and the Preferred Alternative, such a road would bury about 470 acres of land (i.e., vegetation) and alter the vegetation on up to 4,400 acres as a consequence of dust or gravel spray and changes in moisture regimes. This new highway, if built, would be in addition to the existing 150 mi of the Dalton Highway north of the Brooks Range. This represents a 70 percent increase in highway miles, and a similar magnitude of impacts to vegetation as for all development assumed under Alternative A.

Impacts of seismic train moves are described under the No Action Alternative and the Preferred Alternative. It is assumed that seismic trains would originate from the Kuparuk oil field, requiring about a 130-mi traverse in each direction of the lands east of the Planning Area. This would impact about 950 acres per crew per year of tundra vegetation, for a total of less than 2,900 acres per year. For all of Alaska's North Slope, there are a small percentage of seismic trails which do not recover to the original vegetation type within the period that comprehensive, long-term studies have occurred (15 years; NRC, 2003). If this continues with current seismic vehicle technology, then some effects of seismic trains will accumulate.

Oil developed as a result of Alternative A, Alternative B, or the Preferred Alternative would contribute less than 8 percent of future spills from the TAPS. Spills of oil from Alternative A, Alternative B, or the Preferred Alternative that occurred prior to reaching TAPS would contribute less than 17 percent of all onshore, non-TAPS spills on Alaska's North Slope and less than 15 percent of TAPS pipeline spills. Overall, the effects of spills have not accumulated on vegetation on Alaska's North Slope because the spills have been small and cleanup and rehabilitation efforts have generally been successful (NRC, 2003).

(2) Conclusion

Impacts to the vegetation of Alaska's North Slope from oil and gas exploration and development in the Planning Area are expected to be additive in nature with respect to the impacts (present and future) from other oil/gas activities outside the Planning Area. In other words, the acres affected within the Planning Area simply increase the total acres affected on the North Slope by that much. As noted above, that continues to be a very small fraction of the total North Slope acreage. It is not expected that synergistic impacts to vegetation would occur by affecting additional acres, nor would any effects (whether beneficial or countervailing) occur to vegetation as a result of additional acres developed.

The effects of habitat destruction or habitat change on wildlife are more complex to predict, but again, it is not expected that synergistic effects would occur simply from total additional acres directly affected. Again, this is because of the small proportion of the total vegetation of the region affected. The indirect effects of development that may prevent animals from using a habitat despite no change to the vegetation within the habitat are discussed elsewhere. Some forms of habitat alteration, as through flooding or draining of the tundra, may have countervailing impacts on wildlife, (i.e., one or more species may be adversely affected by the change while another or others may benefit from the same change).

In addition to oil and gas development projects that would directly affect North Slope vegetation, global climate change could alter the species composition. Increasing temperature would result in an increased presence of deciduous shrubs with a decrease in sedges and grasses. Continued temperature increase could eventually result in the invasion of arctic tundra by taiga forests (Anderson and Weller, 1996).

h. Fish

(1) Freshwater and Anadromous/Amphidromous Fish

(a) Cumulative Analysis

This section considers other actions in addition to those associated with the Preferred Alternative that might affect arctic fish in and near the NPR-A. All are directly related to the oil and gas industry, including a road connecting Nuiqsut to the Dalton Highway. The activities associated with the oil and gas actions that may affect arctic fish are the same as discussed for the Preferred Alternative (seismic surveys, construction, and oil spills). The individual effects of these activities and the agents associated with them already have been discussed (See the analyses of the alternatives). This analysis focuses on the additional amount of exposure arctic fish would have to the oil and gas and road activities/agents for the cumulative case over that of the Preferred Alternative and estimates the cumulative effect of that exposure on arctic fish.

The cumulative case involves more seismic surveys and construction-related activities than the Preferred Alternative. Seismic trains are likely to originate from developed fields to the east of the Planning Area. Concerns related to habitat degradation from seismic train movement are minimal, given stipulations in the Northeast NPR-A EIS, those proposed in this IAP/EIS (e.g., equipment operators would cross streams at shallow riffles), and State regulations. As discussed in the Preferred Alternative, fuel spills associated with seismic work would be expected to consist of small spills of refined fuel that are unlikely to reach aquatic habitat. The effects of vibration on most overwintering fish are expected to be minimal (short-term avoidance) given the low density of fish in most of the north slope oil and gas exploration sites during the winter and the short time duration of vibration impulses in any given spot. As a result, increased seismic activity is unlikely to have a measurable effect on fish populations.

Additional construction outside of the Planning Area necessary to support oil/gas exploration and development in the Northwest NPR-A Planning Area would include an increased number of ice roads and new pipelines. Potential impacts to fish both within and beyond the Planning Area boundaries are related to water withdrawal and direct habitat loss or indirect disturbance related to building a pipeline. Increased water use, in and of itself, would not necessarily increase impacts to fish species. Effects are dependent on location of withdrawal and amount of water used. Assuming that water withdrawals outside the Planning Area are also limited to 15 percent of the free water volume from lakes that do not freeze solid, impacts to fish are likely to be limited to localized, short-term, population abundance and distribution changes. Pipelines built to carry product out of the Planning Area along northern and southern routes could extend approximately 250 mi east of the Planning Area. Impacts from pipeline construction--and the accompanying gravel extraction, with its resultant erosion and sedimentation--would be similar to those described under the Preferred Alternative. Though dependent on the actual level and location of implementation, the increase in the overall effect of construction-related activities in the cumulative case is expected to be small.

The cumulative case involves the potential for more oil spills than the Preferred Alternative, though oil developed as a result of the Preferred Alternative would contribute less than 8 percent of future spills from the TAPS. Many of the projects considered in the cumulative case would be conducted outside of the Northwest NPR-A Planning Area. The additional oil spills associated with some of these projects could adversely affect the migratory and marine fish that use the coastal areas of the NPR-A. Offshore oil spills, or those that occur in rivers and move into coastal waters, would be likely to increase oil-related adverse effects on arctic fish over that of the Preferred Alternative. Cumulative effects would depend on the number, size, and seasonal timing of the spills, concentrations of hydrocarbons, and the life stages of those fish exposed to the spills. As indicated for the Preferred Alternative, lethal effects on fish from oil spills are seldom observed outside of the laboratory environment. For this reason, oil spills are expected to have mostly sublethal effects on the fish affected by them. For example, displacement from oiled water may lead to increased energy expenditures while foraging, with subsequent reduction in growth and reproduction. Juvenile fish that are common in the nearshore area during summer, migratory fish, and nearshore spawners would be among those most likely to receive lethal or sublethal effects. Because in the cumulative case there would be a greater probability of an oil spill contacting coastal waters, it is likely that a greater percentage of fish would be affected than estimated for the Preferred Alternative. Land-based, cumulative-case oil spills that do not enter coastal waters would be expected to have minimal increased measurable effects on overall fish populations, since the likelihood of a large spill contacting water is low. Losses onshore would be greatest in waterbodies with limited water exchange.

A road connecting Nuiqsut to the Dalton Highway could result in additional impacts to freshwater fish. Potential impacts are related to added fishing pressure. Extending and opening the road to the public would increase public access from the Dalton Highway (assumes the State portion of the road is open to the public) to the Colville River for fishing and other recreational activities. Increased fishing pressure and harvest would take place on fish-bearing rivers that cross the road. Lakes in close proximity to the road would also receive increased fishing pressure. Species such as lake trout, arctic grayling, northern pike, burbot, and Arctic char would be targeted. Since fish grow slowly in the arctic due to the harsh environmental conditions, fish are more susceptible to over-harvest. The expected result of opening the road with a subsequent increase in fishing pressure would be the eventual need for changes in harvest regulations in order to sustain fish populations.

(b) Conclusion

Wide-ranging increased impacts to arctic fish populations found on the North Slope would not be anticipated based on the cumulative analysis. Localized changes to fish populations in the vicinity of a road connecting to the Dalton Highway are possible. Also, synergistic impacts to fish from disturbance related to oil and gas production under any of the alternatives in this IAP/EIS are not anticipated. Countervailing effects related to material extraction at gravel sites are possible in certain situations. Past reclamation of deep pits that have been mined has proved beneficial when new habitat for arctic fish species has been established.

(2) Marine Fish

(a) Cumulative Analysis

This section considers other actions in addition to those associated with Alternative A that could affect marine fish. They include: 1) additional lease sales in the Northeast NPR-A; 2) additional lease sales in the remainder of the NPR-A; 3) current and projected North Slope oil-development projects; 4) former Federal and State oil and gas lease sales; and 5) the transportation of oil and gas by pipeline. The cumulative case also considers the effects of three hypothetical oil fields on arctic fish--one in the offshore area north of Smith Bay, one in the central portion of the NPR-A, and another on Kuukpik Land near Nuiqsut. The activities that may affect arctic fish are the same as discussed for Alternative A (seismic surveys, construction, marine vessel traffic, and oil spills). The individual effects of these activities and the agents associated with them have been already discussed (see Alternatives A-C and the Preferred Alternative). This analysis focuses on the additional amount of exposure to these activities/agents to which arctic fish would be subjected for the cumulative case over that of Alternative A, and estimates the cumulative effect of that exposure on marine fish.

1) Effects from Seismic Surveys and Construction

The cumulative case consideres more seismic surveys and construction-related activities than do the analyses of the alternatives. These additional activities would be conducted outside the Northwest NPR-A Planning Area, and many would not involve land-based seismic surveys or construction. Hence, they would not be expected to have a significant effect on arctic fish. Impacts on marine fish overall are, for the most part, localized and fish are unaffected by activities not in the immediate vicinity. Over-water seismic surveys conducted outside the Planning Area would not be expected to have a measurable effect on marine fish (USDOI, MMS, Alaska OCS Region, 1990). Projects that would be likely to cause additional seismic- and construction-related effects would be those associated with additional lease sales and future oil field development. This could result in an increase in the overall effect of seismic- and construction-related activities on arctic fish in the cumulative case. If there were insufficient time for recovery by impacted fishes or their prey between seismic surveys or construction activities, the affected fish populations would be expected to experience compounding adverse effects and might require a longer period of time for full recovery.

2) Effects from Oil Spills

The cumulative case also considers more oil spills than the alternative analyses. As indicated above, many of the cumulative-case projects (including the three hypothetical oil fields mentioned above) would be conducted outside the Planning Area. The additional oil spills associated with some of these projects could adversely affect some marine fish that use the coastal areas. Offshore oil spills or those that occur in rivers and move into coastal waters would be likely to increase oil-related adverse effects on marine fish over that of Alternative A. This is because oil spills associated with Alternative A are expected to be very small and would seldom enter marine waters, where the marine and migratory fish concentrate during the summer. By contrast, spills associated with: 1) North Slope oil-development projects, 2) former and future Federal and State oil and gas lease sales, 3) the offshore hypothetical oil field mentioned above, and 4) pipelines could all release comparatively large volumes of oil into the coastal environment.

Oil spills are expected to have mostly sublethal effects on the marine fish affected by them. Juvenile marine fish (e.g., arctic cod), which are common in nearshore waters during summer, nearshore spawners (e.g., capelin), and overwintering marine fish are the most likely to be lethally or sublethally affected. Because there would be greater probability of an oil spill contacting the coastal waters in the cumulative case, spills considered under the cumulative case would be expected to affect a greater percentage of marine fish than estimated for Alternative A. However, assuming sufficient recovery time between spills, the estimated recovery from each spill is likely to be similar to that of Alternative A (estimated at 5 to 10 years), with no measurable effect on marine fish populations. Cumulative-case oil spills that do not enter coastal waters are expected to have no measurable effect on marine and migratory fish.

(b) Conclusion

The additional effect of future seismic surveys and construction-related activities over that of the activities under the alternatives is expected to be proportional to the number of such activities. Their effect on marine fish populations could be greater if there were insufficient time for full recovery between these activities. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on marine fish populations. Those that enter coastal waters are expected to affect a greater percentage of fish than estimated for Alternative A. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill would be expected within 3 to 5 years.

i. Birds

(1) Cumulative Analysis

In addition to routine annual management actions (see Section IV.B and Table IV-28) and subsistence-harvest activities in the Northwest NPR-A Planning Area, oil and gas exploration and development, as described for the Preferred Alternative and Alternatives A-C (Sections V.B.9 and IV.C-E.9), is the principal activity that could contribute to cumulative effects on seasonally occurring or resident nonendangered birds. Activities along migration routes or on winter ranges that potentially could contribute to current and future cumulative effects include: wildlife research and survey activities; subsistence and sport harvests; predation; commercial fishing; commercial development; environmental contamination; marine shipping; and recreational activities. In combination, effects of these activities on local bird populations potentially could be comparable to effects from routine petroleum exploration and development activities following construction (many of which occur in winter when most birds are absent from the Planning Area), and may have contributed importantly to recent declines in some populations. Although the effects of some non-oil and gas activities are likely to be short term (e.g., aerial survey overflights, temporary camps, recreational activities), several have the potential for substantial population effects (e.g., harvests, roads, and commercial development). Oil exploration and development, as well as other projects and activities, could result in 1) oil or other toxic pollution effects (see discussions in Section IV.C.9); 2) additional disturbance during breeding and postbreeding periods; and 3) habitat degradation.

(a) Effects of Disturbance

Potentially disturbing factors associated with oil and gas development include aircraft, vessel, and vehicle traffic; human presence; construction of facilities, roads, and pads; drilling operations; spill cleanup; and attracted predators. Disturbance of some individual birds as a result of oil and gas operations is expected to be unavoidable.

1) Aircraft and Vessel Disturbance

Oil and gas development and production in the Northwest NPR-A, expected to be essentially roadless, is likely to require substantial aircraft (both fixed-wing and helicopter) and occasional barge support during periods when birds are present. Exploration is expected to occur primarily during winter months when all but a few bird species are absent. Roadless developments such as Alpine and Badami have required substantial air support for construction, development, and production, although most construction has been done during winter months, as is expected for any NPR-A development. Construction of these two projects required an estimated 300 to 600 helicopter roundtrips/month for 1 to 2 years. If two projects were to overlap at this level of air support, 30 to 40 roundtrips per day could occur. This could represent a significant increase in air traffic above that annually required for aerial surveys and transportation. The development phase of these two projects required an estimated 28 to 56 roundtrips/month, and production 12 to 28/month, representing substantial increases that would continue through the nesting season. Offshore development at Northstar required 2,480 aircraft (all types) per winter season (approximately 30 November to 20 April) or about 18 flights per day. Cumulative air traffic activity in the Prudhoe Bay, Kuparuk River, Point McIntyre, Northstar, and Alpine fields is likely to represent the greatest source of disturbance for eiders from currently developed areas.

Regardless of attempts to mitigate effects by adjusting routes, continued activity at this level in support of developing fields and future development would be likely to result in some low-altitude flights over nesting, brood-rearing, molting, staging, or migrating birds. Such disturbance would be expected to cause excessive short-term energy use by disturbed individuals and displacement of birds from the vicinity of routinely used air corridors. The latter would be similar to bird responses observed during low-level aerial bird-survey overflights, where individuals either run or take flight, depending on species and circumstances. Such disturbance could flush females from nests, resulting in lower productivity if eggs are lost to predators or exposure to low temperatures, or could cause displacement of females with broods from preferred foraging areas during brood rearing, or could disturb any individuals during preparation for migration. Long-term displacement (1 year or more) from the vicinity of heavily used air traffic corridors and onshore facilities could result in fewer young produced and somewhat lower survival of both adults and young. For example, helicopter pipeline inspection flights during a facility"s production phase could displace some species from within at least 1 km (0.62 mi) of a pipeline, whether a regional pipeline or TAPS. Some species may actually tolerate the disturbance and nest, rear their broods, or forage within a pipeline corridor. Because of the relatively low density of most species nesting in the NPR-A and elsewhere on the North Slope, disturbance resulting from support aircraft noise and visual presence would be likely to be temporary, with effects lasting less than an hour.

Aircraft that overfly open-water areas in spring could displace loons, king and common eiders, long-tailed ducks, and other species from this essential habitat. Because of the limited quantity of open water in spring, access to such areas is likely to be less available than in the postbreeding period. This could increase competition for food during the energetically stressful period following spring migration and could result in decreased survival or breeding success. During the summer, nonbreeding individuals, failed breeders, molting individuals, and males could be feeding in nearshore areas. Helicopters flying 15+ roundtrips per day over these areas could cause birds to move away from routinely used flight paths, increasing the stress of preparing for migration in some individuals and lowering survival chances.

Marine docking facilities potentially could be located in Peard Bay, Barrow, or Dease Inlet, although initial development projects could be staged out of Prudhoe Bay, with materials transported by vehicle in winter or barge in summer. Displacement of birds from the vicinity of vessel transportation corridors may last through an entire open-water season, depending on the number of concurrent projects and the stage of development (which determines trip frequency). Because numbers of vessel roundtrips (10/summer + 1/month) for a project are forecast during construction period, and supply vessels are likely to follow established routes, the actual area disturbed would be limited. The area and potentially the numbers of individuals affected would increase if concurrent projects at different locations were developed. Vessel traffic occurs during the open-water season and, although numbers of birds displaced could be substantial depending upon the season of occurrence (tens or hundreds of individuals during a season; possibly thousands during fall migration), alternate foraging and staging habitat would be available away from probable routes.

In addition, tanker traffic transporting North Slope oil through Prince William Sound and the Gulf of Alaska is likely to result in some intermittent disturbance and/or displacement of marine birds along the tanker route. In terms of displacement of birds from foraging areas along the route, this would likely be a minor effect, since there are alternate foraging sites available throughout these areas with similar prey available.

The presence of onshore facilities could cause loons, eiders, and other waterbirds to avoid the immediate vicinity for variable periods up to the duration of such presence. This potentially could result in lowered productivity, although adequate nesting habitat is not likely to be a limiting factor for most species on the North Slope.

2) Vehicle Disturbance

Although most future oil and gas developments are expected to be isolated from existing road systems, production pads would be connected by roads several miles long and would have an associated airstrip approximately 1 mi long. Gravel transport is assumed to occur during winter. Summer traffic, though expected to be relatively low volume, could disturb nesting, brood-rearing, or molting waterfowl in the immediate vicinity of pads and roads throughout the life of any field. During development of the Lisburne field, geese and swans appeared tolerant of vehicle traffic on roads during most seasons; however, during brood-rearing, they moved away from roads (Murphy and Anderson, 1993). Early season snowmelt in dust shadows of roads or pads may attract nesting birds. The Lisburne development activities had no apparent effect on overall bird habitat use in the area. However, some species of shorebirds such as the semipalmated sandpiper and the dunlin were reduced in density (up to 40%) within about 100 m of roads during breeding compared to postbreeding periods and undisturbed areas (Troy, 1988; TERA., 1993b).

3) Other Disturbance Factors

Human presence, construction and drilling activities, spill cleanup, and attracted predators associated with oil and gas development vary considerably in the severity of disturbance they cause. The presence of unconcealed humans, whether associated with oil and gas, hunting, or recreational activities, is disturbing to birds especially during nesting, brood-rearing, and molting periods. Common experience confirms that such presence generally causes birds to move from the immediate area of disturbance and may displace them for several hours or longer. This includes individuals that would be displaced from areas buried by gravel, and some indeterminate number that would be displaced from the area adjacent to gravel structures by construction disturbance and by subsequent activity on on the structures. Studies on the ACP often indicate that displaced birds don't necessarily move very far. For example, this is supported by observations that a) shorebird distributions often indicated displacement from roadside areas but resettlement in nearby areas beyond the zone of disturbance, and b) most banded birds tracked after displacement by construction were found to have resettled in nearby areas. Most confirm that there is rearrangement of birds (following gravel placement and disturbance) but probably no net change in bird abundance within the oil field. Future oil and gas developments on the North Slope are expected to resemble the Alpine development rather than development in the Prudhoe Bay area, with a much smaller footprint (e.g., 100 acres for an Alpine-like development versus a North Slope development to date of about 9,500 acres), and thus are not likely to displace substantial numbers of shorebirds. Cumulative effects of such disturbance, with several activities occurring in the same period or one after another through the summer season, could cause decreased survival and productivity if eggs or young are exposed to predators or low temperatures.

Predators and hunters cause direct mortality. Predators (such as foxes) attracted to island or colonial species' nesting areas may cause losses of varying severity, including up to total destruction of the season"s productivity (Quinlan and Lehnhausen, 1982). Foxes may have increased in certain areas because of reduced trapping efforts by local people. Most such disturbance associated with commercial activities could be controlled by mitigation. Although it is likely that behavioral effects resulting from disturbance associated with oil and gas development would be additive to naturally occurring disturbances, there currently is no evidence for synergism (where the combination of effects from natural and/or development-related factors is greater than their additive effects).

(b) Effects of Habitat Alteration

Future oil and gas development is expected to occur with a much smaller disturbed area (footprint) than has occurred in Prudhoe Bay-Kuparuk area. For example, the total area covered by roads/pads/airstrips for the Badami and Alpine developments is about 182 acres plus 89 acres of gravel mines (USDOI, MMS, Alaska OCS Region, 2002b:Table IV-03). Presumably the effect of facilities for future projects on bird populations, though additive, would be substantially less severe because of the smaller areas involved. Such effects as from dust fallout, thermokarst, and hydrologic change (USDOI, MMS, 1998) would be restricted to much smaller areas and would result in smaller habitat loss. Comparison of gravel mine areas alone indicates that Alpine and Badami developments disturbed between 0 and 5.9 percent of that altered by Prudhoe Bay region development. Withdrawal of freshwater from lakes during winter for construction of ice roads and pads is expected to have little effect on tundra-nesting bird populations. Use of lakes as water sources would be limited by stipulations. Water used for this purpose generally is replaced rapidly by snowmelt runoff in spring; therefore, it is not likely that waterbodies depleted somewhat in winter would present decreased foraging opportunities for birds. Also, species of concern, because of small and/or declining populations, are present at low density on the coastal plain so it is unlikely that more than a few individuals would by chance attempt to nest at lakes used as winter water sources. In addition, most species potentially affected are not considered habitat limited because they have rather general nest site requirements, so acceptable nesting habitat would be widely available if areas used for water withdrawal were to lack some necessary characteristics. However, even modest decreases in breeding productivity of some species with small ACP populations, such as the yellow-billed billed loon and buff-breasted sandpiper, resulting from cumulative local habitat alteration and disturbance, may represent a relatively serious adverse situation. For example, the Nature Conservancy has concluded that persistence of the buff-breasted sandpiper population is threatened by habitat loss and documented declines (Wilbur, 1997), so that it is classified as a species of high concern by the U.S. Shorebird Plan (Brown et al., 2001). Population decreases are suspected in recent years (Lanctot and Laredo, 1994). Protection of coastal corridor habitats used by premigratory sandpipers for staging and feeding from excessive development (as well as nearshore marine spill events) is likely to be important for avoiding impacts to the ACP population. The overlap of breeding range with current and potential oil development on the ACP may predispose this and several other uncommon species to cumulative impacts from the effects of oil development such as habitat loss, fragmentation, and enhanced predation.

Low-flying birds could collide with onshore buildings or structures or offshore drilling structures under conditions of poor visibility (e.g., darkness or fog). Because structures cumulatively represent relatively small obstructions on the landscape, and birds encountering them when visibility is good are expected to see and avoid them, bird mortality from collisions is expected to be low. However, there is little information on which to base a projected mortality estimate.

(c) Effects of Other Factors

Subsistence harvesting is estimated to remove hundreds of seaducks from the Alaskan populations annually. Effects of the other factors (e.g., fishing-net entanglement, bioaccumulation of toxins in the food chain) on the seaduck and other species' populations currently are unknown. Another factor that potentially could affect these populations would be improper containment or disposal of refuse at onshore support camps, which could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adults. The overall cumulative impact on birds from all of these other factors could be potentially greater than the impact from oil and gas development activities.

(d) Effects of Natural Events

On August 10, 2000, a violent windstorm occurred in the Beaufort Sea producing extreme wave action that eroded coastlines and restructured barrier island habitats. The storm was followed by several days of subnormal temperatures and 1.5 inches of snow (Divoky and Mendenhall, 2000). Many islands were heavily eroded, with some sloping shores converted to cliffs; low-lying spits and islands were inundated. The immediate effect may have been the loss of black guillemot or common eider broods. Perhaps more importantly, much of the accumulated driftwood and other materials typically used by guillemots and common eiders for nesting habitat on barrier islands were swept away; investigators at one island study site estimated that three quarters of the driftwood disappeared. Because it is not known how quickly new driftwood will accumulate on the islands, the ultimate effect of this change is difficult to gauge. It also is not possible to estimate either the extent or the long-term effect of brood loss associated with this event. However, the declining status of both species, as well as the potential for greatly reduced nesting habitat in the immediate future, suggest that recovery from any short-term losses associated with oil and gas development could be hindered by already-lowered productivity.

If significant increases in temperature were to occur in the arctic region, woody plant species may invade or expand in tundra habitats (Anderson and Weller, 1996), providing a less favorable habitat for tundra-nesting species (e.g., shorebirds, longspurs), but more favorable conditions for those occupying shrub habitats (e.g., willow ptarmigan, several passerine species). Adverse effects on black guillemots, a species that nests on Cooper Island and forages along the pack ice edge, potentially resulting from a recent warming trend have been documented (Divoky, 2001, pers. comm.). As the ice edge has retreated farther from the nesting areas, guillemots apparently are finding it more difficult to provision their chicks and productivity has declined.

Persistent organic compounds (including pesticides), oil, heavy metals and other toxic materials can produce adverse effects on bird physiological systems. Relatively little information is available on Alaskan arctic species, and effects of bio-accumulation of compounds is unclear. Ingested lead shot may be of concern in some waterfowl species.

(e) Effects of a Large Oil Spill

Although the magnitude of oil spill effects is uncertain, if the estimated one large spill of 500 bbl (pipeline) or 900 bbl (at a gravel pad) (the most likely number of spills is 0, Table App 9-14) were to occur in or to enter the marine environment during the life of oil and gas projects on the North Slope, substantial losses could result, potentially in the low thousands if the oil were released during the summer/fall season when numerous flocks of birds would be present. This primarily would involve large flocks of postbreeding waterfowl and shorebirds staging before migration in lagoons or along beaches. For example, using average estimated bird density in the central Beaufort Sea area (calculated from FWS survey data) and average severity of spill-trajectory paths (and thus exposure of birds to oil), an average of 1,443 long-tailed ducks, 232 king eiders, 147 scoters, 159 common eiders, 217 glaucous gulls, and 23 Pacific loons could be exposed to a large spill (5,912 barrels) within 30 days in July (see details in Stehn and Platte, 2000). Mortality resulting from oil spills would be additive to naturally occurring mortality. In addition to direct contact losses, any declines of prey populations in oiled foraging areas at any time of year could result in secondary impacts to birds, affecting productivity and/or survival. Likewise, negative effects of a spill on shoreline and coastal marsh habitat and water quality could affect several species of shorebirds and waterfowl adversely in subsequent years.

A large onshore spill released during the summer season could cause losses of up to hundreds of individual molting and brood-rearing waterfowl (plus smaller numbers of nesting waterfowl, shorebirds, and passerines) if it were to enter a heavily used lake/river system or coastal marsh habitat.

Spills from a regional pipeline or the TAPS would not be expected to cause substantial losses of those species occurring in the Beaufort Sea region. Some oiled habitat in the immediate vicinity of the pipeline would become unsuitable for nesting, brood-rearing, or foraging by birds. Oil entering freshwater aquatic habitats could spread more widely including into river deltas and nearshore marine habitats and result in death of oiled birds and/or a larger area rendered unsuitable for the above activities. Loons, waterfowl, and shorebirds would be the groups most likely affected.

A tanker spill of North Slope crude oil in the Gulf of Alaska could cause substantial losses of migrating shorebirds and waterfowl that use Beaufort Sea habitats during the breeding season if major stopover areas such as the Copper River Delta and Prince William Sound were contacted. In the latter areas (as well as in bays to the west and in lower Cook Inlet), populations of overwintering loons, seaducks, and gulls could suffer major impacts if contacted by an oil spill. Oil produced by development of Northwest NPR-A projects is expected to contribute only a small fraction of (very unlikely) future spills of arctic oil from TAPS tankers (0.32 spills, or 3.4% of 9.4 total estimated tanker spills, Table App 9-14). The contribution of oil from Northwest NPR-A to overall effects of a tanker spill on marine and coastal birds in Prince William Sound and the Gulf of Alaska would be expected to be proportional to its percentage in the particular shipment.

The principal example for estimating potential effects in Prince William Sound and the northern Gulf of Alaska are those resulting from the *Exxon Valdez* oil spill, an unusually large spill (Table App 9-03). Following the *Exxon Valdez* spill, more than 30,000 dead oiled birds were collected, most of them outside Prince William Sound (Piatt et al., 1990). The actual toll probably was 3 to 10 times this number. Species that have recovered or are recovering include the bald eagle, black oystercatcher, marbled murrelet, and common murre (*Exxon Valdez* Oil Spill Trustee Council, 2001). Those that are not recovering (or recovery is unknown) include the common loon, cormorants, harlequin duck, pigeon guillemot, and Kittlitz's murrelet. As the recovery period for these species already has spanned up to four generations, it is apparent that recovery from an event of this magnitude requires a lengthy period and is complicated by factors operating before and after the spill that increase mortality and/or decrease production of offspring.

A realistic projection of the risk from tanker spills is indicated by the average estimated size of tanker spills (Table App 9-15) calculated from tanker spill records (Table App 9-03). Most spills (8 of 10) are expected to average 13,000 bbl or less (Table App 9-15). Of these, four likely would occur in ports with readily available containment and cleanup equipment. When the effects have been studied, at-sea spills of this size have not been found to cause serious effects on bird populations. Also, they are not expected to reach large areas of habitat that are critical to the survival of bird populations until the oil is rendered much less harmful by weathering and dispersion in the water. This suggests that for average-sized spills, mortality would be relatively low and recovery periods could be relatively short, except for species whose populations are declining and/or have a low reproductive rate (e.g., seaducks).

In the unlikely event that a large spill of oil produced by cumulative arctic oil development were to occur along the transportation route in the Gulf of Alaska, marine and coastal bird populations could be affected. According to spill simulations by LaBelle and Marshall (1995), a large tanker spill assumed to occur 100 to 200 mi offshore would not be expected to contact sensitive coastal bird habitats for more than 30 days (model spills 80 to 100 mi offshore contacted shore in 30 days), at which point, the oil would have weathered and dispersed. In addition, bird densities generally are quite low in the pelagic habitat. Shearwaters, kittiwakes, and various species of auks probably are most vulnerable. If a tanker spill were to occur, the probability of bird contact in summer or winter habitat within 30 days would be less than 0.5 percent. The effect of such a spill on overwintering waterfowl in Gulf of Alaska is likely to be substantial.

Small spills, whether originating from field pipelines or from supplies of refined products, would be expected to be contained on gravel pads and/or cleaned up before substantial losses would occur. However, some mortality could result from the numerous projected small spills (130 crude oil and 323 refined oil spills, estimated at 3 bbl and 1 bbl, respectively; see Tables App 9-06 and App 9-09) over the 28-year production life of fields assumed in this cumulative analysis.

(f) Summary

The effects of cumulative factors on birds may be comparable to routine non-oil and gas activities associated with activities on individual oil and gas leases. Disturbance of some individual birds as a result of both onshore and offshore oil and gas operations is likely to be unavoidable over the long term. The cumulative effects from routine activities associated with exploration and development of oil and gas prospects in the Northwest NPR-A and adjacent onshore, coastal, and marine areas could include small declines in local nesting, or loss of small numbers of waterfowl and loon species through disturbance effects on survival and productivity, predation pressure enhanced by human activities, and collisions with structures.

Declines in fitness, survival, or production of young could occur where birds are exposed frequently to various disturbance factors, particularly helicopter traffic. Human presence that disturbs nesting or brood-rearing birds, or attracts predators, may result in predation of unprotected eggs or young. Because the disturbed area will be smaller, the effect of future project infrastructure on bird populations, although additive to natural effects, is expected to be less severe than that of previous arctic developments. The frequency of such disturbance is expected to be highest in the vicinity of primary support facilities at Deadhorse. Disturbances often may last less than an hour, but could continue for extended periods in the case of summer drilling operations, and overlap between cumulative project developments could increase disturbance effects. Several waterbird populations currently declining at non-significant or significant rates could be slow to recover from small losses or declines in fitness or productivity. No significant overall population effect would be expected to result from small losses. However, for species (such as the common eider) that are experiencing a population decline, recovery from short-term losses associated with oil and gas development could be hindered by already-lowered productivity resulting from natural occurrences. For example, greatly reduced potential nesting habitat resulting from the major storm in August 2000 could substantially reduce productivity in the region.

Although the chance of oil-spill occurrence is relatively small, the potential for contact with bird concentrations would be highest in the vicinity of primary support facilities. As a result of the apparent decline in populations of some species (for example, several seaduck species), and the challenge of recovering spilled oil, particularly in broken-ice conditions, there is uncertainty regarding the ultimate effect of any spills on bird populations. In the event a large oil spill were to occur in or enter the marine environment during high-use periods, mortality of loons, king and common eiders, and long-tailed ducks is possible; any substantial loss of long-tailed ducks or common eiders would represent a significant effect. Mortality resulting from the cumulative effects of oil and gas projects would be additive to natural mortality and could interfere with the recovery of these species' Arctic Coastal Plain populations. Recovery from substantial mortality would not be expected to occur while the population exhibits a declining trend, but determination of population status could be obscured by natural variation in population numbers and difficulty in obtaining precise survey data. Onshore spills, also considered unlikely to occur, are expected to be contained and cleaned up; however, a spill entering a lake could cause some loss of molting and brood-rearing waterfowl, along with smaller losses of nesting waterfowl, shorebirds, and passerines. Any tanker spill in the Gulf of Alaska could result in the loss of migrating shorebirds and waterfowl that use Beaufort Sea habitats during the breeding season, or of overwintering loons, seaducks, and gulls.

Primarily as a result of mortality in the unlikely event a large oil spill were to occur, cumulative local effects of oil-industry activities on birds potentially could be substantial in the case of loons and king eider, and significant in the case of long-tailed duck and common eider. Disturbance could cause some small loss of productivity and lowered fitness or survival of birds occupying areas with high levels of industry activity, but these effects are not expected to be significant. Effects resulting from oil and gas development activities likely would be additive to naturally occurring effects or those occurring as a result of other activities in Northwest NPR-A.

(2) Conclusion

Cumulative disturbance effects from routine oil and gas activities--particularly from helicopter or human presence--could include minor declines in local nesting attempts, losses of small numbers of waterfowl and loon species as a result of decreased survival of adults and young and losses of eggs or young from exposure or increased predation, and collision with structures. Overlap between project developments is expected to increase cumulative effects. Several currently declining waterbird populations are not likely to recover from even small losses or declines in fitness or productivity. However, none of the routine management or industrial activities are likely to cause significant population effects.

A large oil spill entering the marine environment could increase cumulative effects on several regional seaduck populations by causing substantial mortality. Substantial losses of long-tailed ducks or common eiders would be a significant effect. Recovery from substantial mortality is not expected to occur while a population is declining. Onshore spills are not likely to cause substantial losses of land or water birds.

j. Mammals

(1) Terrestrial Mammals

(a) Cumulative Analysis

In addition to the multiple sales scenario of the Preferred Alternative, other activities associated with the cumulative case that may affect terrestrial mammals on Alaska's North Slope include oil and gas development in the Northeast NPR-A, Federal and State offshore oil development, State onshore oil development, oil and gas transportation, and construction of a road from Nuiqsut to the Dalton Highway. Activities associated with exploration, facility and road construction, operation and maintenance, and oil spills have both disturbance and habitat impacts on terrestrial mammals. Direct effects include delay or deflection of movements, and mortality; indirect effects include destruction, fragmentation, or degradation of habitat and changes in productivity.

Cumulatively, non-oil and gas activities and spills would have little impact on terrestrial mammals. The level of non-oil and gas activities on the North Slope is very low and impacts consist primarily of short-term disturbance of individual animals. Aircraft disturbance of terrestrial mammals associated with cumulative resource-inventory survey activities (particularly by helicopter traffic) is expected to have short-term effects on some caribou and muskoxen (particularly cow/calf groups), with animals being briefly displaced within about 1 mi from feeding and resting areas when aircraft pass nearby.

1) Impacts from Oil and Gas Exploration

Past seismic surveys in NPR-A included approximately 4,000 line-miles of Federal and 12,000 line-miles of industry-conducted seismic surveys, resulting in the discovery of three noncommercial fields at Umiat, Fish Creek, and Square Lake (USDOI, BLM, 1998). More recently, nine exploratory wells were drilled in Northeast NPR-A. These activities probably briefly disturbed and displaced TLH caribou near seismic grids, exploration drill sites, and along ice roads and aircraft transportation routes. However, this effect would not have persisted after exploration was complete and probably had no consequential effect on the abundance or productivity of the TLH. Future exploratory work in the Planning Area would occur primarily in habitat for the TLH and disturbance would be temporary. Some wintering WAH caribou may be temporarily disturbed by exploration activities as up to 10 percent of the population may winter on the North Slope. Exploratory work would not result in additional cumulative impacts to the CAH.

2) Impacts from Oil and Gas Development

Motorized traffic along about 364 mi (582 km) of existing roads (Table IV-09), and future construction of an additional several hundred miles of roads associated with future development (as well as traffic on ice roads) would disturb, impede movement of, or displace caribou and other terrestrial mammals. In the cumulative case, disturbance of caribou from road traffic associated with pipelines would be expected to cause short-term displacement of caribou within about 1 mi of the road. Road traffic temporarily delays the successful crossing of pipelines and roads by caribou and may have significant energetic effects on some animals, but generally has no measurable effect on herd abundance or overall distribution. The exception would occur when disturbance levels were very high or when development facilities on the calving grounds caused long-term (over the life of the field) displacement or local change in distribution of cows and calves (Dau and Cameron, 1986; Cameron et al., 1992; Nellemann and Cameron, 1996). Grizzly bears, wolves, arctic foxes, and other mammals cross these roads, travel on them, and feed on animals killed by vehicle traffic. However, increases in traffic eventually would reduce the use of roads and adjacent habitat by these animals. Potential construction of an east-west road from the Dalton Highway to Nuiqsut by the State of Alaska would impact the CAH by adding another road through their summer range, and between their winter range and calving grounds. This new road may temporily impede or alter caribou movements during migration and during the summer. Construction of the Dalton to Nuiqsut road may result in additional development of oil and gas leases on State Land within both the summer and winter range of CAH caribou resulting in additional disturbance impacts to this herd.

Cumulative oil and gas development on the North Slope could result in a long-term displacement and/or functional loss of habitat for CAH, TLH, and WAH caribou over the productive life of the leases. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oil fields (Lawhead, 1997; Nellemann and Cameron, 1996; Cameron et al., 2002). Future State oil-lease sales on the Arctic Slope between NPR-A and the Arctic National Wildlife Refuge, and the foothills of the Brooks Range would increase the amount of activity associated with oil exploration and development within the CAH range. Future State offshore leases in the Beaufort Sea could expose TLH and CAH caribou to additional activities related to oil and gas development (through onshore facilities to support offshore leases). Ongoing and future lease sales in NPR-A could expose a large number of the TLH calving and summering caribou to exploration and development activities. Some animals from the WAH would be exposed to development activites on their summer range, and both exploration and development activities on North Slope portions of their winter range.

Development of onshore oil and gas resources in Northeast NPR-A could result in construction of an additional pipeline south of Teshekpuk Lake. Construction of a pipeline from Northwest NPR-A east to Kuparuk or a southern pipeline route connecting to TAPS pump station 2 would temporarily disrupt movements of CAH and TLH caribou. Movements of TLH and WAH caribou from wintering habitat to calving grounds could be temporarily disrupted. However, pipelines associated with sales under this document would not have associated roads and should therefore, have minimal effect on caribou movements once construction is completed. Existing State of Alaska oil and gas leasing offshore and adjacent to the CAH and TLH ranges--as well as Federal OCS leases in Harrison Bay west to Barrow--might include offshore pipelines that would come ashore within TLH range and connect with the facilities at Kuparuk. Potential offshore oil development adjacent to the TLH and CAH ranges could increase surface-vehicle traffic disturbance of caribou along transportation corridors that would connect offshore oil discoveries with the existing infrastructure. Development also might increase motor-vehicle and air-traffic disturbance of caribou in insect-relief areas along the coast, and perhaps reduce the seasonal use of coastal areas by cows and calves.

The reduction in calving habitat use near oil development facilities, in theory, eventually could limit the growth of the arctic caribou herds within their present ranges and prevent the herds from reaching the maximum population size that they could achieve without the presence of development. Such an effect may not be apparent, because natural changes in the distribution and productivity of the herds would be likely to influence the abundance and growth of caribou populations over and above the effect of reduced habitat use caused by cumulative oil development. For example, the CAH population estimate decreased from 23,000 in 1992 to 18,100 animals in 1995, then rose to 31,857 caribou in 2002. However, recent information on the body weights of CAH cow caribou that calve west of the Sagavanirktok River compared with CAH cow caribou calving east of the River suggests that disturbance displacement of cow caribou may be affecting CAH caribou productivity (Cameron, 1994; Nellemann and Cameron, 1996, Cameron, 2002). On the other hand, differences in densities and movements between segments of the CAH on the oil fields and east of the fields may have contributed to the decline (Cronin et al., 1997).

The no-lease and no-surface-occupancy restrictions in Northeast NPR-A encompass 51 percent of the TLH primary calving area as identified by ADF&G and 74 percent of the extent of concentrated calving within the Teshekpuk Lake Special Area (Audubon Alaska, 2002). In years with unusual weather patterns, caribou may calve before reaching core calving areas. This occurred with the TLH in 1999 and 2000 when a greater number of cows calved south and west of Teshekpuk Lake (Carroll, In Press). In these instances, calving TLH caribou could be exposed to oil and gas development structures and activities at a time of year when they are most sensitive to disturbance possibly resulting in reduced productivity.

Oil development within Northwest NPR-A could expose both summering and wintering WAH caribou to noise and disturbance impacts. If development occurs in the southern part of the Planning Area, some WAH animals may be exposed to development structures during insect-season and normal movement patterns may be disrupted. This herd is not exposed to oil and gas development activities in any other part of their primary range and thus cumulative impacts to the WAH would be low.

Cumulative oil development in the Prudhoe Bay-Kuparuk area encompasses > 500 mi², and hundreds of miles of gravel roads cross a large portion of the calving range of the CAH. More than 8,000 acres of habitat have been destroyed or altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located on the Arctic Slope (USDOI, BLM, 1998), and an additional 120 acres are expected to be affected by reasonably foreseeable development in the Northwest NPR-A (Table IV-13). An additional 521 acres on the North Slope could be affected by construction of infrastructure associated with reasonably foreseeable future development on the North Slope (Table IV-13). Oil and gas activities associated with Northeast NPR-A, and other onshore and offshore projects east of NPR-A would subject TLH and CAH caribou to effects of oil-development projects. Some TLH, CAH and WAH habitat may be altered or destroyed through construction associated with oil and gas development and due to avoidance of habitats in close proximity to roads. The loss of additional habitat due to facility construction in future oil development within NPR-A is expected to represent a smaller proportion of the available grazing habitat of the TLH and WAH caribou (than that experienced by the CAH) because of consolidation of facilities and "roadless" development. This particular loss or alteration of habitat is expected to represent a minor effect on caribou. Displacement of calving caribou caused by disturbance has resulted in a significant functional loss of habitat for the CAH in areas of existing development.

The alteration of > 8,000 acres of tundra habitat in the Prudhoe Bay area has not had any apparent effect on the distribution and abundance of other terrestrial mammals, with the possible exception of arctic foxes that apparently have increased in numbers near the oil fields. Muskoxen have continued to expand their range westward across the North Slope from an introduced population in the Arctic National Wildlife Refuge. There are no apparent effects on grizzly bears, wolves, and other terrestrial mammal populations associated with this development.

The increase in the number of development facilities on the North Slope would be expected to increase the number of adverse interactions between humans and grizzly bears, and to result in the loss of bears because of their attraction to human refuse. These interactions could eventually result in a decline in grizzly bear abundance near development areas. Cumulative oil development on the North Slope also is expected to result in an increase in abundance of arctic foxes near development areas, which could adversely affect tundra-nesting birds and could also pose a health hazard to humans through the spread of rabies among the growing fox population.

The cumulative case involves a greater potential for oil spills than predicted under Alternative A. Spills resulting from implementation of the Northwest NPR-A Plan would contribute < 17 percent of all onshore, non-TAPS spills on the North Slope. Many of the projects considered in the cumulative case would be conducted outside of the Planning Area. The additional spills associated with these reasonably foreseeable future projects could adversely affect terrestrial mammals on the North Slope. Cumulative effects would depend on the number, size, location and timing of spills, and the species and population of terrestrial mammals exposed to the spill. Potential oil spills from both offshore and onshore oil activities associated with Federal and State of Alaska leases would be likely to have a small effect on terrestrial mammals because comparatively low numbers of animals would be expected to be disturbed, contaminated or to ingest contaminated food sources and die as a result. As indicted in Alternative A, spills are expected to have mostly sublethal effects on terrestrial mammals and would impact only a very minor percentage of the available habitat. The greatest potential for impact to terrestrial mammals is disturbance impacts during response, cleanup and rehabilitation. The National Research Councils Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (NRC, 2003) found that most spills to date have had only local effects and there is no evidence that effects of spills have accumulated. Impacts from oil spills are described under Alternative A Terrestrial Mammals, Effects of Spills (Section IV.C.10.a.2.a).

Predicting the effects of climate change on terrestrial mammals is difficult because of the complexity of tundra ecosystems. An increase in abundance of deciduous shrubs, especially birch (less favorable caribou forage), and a decline in the abundance of grasses-sedges such as Eriophorum vaginatum (an especially important food of calving caribou) are predicted to occur if a significant increase in temperatures were to occur in the Arctic, thereby reducing productivity of caribou habitats on the Arctic Slope (Anderson and Weller, 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests), a less favorable habitat for tundra mammals, thereby adversely affecting their populations (Anderson and Weller, 1996). Warmer temperatures may also result in increased insect abundance and periods of activity (NRC, 2003). Changes in weather patterns could alter caribou movements and distribution. Calving grounds may shift in response to changes in vegetation. Insect-relief habitat may become increasingly important due to increased insect abundance and activity. Over time, areas that are currently closed to leasing may become less important to caribou while areas that are open to leasing may become more important.

(b) Conclusion

Cumulative effects on caribou distribution and abundance are likely to be long term over the life of the oil fields. Any reduction in the calving and summer habitat use by cows and calves from future onshore leasing represents a functional loss of habitat that may result in long-term effects on the caribou herd's productivity and abundance. However, this potential effect may not be measurable due to the great natural variability in the caribou population productivity. The contribution of oil and gas activities in the Northwest NPR-A would be greatest on those herds that use the Northwest NPR-A Planning Area (TLH and WAH). If global warming over the next several decades results in widespread changes in vegetation and insect abundance, effects to terrestrial mammals may be exacerbated and would extend beyond the life of the oil fields. If these cumulative effects result in reductions in caribou populations, there may be a reduction in the abudance of predators such as wolves, bears and wolverines.

Cumulative oil development on the Arctic Slope would likely result in increased abundance of arctic foxes near development areas, which may present a rabies health hazard to humans in the oil-field areas. The attraction of grizzly bears to human refuse would lead to the lost of bears due to interactions with humans and eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, wolverines, and small mammals from oil and gas development on the North Slope would be local and short term, within 1 to 2 mi of the exploration or development facilities, with no significant adverse effects on abundance.

(2) Marine Mammals

Discussed in this section are the additive effects of Alternative A (full leasing in the Northwest NPR-A Planning Area) or the Preferred Alternative (full leasing in the Northwest NPR-A with a 10-year deferral on leasing in the eastern portion of the Planning Area) and ongoing and future development on marine mammals in the Alaskan Arctic, in winter ranges in the Bering Sea, and along oil-tanker routes in the Gulf of Alaska. Development could have actual or potential adverse effects on the distribution or abundance of ice seals (ringed, spotted, and bearded seals), walruses, beluga whales, gray whales, and polar bears in the Alaskan Arctic (and subarctic Bering Sea), and harbor seals and sea otters in the Gulf of Alaska. Oil and gas development could affect these species as a result of oil spills, noise and disturbance, and habitat alteration. Other activities with potential effects would be contamination by hazardous materials from past development activities on the North Slope, atmospheric environmental pollutants accumulating in the Arctic, global warming, commercial fishing and hunting/harvesting of marine mammals.

Future development in the NPR-A could include one or more of the three following scenarios:

> Offshore Scenario--Development of an oil field in the Smith Bay-Dease Inlet area would expose some spotted seals, and perhaps some polar bears to additional noise and disturbance from air and vessel traffic associated with oil production in Smith Bay-Dease Inlet.

> Central and Southern NPR-A Scenarios--Development of potential oil fields would occur far inland from the coast and would not affect marine mammals.

> Kuukpik/ASRC Lands Scenario--Development of a field on Kuukpik lands near Nuiqsut. Under this scenario, development along the Colville River would increase over that associated with the Alpine and Fjord projects. Some spotted seals and a few polar bears would be exposed to increased noise and disturbance associated with vessel and air traffic along the Colville River.

Development outside the NPR-A on State Lands (coastal waters) or on the OCS also would contribute to the cumulative effects on marine mammals.

(a) Cumulative Analysis

1) Effects of Noise and Disturbance on Pinnipeds, Beluga, and Gray Whales

In the Beaufort Sea, noise and disturbance from on-ice seismic surveys during any one year would affect breeding ringed seals in that area for no more than 1 year, because less than 1% of the population would be likely to be exposed to and potentially be disturbed by the operations. Surveys in other areas during other years have disturbed different seals and subsequent surveys would be expected to in the future. A few pups could be lost, because mothers might abandon maternity lairs or because seismic vehicles might destroy snow lairs along the shot line. Past seismic exploration on the sea ice over several years might have killed some pups and displaced some seals locally (within 150 m of seismic lines) during operations for that ice season (Burns et al., 1983; Link, Olson, and Williams, 1999). However, these additive effects probably were not significant to the seal population above distribution changes associated with changes in sea ice.

Noise and disturbance effects on seals, walruses, and beluga and gray whales in the Beaufort Sea from an estimated total of more than 450 helicopter round trips per month and at least 200 vessel round trips per month should last a few minutes to less than an hour for any one disturbance event. Disturbance reactions of seals, walruses, and beluga and gray whales would be brief; they would return to normal behavior patterns and distribution shortly after the boat or aircraft left the area. Effects would not be expected to be additive or synergistic, because disturbance reactions most likely would involve different animals and occur in different areas. Seals and walruses also might get used to aircraft and vessels, if they were to see them often and routinely.

Ringed and bearded seals, walruses, and beluga and gray whales have already been exposed to oil-exploration activities in the Beaufort Sea, including seismic surveying, drilling, air and vessel traffic, dredging, and gravel dumping. These activities in the Beaufort Sea (especially barge traffic to the North Slope, and some icebreaker activity to support oil exploration)--if they were to increase in the future--could affect how seals are distributed near the activity for 1 season (less than 1 year) during high levels of activity. However, some seals would get used to marine and air traffic, industrial noise, and human presence. Displacement from cumulative industrial activities is not likely to affect the overall abundance, productivity, or distribution of ringed and bearded seals, walruses, gray, and beluga whales in Alaska's Beaufort Sea.

Cumulative noise sources that could affect beluga and gray whales are from seismic activities and drilling, and other noise associated with exploration, development, and production operations, such as vessel and aircraft traffic, construction, and oil-spill cleanup. Underwater industrial noise, including drilling noise measured from artificial gravel islands, has not been audible in the water more than a few kilometers away. Because the beluga whale's migration corridor is far offshore of the barrier islands, seismic exploration, drilling, development, and production noise from most development in the nearshore area is not likely to reach many migrating beluga or gray whales. Noise also is unlikely to affect the few whales that may be in lagoon entrances or inside the barrier islands due to the rapid attenuation of industrial sounds in a shallow-water environment. Because island and pipeline construction would occur during the winter and be well inside the barrier islands, it would not be likely to affect beluga or gray whales.

Migratory populations of beluga whales, walruses, and spotted, ringed, and bearded seals have already been exposed to oil-exploration activities (seismic surveying, drilling, air and vessel traffic, dredging, and gravel-dumping operations) in the Beaufort Sea as well as some industrial activities in the Bering and Chukchi seas. The exposure of the marine mammal populations to the above activities and to other marine vessel traffic (sealift barge traffic to the Arctic Slope, including NPR-A, and increased icebreaker activity in support of offshore oil exploration) could increase in the future. These industrial activities would be likely to have some short-term (1 generation) effects on the distribution of migratory seals, walruses, and beluga whales during the drilling season. If and when oil development occurs, some local changes (within a few miles of the activity) in the distribution of those populations could occur. However, some habituation of seals, walruses, and beluga whales to noise and human presence is likely to occur. The displacement associated with cumulative industrial activities or coincidental to such activities would not be expected to result in a significant reduction in the overall abundance, productivity, or distribution of these marine mammals adjacent to the Northwest NPR-A Planning Area and in the Beaufort Sea.

Helicopters flying along the coast to and from Camp Lonely, Prudhoe Bay, and NPR-A exploration and production facilities in the Planning Area could disturb some polar bears and seals hauled out near the coast. Disturbance of some hauled-out seals during the spring pupping season could cause them to panic and charge into the water, resulting perhaps in the injury, death, or abandonment of small numbers of seal pups. This potential disturbance of seals and polar bears would be expected to cause short-term displacement of individual animals (a few minutes to less than a few days) within about 1 mi of the air-traffic route and to have no significant effects on their populations.

2) Effects of Noise and Disturbance on Polar Bears

Individual air- and vessel-traffic disturbances assumed for this analysis likely would disturb a few polar bears for a few minutes to less than an hour. Seismic operations, ice-road traffic, and other activities could disturb some coastal denning sites in Alaska. A few females may have abandoned maternity dens because of nearby noise and humans, and some cubs might have been harmed. However, the number of bears disturbed in any given year is likely to be very low (probably no more than 1 to 3 animals). Bears disturbed in one year would not be expected to be disturbed the next year, because den locations change with snow cover. Current information on the distribution of den locations near oil facilities does not show that bears were permanently displaced from denning habitat. There is no clear indication that disturbance from oil exploration and development has had an additive or synergistic effect on the polar bear population. "Two hunters from Nuiqsut reported that polar bear activity has decreased in recent decades around Prudhoe Bay and west, to the Colville River," while "some hunters stated that the number of polar bears varies from year to year but has remained stable overall" (Kalxdorff, 1997).

The Marine Mammal Protection Act (MMPA) requirements should prevent excessive disturbance to polar bears. Letters of Authorization (LOA) requested by industry and issued by the FWS for incidental take of polar bears recommend a 1-mi buffer around occupied polar bear dens. Significant disturbance of polar bears in the Beaufort Sea and along the coast of NPR-A would be avoided by compliance with the LOA.

A very small number of polar bears has been and could continue to be killed in encounters with humans near industrial sites and settlements associated with cumulative oil development. In the Northwest Territories in Canada, conflicts with humans near industrial sites from 1976-1986 accounted for 15 percent (33 out of 265) of the polar bears killed (Stenhouse, Lee, and Poole, 1988). Some of these losses were unavoidable, and the polar bear population recovered through recruitment within 1 year. Four bears were unavoidably killed after being attracted to offshore platforms in the Canadian Beaufort Sea during 5 years of intensive oil exploration (Stirling, 1988). Fewer losses of polar bears in arctic Alaska are expected, because the Marine Mammal Protection Act requires that the oil industry avoid killing bears. Polar bear loss in Alaska would not be likely to exceed one animal per year, and it probably would be less. Three lethal takes of polar bears have been related to industrial activities on the North Slope over the past 20 years (Gorbics, Garlich-Miller, and Schliebe, 1998). These losses have not significantly increased the mortality rate of the polar bear population over that from subsistence harvest and natural causes. The loss rate in Canada over a 5-year period was higher than that in Alaska but was not significant to the population, which increased at 2.4 percent per year. The MMPA has kept losses low in Alaska.

3) Effects of Spills

Cumulative oil-spill risks to marine mammal habitats from Camden Bay west to Point Barrow could develop from activities associated with Federal OCS offshore development at Endicott, North Star, and Liberty; onshore and possible offshore development in the Dease Inlet in the NPR-A; and at Sourdough, Alpine, and Badami, as well as possible barging of fuel oil for oil exploration and development in the Planning Area.

An important habitat for marine mammals is the active-ice, or ice-flaw, zone. Seals, walruses, and beluga whales would be most vulnerable to spills that were to contact this zone. Polar bears would be most vulnerable to spills contacting the flaw zone or the coast.

Offshore spills obviously pose a higher risk to marine mammals than onshore spills, but along the coast of the Planning Area, some aggregations of seals and walruses and a small number of polar bears could be contaminated by onshore spills that might reach marine waters and could suffer lethal or sublethal effects.

Spills that occurred during the open-water season (summer)--or that occurred during the winter and persisted in the Beaufort Sea area after meltout--would pose the highest risk to marine mammal habitats. However, spills also could cause effects in winter. A small number of breeding ringed seals and their pups would be likely to be contaminated by spills that might occur during the winter, resulting in the death of a relatively small number of pups because of the sparse distribution of pupping lairs. During the winter season, nonbreeding ringed seals, bearded seals, and polar bears could be exposed to cumulative oil spills that might contact the ice-flaw-zone habitat and the Northern Lead System off Point Barrow. During the summer, or open-water season, marine mammals in the western Beaufort Sea could be exposed to spills that might occur to the east during the winter and contact the flaw-zone habitat.

The most noticeable effects of potential oil spills from offshore oil activities would be through contamination of seals, walruses, and polar bears, with lesser effects on beluga whales. Losses of seal pups and adults, walrus calves and adults, and polar bears would be likely to be replaced within one generation or less, with a generation time of about 5 years for ringed seals and at least 7 years for polar bears (Kelly, 1988; USDOI, FWS, 1995). Beluga whales would be likely to suffer low mortality (10 whales), with population recovery expected within 1 year.

4) Arctic Oil Transportation through Prince William Sound and Gulf of Alaska

Potential future oil-spill effects from tanker transportation of arctic oil (including NPR-A oil) from the TAPS terminal at Valdez could have serious cumulative effects on marine mammals (especially sea otters) in Prince William Sound and the Gulf of Alaska. There also could be local effects on the survival of young harbor seals if the spill were to occur during the pupping season, as did the 1989 *Exxon Valdez* spill (11 million gallons or 258,000 bbl of crude oil). Indications from scientific studies of the effects of the spill suggest that the local sea otter populations in Prince William Sound, Kenai Peninsula, and the Kodiak-Katmai Bay area were reduced substantially. The western Prince William Sound sea otter population may have been reduced by at least 2,650 otters out of an estimated 6,500 otters (Garrott, Eberhardt, and Burn, 1993). The Kenai Peninsula and Kodiak-Katmai Bay sea otter populations probably suffered smaller losses (a few hundred otters) because the oil had time to weather and disperse before reaching them. It is likely that local assemblages or populations of sea otters in heavily contaminated coastal areas of Prince William Sound will take more than one to two generations, or $\geq$ 5 years, to recover from the spill. The spill also adversely affected the survival of harbor seal pups at pupping areas contaminated by oil and was estimated to have killed about 300 harbor seals (Frost, Lowry, and Carroll, 1993). Oil resources estimated for Alternative A represent approximately 3.5 percent of total North Slope onshore and offshore oil resources. By 2013, projected NPR-A production (under Alternative A multiple sales) could constitute about 3 percent (0.37 Bbbl) of the oil transported through the TAPS and in tankers through Prince William Sound. Assuming tanker spills occur, cumulative transportation of North Slope oil through Prince William Sound is expected to have a long-term ($\geq$ 5 years) effect on sea otters and harbor seals. The estimated contribution from projected Northwest NPR-A Planning Area production would be about 3 percent (0.32 spills) of the spills (Table App 9-14).

5) Effects of Habitat Alteration

More than 40 exploration-drilling units (gravel islands, drill ships, and other platforms) have been installed or constructed in the Beaufort Sea as a result of past Federal and State oil and gas leases. Several million cubic yards of gravel and dredge-fill material have altered at least a few square kilometers of benthic habitat in the Beaufort Sea. Alterations from island construction, trench dredging, and pipeline burial are expected to affect some benthic organisms and some fish species within 1 km for less than 1 year or season. These activities also may temporarily affect the availability of some local food sources up to 1 to 3 km (0.62 to 1.9 mi) distance during island construction. These activities are not expected to affect food availability over the long term for the following reasons:

- Common prey species for seals, such as arctic cod, have a very broad distribution and would not suffer from the fractional loss of benthic habitat associated with platforms and pipelines.
- Ringed and bearded seals and walruses can forage over large areas of the Beaufort Sea; they do not rely

exclusively on the abundance of local prey.

- Although gravel islands used for oil production may provide habitat for some prey species, they are not likely to affect the availability of seals and walruses as prey for polar bears in the Beaufort Sea.

Drilling units for exploration and platforms for future production (including gravel islands) in the Beaufort Sea are likely to have local effects on ice movements and fast-ice formation around the structures. These local changes in ice movements and ice formation are not likely to change the seal distribution. Noise, movements, and human presence associated with installing platforms and other construction activities could displace some seals, walruses, beluga whales, and polar bears within 1 mi of the activity for 1 season or year. Offshore exploration platforms and onshore NPR-A exploration have not had any apparent lasting effect on seal, walrus, beluga whale, gray whale, and polar bear distribution and abundance in the Beaufort Sea. The number of production platforms that will be built in the Beaufort Sea over the next 20 years is uncertain. An optimistic estimate would be about eight platforms, including six platforms from Sales 186, 195, and 202: Liberty; and Northstar. That number is not expected to affect ice habitats of seals and polar bears in the Beaufort Sea. Natural variation in ice conditions and resulting changes in the distribution of seals, walruses, beluga and gray whales, and polar bears are likely to reverse or overwhelm any local reduction (or increase) in their distribution due to cumulative exploration and production.

6) Effects of Atmospheric Environmental Contaminants

Numerous scientific studies have shown that atmospheric contaminants are being deposited in the Arctic (Proshutinsky and Johnson, 2001; Aguilar, Borrell, and Reijnders, 2002). The contaminants of greatest concern are persistent organic pollutants such as organochlorines and heavy metals such as mercury. These pollutants are known to biomagnify up the food chain. Organochlorines have been shown to adversely affect marine mammal reproduction and immune systems in temperate regions (Aguilar, Borrell, and Reijnders, 2002). While marine mammals possess biochemical methods of deactivating the toxic effects of heavy metals such as mercury (binding it with proteins), the role that organochlorines might play in affecting arctic marine mammal populations is unclear.

7) Effects of Hazardous Material

The dumping and discarding of solid and liquid hazardous materials has been associated with Department of Defense facilities on the North Slope (including the NPR-A) and with past oil and gas exploration drilling on the NPR-A (see Section III.A.1.f Hazardous Materials). These wastes included fuel drums and solid wastes stored or buried onshore. Several land fill sites contain low concentrations of petroleum hydrocarbons and the pesticide d-BHC. Other sites have been cleaned up and the debris has been removed or burned. While these hazardous material sites are small local sources of contamination and environmental degradation, they probably do not represent enough habitat degradation to affect marine mammal abundance and distribution.

8) Effects of Global Warming

Recent analysis of seasonal ice cover in the Arctic over the past 20 to 30 years shows a decrease in ice extent and thickness coincidental with temperature warming trends (Maslanik et al., 1996 and Martin et al 1997 as cited by Tynan and DeMaster 1997). Climate warming has reduced the total Arctic sea ice coverage by about 15 percent in the past 20 years (Stirling and Lunn, 2001). Changes in the extent, concentration, and thickness of the sea ice in the Arctic may alter the distribution, geographic ranges, migration patterns, nutritional status, reproductive success, and ultimately the abundance of ringed and bearded seals, and other arctic pinnipeds which rely on the ice platform for pupping, rest, and molting (Tynan and DeMaster, 1997). Reductions in sea ice coverage would adversely affect the availability of pinnipeds as prey for polar bears (Stirling and Lunn, 2001). If the current warming trend--and associated reduced ice coverage--continues, polar bear and arctic pinniped populations are expected to decline drastically.

9) Effects from Commercial Fishing

In the Bering Sea, the actual and potential effects of commercial fishing on harbor seals, ice seals, walruses, and beluga whales include the following: 1) direct mortality from entanglement in fishing gear and from shooting of marine mammals raiding fishing nets; 2) competition for prey/commercial fish species that could reduce the availability of prey for marine mammals; and 3) displacement of marine mammals caused by noise and disturbance from boats and aircraft associated with intense fishing activities. In Bristol Bay, the entanglement of beluga whales in the salmon gillnet fishery is an additive source of mortality for some pods of belugas. In the Bering Sea, migratory spotted seals experience some mortality through entanglement in nets used by herring-fishing operations along the coast. In the southern Bering Sea and Gulf of Alaska, entanglement of migratory fur seals in discarded fishing gear and incidental catches of sea lions in bottom-fishing trawl operations are likely to have been contributing factors in the decline of these populations.

Competition for fish (particularly pollock and perhaps pandalid shrimp in the western Gulf of Alaska) is known to occur between marine mammals and commercial fishing. The rapid increase in the bottomfish fishery in the Gulf of Alaska and in the southern Bering Sea and/or the crash in the shrimp and capelin populations in the western Gulf of Alaska might be contributing causes for the greater than 80 percent decline of northern sea lions and harbor seals over the past 20 to 30 years (Loughlin, 1989; Hansen, 1996).

At present, migratory ice seals (spotted, ringed, and bearded seals) and beluga whales that summer in the Arctic and winter in the Bering Sea are believed to have experienced low population losses due to direct mortality or food competition from commercial fishing in the northern Bering Sea, because the fleet is smaller (hundreds of boats) than the fleet in the southern Bering Sea-Bristol Bay and Gulf of Alaska (thousands of boats). These arctic marine mammal populations are not exposed to such intense fishing activities during the winter months when they migrate to the northern Bering Sea. However, the amount of commercial-fishing activity has increased greatly in the northern Bering Sea, and migratory marine mammals are being exposed to an increasing number of vessels. It is likely that temporary displacement (minutes to hours to 2 to 3 days) of seals, walruses, and beluga whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and Norton Sound.

Longer displacement (several days to a few months) of some portions of migratory marine mammal populations probably is occurring in areas of intense commercial-fishing activity. Up to 33 percent of the walrus herd that seasonally hauls out on Round Island in Bristol Bay apparently has been displaced from the area as a result of the bottom-trawl-fishing operations occurring near the island in the summer. This seasonal displacement of about 6,000 walruses to other haulout sites is not likely to have had a significant adverse effect on the productivity and abundance of the walrus population, but could represent a long-term (several-year), seasonal effect on the distribution of a portion of the population if this reduction in habitat use were to persist for several years.

To summarize, the overall effects of commercial fishing on seals, walruses, and beluga whales include direct mortality from entanglement in fishing gear and shooting, competition for prey/commercial-fish species, and disturbance/displacement from vessel traffic. In the Bering Sea and in the Arctic, some populations of spotted seals and walrus could experience long-term (several-generation) displacement caused by increased traffic and competition for prey species. In the future, seals and beluga whales could experience an increase in direct mortality as a result of net entanglements and shootings. They also could experience a long-term (several-generation) decline in productivity and abundance as a result of increased competition for prey species. The intense commercial bottom-trawl fishery for pollock and other bottomfish may have had a long-term effect on regional northern sea lion and harbor seal populations in the southern Bering Sea and in the Gulf of Alaska.

10) Effects of Hunting and Harvesting on Marine Mammal Populations

International subsistence hunting of seals and polar bears would have no more than a very short-term effect on the abundance of these species (USDOI, MMS, 1998).

(b) Conclusion

The overall effects (mainly from one oil spill estimated to occur in the marine environment) are the potential loss of up to 10 polar bears, a few hundred seals and walruses, and small numbers (probably less than 10) of beluga and gray whales. In the likely cumulative case (including the estimated 1,000-bbl spill) , pinnipeds, polar bear, and beluga and gray whale populations would be expected to recover within 1 year. Potential cumulative oil spills along the tanker route to the U.S. west coast could have a long-term (more than one generation, perhaps 5 to 10 years) effect on sea otters and perhaps harbor seals and other marine mammals. Cumulative noise and disturbance in the Beaufort Sea and on the North Slope (including NPR-A) are expected to briefly and locally disturb or displace a few seals, walruses, beluga and gray whales, and polar bears. A few polar bears could be temporarily attracted to oil development facilities, with no significant effects on the population"s distribution and abundance. The overall "likely" cumulative effects (i.e., not including effects of a very large oil spill, accelerated global warming, or the introduction of some major contaminant) on marine mammals would be minor.

k. Endangered and Threatened Species

Cumulative effects are defined in 50 CFR 402.02 (Interagency Cooperation on the Endangered Species Act of 1973, as amended) as "...those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." The NEPA definitions of cumulative impacts also apply to ESA listed species.

Since 1965, approximately 9.7 million acres of North Slope/Beaufort Sea acreage have been leased through 32 State sales (many are combined sales). In the past 10 years, the State has conducted 12 lease sales in the North Slope/Beaufort Sea area, leasing approximately 4.5 million acres. The State has conducted annual areawide sales in the Beaufort Sea and on the North Slope since 1995, missing only 2 years since 1982. In January 2001, the State proposed to offer 6 areawide lease sales over the following 5 years. Each State Beaufort Sea offering will extend from Barrow to the Canadian border, while onshore sales will offer all unleased State lands between the Arctic National Wildlife Refuge and the NPR-A. The most recent sales were held in October 2002.

There currently are 25 producing oil fields on the North Slope with Prudhoe Bay, North Prudhoe Bay, Kuparuk River, Alpine, Milne Point, and Endicott being the most productive (Table IV-08). Alpine, which began producing on the Colville River delta in 2000, is the closest that oil field infrastructure has approached the NPR-A Planning Area. Current and reasonably foreseeable development are presented in Tables IV-11 and IV-13.

Since 1979, the U.S. Department of the Interior has conducted a total of 7 Federal lease sales in the Beaufort Sea OCS Planning Area, the most recent having been Sale 170 in August 1998. A total of 688 leases have been sold, totaling 3.5 million acres, and 30 wells have been drilled on Federal leases. Currently, there are 54 active leases on Federal submerged lands in the Beaufort Sea, totaling 181,761 acres. Northstar, the only Beaufort Sea producing unit, began production in 2001. The Northstar Unit contains some Federal leases, although the majority of submerged tracts comprising this unit lie under State waters.

The history of oil spills indicates that there are numerous spills that are small in size. The total number of oil spills from activities on the North Slope from 1989 to 1996 was 975 spills, with the average spill size being 2.7 bbl (USDOI, BLM and MMS, 1998). The estimated volume of small crude-oil spill size over the projected production life of the Northwest NPR-A Planning Area is about 3.0 bbl (for refined-oil spills, about 0.7 bbl). Approximately

65 to 80 percent of all crude-oil spills occur on a pad and have little or no effect on the environment. Approximately 20 to 35 percent could occur on or reach the surrounding environment. Those spills reaching the surrounding environment generally remain restricted to a limited area of the tundra, unless they reach a river, stream, or other waterbody. Off-pad spills that occur in or reach the environment generally cover a small area (less than 500 ft^2 [46.5 m^2]). Larger contamination areas appear to have occurred by wind blowing a fine oil mist over a large area (up to 4.8 acres--one spill area estimated at over 100 acres). Detailed information on oil spills and fate and behavior of oil spills can be found in Sections IV.A.2 and IV.A.3, and Appendix 9 .

Since December 1959, the State of Alaska has held 32 oil and gas lease sales involving North Slope and Beaufort Sea leases. More than 4.6 million acres have been leased. About 78 percent of the leased areas are onshore, and about 22 percent are offshore. As of December 200, there are 931 active state leases broken down as follows: 1.35 million acres onshore along the Slope, 498,000 acres offshore in the Beaufort Sea, and 456,000 acres of active leases that straddle on and offshore acreage. Production to date from state leases (with a small recent contribution from federal leases at Northstar) totals 13.625 Bbbl. Between 2002 and 2006, the State of Alaska is expected to hold the following annual areawide lease sales: 1) Beaufort Sea from Barrow to the Canadian border; 2) Onshore Arctic Slope, including unleased state lands between the Arctic National Wildlife Refuge and the National Petroleum Reserve-Alaska; and 3) Foothills extending into the foothills of the Brooks Range. The state has not yet estimated oil and gas resources involved in these future lease sales (see Table IV-16), but Table IV-18 shows 4.0 Bbbl in undiscovered resources on state lands on the North Slope.

Other than routine annual management actions in the Northwest NPR-A Planning Area, oil and gas exploration and development, as described for the Preferred Alternative and Alternatives A-C (Sections V.B.9 and IV.C.9, D.9, and E.9), is the principal activity that could contribute to cumulative effects on the endangered bowhead whale and threatened spectacled and Steller's eiders. Activities on the ACP associated with other Federal and State projects, actions of nongovernmental entities, and those occurring along bird migration routes or on winter ranges, that could contribute to current and future cumulative effects are outlined in Section IV.F.8.i. These include wildlife research and survey activities, subsistence and sport harvests, commercial fishing, commercial development, environmental contamination, marine shipping, and recreational activities. Most projects and activities not associated with petroleum development affect birds at latitudes south of the Beaufort Sea and outside the summer breeding season. Several of these ongoing activities, individually or in combination, probably affect endangered and threatened species populations as much or more than potential effects of petroleum development and may have contributed importantly to declines in these populations. Although the effects of some non-oil and gas activities (e.g., aerial survey overflights, temporary camps, recreational activities) are likely to be short term, several have the potential for substantial population effects (e.g., harvests, roads, commercial development). Oil exploration and development and other projects and activities could result in: 1) oil or other toxic pollution effects (see discussion in Section IV.C.11); 2) additional disturbance during bowhead migration periods or eider breeding and postbreeding periods; and 3) habitat degradation.

(1) Bowhead Whale

Cumulative noise effects on bowhead whales from onshore and offshore activities would be similar to that described in Section IV.C.11. Bowhead whales might experience cumulative effects from OCS activities, such as noise from drilling, vessel and aircraft traffic, construction, seismic surveys, oil spills, or oil-spill-cleanup activities, and from non-OCS activities. The bowhead whale population has been increasing steadily at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range.

The effects from an encounter with aircraft generally are brief, and the whales should resume their normal activities within minutes.

Bowheads may exhibit temporary avoidance behavior to vessels at a distance of 1 to 4 km. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. Many earlier studies indicate that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity at a distance of a few kilometers but rarely show avoidance behavior at distances of more than 7.5 km. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Bowheads appeared to recover from these behavioral changes within 30 to 60 minutes following the end of seismic activity. However, recent monitoring studies indicate that most bowhead whales during the fall migration avoid an area around a seismic vessel operating in nearshore waters by a radius of about 20 km. Avoidance did not persist beyond 12 hours after the end of seismic operations. Bowheads have been sighted within 0.2 to 5 km from drillships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to noise-producing activities. A few bowheads may avoid drilling noise at 20 km or more. There are no observations of bowhead reactions to icebreakers breaking ice, but it has been predicted that roughly half of the bowheads would respond at a distance of 4.6 to 20 km when the signal-to-noise ratio is 30 dB. Since offshore oil and gas activities in State waters generally are well shoreward of the bowhead's main migration route--some activities occur inside barrier island chains--the effects from activities on State leases is likely to be minimal. Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12 hours.

If an oil spill were to occur as a result of development and production operations associated with any past, present, or reasonably foreseeable future development projects in the arctic region, some bowheads could be contacted. However, most whales exposed would be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals could be killed if they were to experience prolonged exposure to freshly spilled oil. Considering the low probability of spilled oil contacting bowhead habitat, the number of individuals so affected would be expected to be very small.

Activities that are not related to oil and gas also could have cumulative effects on bowhead whales. A small number of whales could be injured or killed as a result of entrapment in fishing nets or collisions with ships. Native whalers from Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the International Whaling Commission. An average annual take of 51 whales during the subsistence harvest was allowed between 1995 and 1998. Bowheads also may exhibit avoidance behavior in the presence of subsistence-hunting vessels. Native whalers from Russia also are authorized to harvest bowhead whales under a quota authorized by the International Whaling Commission. The contribution of OCS activities to cumulative effects on bowhead whales is likely to be of short duration and to result primarily in temporary, nonlethal effects.

(a) Cumulative Analysis

1) Projects That May Affect Bowhead Whales

There are several projects that might affect bowhead whales. Endicott and Northstar are past development projects currently producing oil. The Liberty Project is a reasonably foreseeable future development project (currently in suspended status), which is located shoreward of the barrier islands and well shoreward of the bowhead whale's normal fall migration route. The Kuvlum and Hammerhead units, both reasonably foreseeable future development projects, are within the bowhead whale's normal fall migration route. The Sandpiper and Flaxman Island units, also reasonably foreseeable future development projects, are not within the bowhead whale's normal fall migration route. Endicott, Northstar, and Flaxman Island are all or mostly on State lands. Other Federal and State sales in the Beaufort Sea that are scheduled through 2007 could lead to more noise and disturbance from exploratory activities. In the vicinity of the Northwest NPR-A Planning Area, there are 6 active leases off Smith Bay remaining from previous offshore lease sales; the potential for future development of these leases is unknown. Other types of projects mentioned above likely would not affect whales. These include the Trans-Alaska Pipeline System; constructing the Trans-Alaska Gas System, the Alaska Natural Gas Transportation System; converting natural gas to liquefied natural gas; or tankering crude oil from Valdez.

The potential for oil industry activities outside of the Alaskan Beaufort Sea appears to be limited. Two Federal lease sales were conducted in the Chukchi Sea and exploration activities were conducted, but no producible wells were discovered. A Chukchi Sea/Hope Basin lease sale that was scheduled in the 1997-2002 OCS oil and gas leasing program was deferred. Two Chukchi Sea/Hope Basin lease sales are scheduled in the 2002-2007 OCS oil and gas leasing program. The Chukchi Sea will likely proceed through a "special interest" process--a new process for leasing Federal tracts. It is somewhat speculative whether industry interest in the area is sufficient that sales will be held in the future. Although there are no plans for future oil and gas exploration activities in the Bering Sea south of St. Lawrence Island, a "special interest" offering in Norton Sound in the northern Bering Sea was completed on April 22, 2002. No nominations were received during the "special interest" offering. Although the entire Norton Sound area was open for nomination, the purpose of the "special interest" process is to identify and offer only small, focused areas where industry has a significant interest in exploration. In the Canadian Beaufort Sea, the main area of industry interest has been around the Mackenzie River Delta and offshore of the Tuktoyaktuk Peninsula.

Oil was discovered in these areas, although industry showed little interest in the area during the 1990's. Interest in the area increased recently, and an open-water, seismic-exploration program was conducted in the summer of 2001.

2) Effects of These Projects on Bowhead Whales

Some effects on bowhead whales may occur because of activities from previous and proposed lease sales of State and Federal areas offshore. Generally, bowhead whales remain far enough offshore to be mainly in Federal waters, but they move into State waters in some areas, such as the Beaufort Sea southeast and north of Kaktovik and near Point Barrow. These potential effects were detailed in *Beaufort Sea Sale 144 Final EIS* (USDOI, MMS, 1996a), *Sale 170 Final EIS* (USDOI, MMS, 1998), and *Beaufort Sea Oil and Gas Sales 186, 195, and 202 Final EIS* (USDOI, MMS, 2003). Offshore oil and gas development associated with future Northwest NPR-A actions is not considered likely.

To date, activities conducted in State waters or on the OCS in the Beaufort Sea as a result of previous Federal lease sales since 1979 apparently have not had adverse effects on the bowhead whale population. Although numerous exploration wells have been drilled in the Beaufort Sea from a variety of platforms (including gravel islands, ice islands, bottom-founded drilling platforms, submersibles, and drillships), and extensive seismic surveys have been conducted, no bowhead whale mortality has been reported. The bowhead whale population has continued to increase over that timeframe. However, Inupiat whalers have stated that noise from these activities at least temporarily displaces whales farther offshore, especially if the operations are conducted in the main migration corridor. Whales may avoid areas where seismic surveys or drilling operations are being conducted. Recent monitoring studies (Miller et al., 1997, 1999; Miller, Elliot, and Richardson, 1998) indicate that most whales migrating in the fall avoid an area with a radius about 20 to 30 km around a seismic vessel operating in nearshore waters. These studies are discussed in detail below.

In general, development projects such as Endicott or Northstar, and potentially foreseeable future development projects such as Liberty, are not likely to harm bowhead whales. Endicott is inside the barrier islands in relatively shallow water. Support traffic travels over the causeway. Although Northstar is not inside the barrier islands, it is well shoreward of the bowhead's fall-migration route. Operations for both Endicott and Northstar projects are conducted from gravel structures, which limits how far noise would travel. The Liberty Project is located inside of the barrier islands, well shoreward of the bowhead's fall migration route (USDOI, MMS, Alaska OCS Region, 2002b). Operations for the Liberty Project, if developed, also likely would be conducted from gravel structures, limiting how far noise would travel. Studies indicate that noise from oil and gas operations on gravel islands is substantially attenuated within 4 km and not detectable at 9.3 km.

Some bowhead whales could be disturbed if development were to proceed at the Kuvlum and Hammerhead units or other reasonably foreseeable future development projects, such as the Sandpiper or Flaxman Island units. The Kuvlum and Hammerhead units are within the bowhead whale's normal fall migration route. Development of these units likely would share infrastructure with the Badami group. Each unit likely would have its own production pads and wells and a pipeline connecting it to an existing or planned field associated with Badami. Installing production platforms and constructing pipelines could disturb some bowhead whales on their fall migration, if pipeline construction in deeper water were to take place during the latter part of the open-water season. If helicopters from Deadhorse were to pass low overhead, they could cause bowheads to dive. Whales would try to avoid close approach by vessels.

The Sandpiper and Flaxman Island units are not within the main bowhead whale fall migration route. Sandpiper is near Northstar, and the effects on bowheads from development at that location likely would be similar to those expected from Northstar. Flaxman Island is closer to the bowhead whale's main fall migration route, but it is a barrier island. In general, noise from oil and gas activities on gravel islands does not travel more than a few kilometers. Development of the Sandpiper unit likely will share infrastructure with the Northstar group. The unit likely would have its own production pads and wells and a pipeline connecting it to Northstar. Development of the Flaxman Island unit likely would share infrastructure with the Badami group. The unit likely would have its own production pads and wells and a pipeline connecting it to a past or present development project associated with Badami.

In the Canadian Beaufort Sea, the main area of industry interest has been around the Mackenzie River Delta and offshore of the Tuktoyaktuk Peninsula. Bowhead whales summering in this area are thought to spend much of their time feeding. Industry interest in the area increased recently and an open-water seismic-exploration program was conducted in the summer of 2001. A monitoring program was conducted in conjunction with seismic surveys but the results of the monitoring are not yet available.

3) Effects of Noise and Oil Spills on Bowhead Whales

Overall, cumulative effects to bowhead whales could include behavioral responses to seismic surveys; aircraft and vessel traffic; exploratory drilling; construction activities, including dredging/trenching and pipelaying; and development drilling, production operations, and oil-spill-cleanup operations that take place at varying distances from the whales. In general, bowheads may try to avoid vessels or seismic surveys if closely approached, but they show little or no response to aircraft flying overhead at 1,000 ft or more. Bowheads also try to avoid close approaches by motorized hunting boats. Bowhead whales whose behavior appeared normal have been observed on several occasions within 10 to 20 km of drillships in the eastern Beaufort Sea, and there have been a number of reports of sightings within 0.2 to 5 km from drillships (Richardson, Wells, and Wursig, 1985; Richardson and Malme, 1993). On several occasions, whales were well within the zone where they should have been able to detect the noise. Some bowheads are likely to change their migration speed and swimming direction to avoid getting close to them. Whales appear less concerned with stationary sources of relatively constant noise than with moving sources. Bowheads do not seem to travel more than a few kilometers in response to a single disturbance, and behavioral changes are temporary, lasting from minutes (for vessels and aircraft) up to 30 to 60 minutes (for seismic activity). The distance at which underwater noise from a self-propelled barge at Northstar island may be detected (Blackwell and Green, 2001) is discussed in the *Beaufort Sea Oil and Gas Sales 186, 195, and 202 Final EIS* (USDOI, MMS, 2003:pg. IV-71). Detailed discussions of how these various activities may affect bowheads can be found in the Final EIS's for Beaufort Sea Lease Sales 144 and 170, the *Final EIS for the Liberty Development and Production Plan*, the *Biological Evaluation for Threatened and Endangered Species with Respect to Reinitiation of Consultation for the Arctic Region Biological Opinion (ARBO) for the Beaufort Sea OCS Planning Area* (USDOI, MMS, 2000), and letter upholding the ARBO for ESA consultation requirements (USDOC, NOAA, NMFS, 2002), the Endangered Species Act-Section 7 Consultation Biological Opinion (Arctic Region Biological Opinion) (USDOC, NOAA, NMFS, 2001), and the *Beaufort Sea Oil and Gas Sales 186, 195, and 202 Final EIS* (USDOI, MMS, 2003). There has been some new information on the effects of seismic surveying activities on bowhead whales from recent studies.

Studies were conducted on the reactions of bowhead whales to marine seismic operations in the Canadian and Alaskan Beaufort Sea during the summer and early autumn in the early to mid 1980's. Detailed monitoring of the reactions of migrating bowheads to nearshore seismic operations was conducted from 1996 to 1998. The results of these two projects were different (LGL Ltd., 2001). Differences also were noted in the seismic operations conducted during the two timeframes. Seismic surveys in the 1980's were 2-D surveys with wider spacing between gridlines, and they generally were conducted in deeper waters using larger arrays. Surveys from 1996 to 1998 were 3-D surveys with gridlines much closer together, and the surveys were conducted in shallow waters, much closer to shore, using smaller arrays.

During the 1980's, the behavior of bowhead whales exposed to noise pulses from seismic surveys was observed during the summer in the Canadian Beaufort Sea and during the fall migration across the Alaskan Beaufort Sea (Reeves et al., 1984; Fraker et al., 1985; Richardson et al., 1986; LGL Ltd., 2001). There also were a number of partially controlled experiments to observe the reactions of bowhead whales to single airguns and to full-scale arrays. These studies showed that most bowheads exhibited strong avoidance behavior and changes in surfacing, respiration, and dive cycles when an operating seismic vessel approached within a few kilometers. During the studies in the 1980's, bowheads exposed to pulses from vessels more than 7.5 km away rarely showed observable avoidance of the vessel, but their surface, respiration, and dive cycles appeared to be altered in a manner similar to that observed in whales exposed at a closer distance (LGL Ltd., 2001). Ljungblad et al. (1985, 1988) conducted a series of four experimental tests of bowhead reactions to seismic surveys in the western Beaufort Sea during the early fall. Total avoidance, with all whales moving away from the source, occurred at 3, 3.5, and 7.2 km from the three vessels using arrays of airguns, and at 1.25 km from the vessel using a single airgun. Whales also demonstrated reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Observers noted that some whales were displaced by several kilometers, and that changes in behavior lasted for up to an hour (LGL Ltd., 2001). A more detailed discussion of the potential for noise disturbance to bowheads from seismic activities and a discussion about some of the limitations of the Ljungblad et al. (1985) study can be found in the Beaufort Sea Planning Area Oil and Gas Lease Sale 170 final EIS and the Section 7 consultation for the Beaufort Sea Region (USDOI, MMS, 1998; National Marine Fisheries Service, 2001, respectively). Various limitations to these studies also were pointed out by Dr. Tom Albert, North Slope Borough during the Arctic Seismic Synthesis and Mitigating Measures Workshop (USDOI, MMS, 1997a).

Richardson et al. (1986) observed whales near another fully operational seismic vessel with a 2,870-cubic-inch airgun array. Whales exposed to sounds from this array began to orient away from the vessel at 7.5 km, but some continued to feed in the area until the vessel was within 3 km. The whales were displaced approximately 2 km, and behavioral changes were noted to persist for at least 2.4 hours.

It is likely that some migrating bowheads avoid seismic operations at distances exceeding those in the studies discussed above. One apparent avoidance response at a greater distance involved bowheads swimming away from a seismic vessel 24 km distant (LGL Ltd., 2001). Subtle changes in surfacing, respiration, and dive cycles (detected only by statistical analysis) were noted at greater distances, out to at least 73 km (LGL Ltd., 2001).

New information on the effects of seismic noise on bowheads is now available from marine mammal monitoring programs conducted in 1996-1998 (Miller et al., 1997, 1999; Miller, Elliot, and Richardson, 1998). The LGL and Greeneridge 1996-1998 monitoring studies were analyzed to determine the general position of the bowhead migration corridor at times with and without seismic activity. The results revealed no clear effect of the 1996 and 1997 seismic programs on the position of the general migration corridor in the central Alaskan Beaufort Sea. In 1996, Miller et al. (1997) found nearly all the bowhead whales in relatively nearshore waters, mainly between the 15-m- and 40-m-depth contours, about 10 to 50 km from shore. Overall, bowhead sightings were fairly broadly distributed between the 10-m- and 50-m-depth contours (Miller et al., 1999). However, the analyses were limited by the low number of sightings potentially influenced by seismic activities. In 1997, nearly all bowhead sightings were in relatively nearshore waters, between the 10-m- and 40-m-depth contours, unusually close to shore (Miller et al., 1999). Many aggregations of feeding whales were observed near or just shoreward of the 10-m depth contour. In 1998, the bowhead migration corridor generally was farther offshore than in either 1996 or 1997, between the 10-m- and 100-m-depth contours and approximately 10 to 60 km from shore (Miller et al., 1999). The distributions of sightings during periods with and without seismic exploration broadly overlapped. The 1996 to 1998 combined data indicated that sighting distributions tended to be farther offshore during times of seismic operations than with no seismic operations.

During 1996-1998 combined survey efforts, sighting distributions tended to be farther offshore on days with seismic airguns operating compared to days without seismic airguns operating. This was true for the study area as a whole, for the East region, and marginally so for the West region. The difference in the Central region was not statistically significant.

Aerial survey results indicated that bowheads tended to avoid the area around the operating source to a radius of about 20 km. Results of the 1996-1998 studies show that bowheads rarely were seen within 20 km of the operations area at times when airguns were operating, but there were some sightings within 20 to 30 km of the nearest shotpoint (Miller et al., 1999). Sighting rates within a radius of 20 km of seismic operations were significantly lower during seismic operations than when no seismic operations were occurring. Within 12 to 24 hours after seismic operations ended, the sighting rate within 20 km was similar to the sighting rate beyond 20 km. There was little or no evidence of differences in headings, general activities, and swimming speeds of bowheads with and without seismic operations. Miller et al. (1999) stated that the lack of any statistically significant difference in headings should be interpreted cautiously. Because it has been shown that most bowheads within 20 or even 30 km of the operating airgun array showed avoidance or deflected offshore, westbound bowheads must have turned to the right at some point as they approached the seismic operation. Miller et al. (1999) noted that the distance at which deflection began cannot be determined precisely, but they stated that considering times with operations on offshore patches, deflection may have begun about 35 km to the east. However, some bowheads approached within 19 to 21 km of the airguns when they were operating on the offshore patches. It appears that in 1998, the offshore deflection might have persisted for at least 40 to 50 km west of the area of seismic operations. In contrast, during 1996-1997 there were several sightings in areas 25 to 40 km west of the most recent shotpoint, indicating the deflection in 1996-1997 may not have persisted as far to the west.

The observed 20- to 30-km (12.5- to 18.8-mi) area of avoidance is a larger avoidance radius than was evident from scientific studies in the 1980's (approximately 7.5 km). However, it is less than the 48 km (30 mi) suggested by subsistence whalers, based on their experience with the types of seismic operations that occurred in the Beaufort Sea before 1996 (Richardson, 2000). Regarding the studies conducted in the 1980's, Richardson and Malme (1993) noted that strong avoidance may occur infrequently at distances of 20 km or more (Koski and Johnson, 1987), although active avoidance usually does not begin unless the seismic ship is closer than 8 kilometers. Richardson and Malme (1993) noted that the apparent avoidance response observed by Koski and Johnson was the greatest distance for a seismic vessel response documented in the studies they reviewed. Regarding the distance suggested by subsistence whalers (including whaling captains from Barrow, Nuiqsut, and Kaktovik) in written testimony at the Arctic Seismic Synthesis and Mitigating Measures Workshop on March 5-6, 1997 (USDOI, MMS, 1997) in Barrow, Alaska, the following conclusion was cited:

> Factual experience of subsistence whalers testify that pods of migrating bowhead whales will begin to divert from their migratory path at distances of 35 mi from an active seismic operation and are displaced from their normal migratory path by as much as 30 mi.

During the 1996-1998 bowhead hunting seasons, seismic operations were moved to locations well west of Cross Island, the area where Nuiqsut-based whalers hunt for bowheads (Miller et al., 1999). This was done under the provisions of the Conflict Avoidance Agreements established between industry and the hunters in 1996-1998. No perceived interference between seismic operations and hunting was reported either in 1998 or in 1996-1997. As a result of mitigation measures implemented under the 1996-1998 Conflict Avoidance Agreements, the 1996-1998 seismic surveys did not adversely affect the accessibility of bowheads to subsistence whalers (Miller et al., 1999).

With respect to these studies (conducted in the Beaufort Sea from 1996-1998), the peer review group at the Arctic

Open-Water Noise Peer Review Workshop in Seattle from June 5-6, 2001, prepared a summary statement supporting the methods and results reported in Richardson, (1999) concerning avoidance of seismic sounds by bowhead whales:

> Monitoring studies of 3-D seismic exploration (8-16 airguns totaling 560-1,500 cubic inches) in the nearshore Beaufort Sea during 1996-1998 have demonstrated that nearly all bowhead whales will avoid an area within 20 km of an active seismic source, while deflection may begin at distances up to 35 km. Sound levels received by bowhead whales at 20 km ranged from 117-135 dB re 1 µPa rms and 107-126 dB re 1 µPa rms at 30 km. The received sound levels at 20-30 km are considerably lower levels than have previously been shown to elicit avoidance in bowhead or other baleen whales exposed to seismic pulses.

> Behavioral studies suggested that some bowhead whales may habituate to noise from distant ongoing drilling, dredging, or seismic operations, but still exhibit some localized avoidance (Richardson and Malme, 1993). Bowhead whales have behaved normally while on their summer feeding grounds within a few kilometers of operating drillships, well within the zone where drillship noise is clearly detectable (Richardson, Wursig, and Greene, 1990; Richardson, Wells, and Wursig, 1985; Richardson and Malme, 1993). Some bowhead whales tolerate considerable underwater noise from drillships and dredges. Biologists saw bowheads within 4 km of a drillship, 10 km from a conical drilling unit, and 0.8 km from a suction dredge. Richardson, Wursig, and Greene also observed behavioral reactions of bowhead whales to underwater playbacks of recorded drillship and dredge noise. Some (but not all) bowheads oriented away when received noise levels and spectral characteristics were comparable to those several kilometers from actual drillships and dredges. During some playback tests call rates decreased; feeding ceased; and cycles of surfacing, respiration, and diving may have changed. The sensitivity of various whales differed. Roughly half responded when the received level of noise was about 115 dB re 1 µPa on a broadband basis, or about 110 decibels in one 1/3-octave band at 0 to 30 decibels above ambient). These levels occurred about 3 to 11 km from a drillship and dredge. The study concluded that some bowheads might habituate to prolonged noise exposure. Alternatively, only the less sensitive individual whales may be found within 5 km of drillships and dredges. There is not enough evidence to know whether or not industrial activity continuing for several years would preclude bowheads from using an area; and no documented evidence shows that noise from outer continental shelf operations would act as a barrier to migration.

> Inupiat whalers observed and reported that noise from some drilling activities, especially drilling from drillships with icebreaker support in the main migration corridor, displaces whales farther offshore away from their traditional hunting areas. Inupiat whalers also have observed and reported that noise from seismic activities displaces whales farther offshore.

> Overall, exposure to noise from oil and gas operations should not kill any bowhead whales, but some could experience temporary, nonlethal effects. There is no clear indication that disturbance from oil and gas exploration and development activities since the mid-1970's has had an additive or synergistic effect on the bowhead whale population. That population has been steadily increasing at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range. Major changes in the bowhead's migration route through the Beaufort Sea are unlikely to result from this noise, although some individuals may be diverted farther offshore.

A more detailed discussion of the potential for noise disturbance to bowheads from industry activities, particularly drillship and seismic, can be found in the Beaufort Sea Planning Area Oil and Gas Lease Sale 170 Final EIS and the ESA Section 7 consultation for the Beaufort Sea Region (USDOI, MMS, 1998 and USDOC, NOAA, NMFS, 2001, respectively).

Bowhead whales could be affected by oil spills from oil and gas projects in the Beaufort Sea area. The Northwest NPR-A Planning Area is likely to represent about 3.3 percent of North Slope past, present, and reasonably foreseeable future oil and gas development projects. It is expected to contribute 0 percent of the mean number of offshore spills and 0.5 percent of mean onshore spills (Table App 9-14). The total estimated mean number of offshore spills is 0 and onshore spills is 0.24 from Northwest NPR-A activities. The most likely number of offshore and onshore spills from Northwest NPR-A activities is 0. The northwest NPR-A is expected to contribute about 3.3 percent of mean number of spills for the Trans-Alaska Pipeline System tanker spills (Table App 9-14). Because more oil spills are likely to occur under the cumulative case than for Northwest NPR-A alone, whales would be more likely to contact spilled oil, and oil-spill effects could be greater. However, oil would have a greater chance of contacting bowhead habitat than the whales themselves.

The effects of oil on bowhead whales would be essentially as described in Section IV.C.11, primarily temporary, nonlethal effects. Individuals exposed to spilled oil could inhale hydrocarbon vapors, experience some damage to skin or sensory organs, ingest spilled oil or oil-contaminated prey, feed less efficiently because of baleen fouling, and lose some prey killed by the spill. Prolonged exposure to freshly spilled oil could kill or injure a few whales, from which the population could recover within 1 to 3 years.

Geraci (1990) reviewed a number of studies on the physiologic and toxic effects of oil on whales and concluded there was no evidence that oil contamination had been responsible for the death of a cetacean. Nevertheless, the effects of oil exposure to the bowhead whale population are uncertain, speculative, and controversial. The effects would depend on how many whales contacted oil, the duration of contact, and the age/degree of weathering of the spilled oil. The number of whales contacting spilled oil would depend on the size, timing, and duration of the spill; how many whales were near the spill; and the whales' ability or inclination to avoid contact. If oil got into leads or ice-free areas frequented by migrating bowheads, a large portion of the population could be exposed to spilled oil. Prolonged exposure to freshly spilled oil could kill some whales, but the number likely would be small.

4) Effects of Other Activities on Bowhead Whales

Activities that are non-oil and gas related also affect bowhead whales. Incidental take of bowhead whales apparently is rare. Between 1976 and 1992, only three ship-strike injuries were documented out of a total of 236 bowhead whales examined from the Alaskan subsistence harvest (George et al., 1994). The low number of observations of ship-strike injuries suggests that bowheads either do not often encounter vessels or they avoid interactions with vessels, or that interactions usually result in the animals' deaths. The bowhead whales' association with sea ice limits the amount of fisheries activity occurring in bowhead habitat. A young bowhead was reported to have died after being entrapped in a fishing net in Japan (Shelden and Rugh, 1995), and another in northwest Greenland, in a net used to capture beluga whales. Several cases of rope or net entanglement, possibly more than 20 incidents, have been reported from whales taken in the subsistence hunt (Angliss, DeMaster, and Lopez, 2001). There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska. Based on the lack of reported mortalities, the estimated annual mortality rate incidental to commercial fisheries is zero whales per year from this stock (Hill and DeMaster, 1999; Angliss, DeMaster, and Lopez, 2001).

Subsistence whaling authorized by the International Whaling Commission is another activity on the outer continental shelf that affects the bowhead whale. Bowheads are harvested by Alaska Natives in the northern Bering Sea and in the Chukchi Sea on their spring migration and in the Beaufort Sea on their fall migration. Canadian and Russian Natives also have requested to harvest bowhead whales. The Canadian Government granted permission in 1991 to kill one bowhead, and a bowhead was harvested in Mackenzie Bay in fall 1991. Additional permits were granted in 1993 and 1994, but no bowheads were harvested in either year. There is renewed interest by villages along the Russian Chukchi Sea coast to hunt bowhead whales.

Subsistence whaling quotas change every few years. A quota of 266 strikes or 204 bowhead whales landed was authorized by the International Whaling Commission for 1995-1997 to be divided among 10 Alaskan villages (Shelden and Rugh, 1995). There was a 5-year block quota of 280 bowhead whales landed, authorized by the International Whaling Commission for 1998-2002 (64 *FR* 28413). The number of bowheads struck in each year may not exceed 67, except that any unused portion of a strike quota from any year may be carried forward; however, no more than 15 strikes may be added to the strike quota for any one year. There were 15 unused strikes available after the 1997 harvest, and the combined strike quota for 1998 was 82 (67 + 15). There were 15 unused strikes available after the 1998 harvest, and the combined strike quota for 1999 was 82 (67 + 15). The Eskimos in Alaska and the Chukotka Natives in the Russian Far East shared the 82 combined strike quota for 1998 and 1999. In 1999, the Chukotka Natives in the Russian Far East were allowed no more than 7 strikes, and the Alaska Eskimos were allowed no more than 75 strikes. The quota for Alaska Eskimos is divided among 10 Alaskan villages in the Bering, Chukchi, and Beaufort seas. This compares with the previous quota of 266 strikes, or 204 bowhead whales landed, authorized by the International Whaling Commission for 1995-1998 to be divided among 10 Alaskan villages (Shelden and Rugh, 1995). This level of harvest was approved by the International Whaling Commission under the supposition that it still would allow for continued growth in the bowhead population. It is likely that the bowhead whale population will continue to be monitored and that the harvest quota will be set accordingly to maintain a healthy bowhead population level; however, the quota was restored at the October 2002 meeting.

The total estimated take annually by Alaska Natives in recent years--including struck and lost whales--was reported to be 41 (1990), 46 (1991), 46 (1992), 51 (1993), 46 (1994), 57 (1995), 44 (1996) (Hill and DeMaster, 1999), 66 (1997), 54 (1998), and 47 (1999) (Angliss, DeMaster, and Lopez, 2001). Hunters from the western Canadian Arctic community of Aklavik killed one whale in 1991 and one in 1996. The average annual subsistence take (by Natives of Alaska and Canada) during the 5-year period from 1995 to 1999 is 54 bowhead whales (Angliss, DeMaster, and Lopez, 2001). It is likely that many more whales than this experience disturbance from subsistence whaling activities.

5) Transportation Effects on Bowhead Whales

Bowhead whales are a marine species that winter in the Bering Sea and migrate through the Chukchi Sea into the Beaufort Sea every spring. In the fall, they migrate back through the Chukchi Sea into the Bering Sea. Bowhead whales and their habitat are far removed from the tanker routes to the Far East and to southern California. Therefore, they would not be affected by overland transportation of oil through the Trans-Alaska Pipeline System or by marine transportation along the tanker routes.

6) Summary

Cumulative noise effects on bowhead whales from onshore and offshore activities would be similar to that described in Section IV.C.11. Bowhead whales might experience cumulative effects from OCS activities, such as noise from drilling, vessel and aircraft traffic, construction, seismic surveys, oil spills, or oil-spill-cleanup activities, and from non-OCS activities. The bowhead whale population has been increasing steadily at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range.

The effects from an encounter with aircraft generally are brief, and the whales should resume their normal activities within minutes.

Bowheads may exhibit temporary avoidance behavior to vessels at a distance of 1 to 4 km. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. Many earlier studies indicate that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity at a distance of a few kilometers but rarely show avoidance behavior at distances of more than 7.5 km. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Bowheads appeared to recover from these behavioral changes within 30 to 60 minutes following the end of seismic activity. However, recent monitoring studies indicate that most bowhead whales during the fall migration avoid an area around a seismic vessel operating in nearshore waters by a radius of about 20 km. Avoidance did not persist beyond 12 hours after the end of seismic operations. Bowheads have been sighted within 0.2 to 5 km from drillships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to noise-producing activities. A few bowheads may avoid drilling noise at 20 km or more. There are no observations of bowhead reactions to icebreakers breaking ice, but it has been predicted that roughly half of the bowheads would respond at a distance of 4.6 to 20 km when the signal-to-noise ratio is 30 dB. Since offshore oil and gas activities in State waters generally are well shoreward of the bowhead's main migration route--some activities occur inside barrier island chains--the effects from activities on State leases is likely to be minimal. Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12 hours.

If an oil spill were to occur as a result of development and production operations associated with any past, present, or reasonably foreseeable future development projects in the arctic region, some bowheads could be contacted. However, most whales exposed would be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals could be killed if they were to experience prolonged exposure to freshly spilled oil. Considering the low probability of spilled oil contacting bowhead habitat, the number of individuals so affected would be expected to be very small.

Activities that are not related to oil and gas also could have cumulative effects on bowhead whales. A small number of whales could be injured or killed as a result of entrapment in fishing nets or collisions with ships. Native whalers from Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the International Whaling Commission. An average annual take of 51 whales during the subsistence harvest was allowed between 1995 and 1998. Bowheads also may exhibit avoidance behavior in the presence of subsistence-hunting vessels. Native whalers from Russia also are authorized to harvest bowhead whales under a quota authorized by the International Whaling Commission. The contribution of OCS activities to cumulative effects on bowhead whales is likely to be of short duration and to result primarily in temporary, nonlethal effects.

(b) Conclusion

Bowhead whales may display a cumulative response to activities that produce underwater noise by increasing their distance from sources such as drilling, seismic surveys, or vessels, through diversion of their route of travel, or by displaying other response behaviors. Whales exposed to such sources are likely to experience temporary nonlethal effects lasting less than 24 hours. Whales contacted by an oil spill that could result from cumulative periods of oil and gas activities are expected to experience temporary nonlethal effects. Few whales are expected to be contacted by oil; the probabilitiy of an oil spill is very small. A few whales may experience cumulative lethal or nonlethal effects from entanglement in fishing nets, collisions with vessels, or encounters with subsistence whalers.

(2) Spectacled and Steller's Eiders

In addition to routine management actions (see Section IV.B) and harvest activities in the Northwest NPR-A Planning Area, oil and gas exploration and development--as described for Alternative A (Section IV.C.11) and the Preferred Alternative (Section V.B.11)--are the principal activity that could contribute to cumulative effects on threatened eiders. Activities associated with other Federal and State projects--as well as actions of nongovernmental entities--on the Arctic Coastal Plain, along migration routes, or on winter ranges that potentially could contribute to current and future cumulative effects include wildlife research and survey activities, subsistence and sport harvests, predation, commercial fishing, commercial development, environmental contamination, marine shipping, and recreational activities. Most projects and activities not associated with petroleum development affect eiders at latitudes south of the Beaufort Sea and outside the summer breeding season. Several of these activities, individually or in combination, probably affect eider populations as much or more than potential effects of petroleum development and may have contributed importantly to recent declines in these populations. Oil exploration and development (and other projects and activities) could result in: 1) oil or other toxic pollution effects (see discussions in Section IV.C.11 and Section V.B.11); 2) additional disturbance during breeding and postbreeding periods; and 3) habitat degradation. Disturbance of some individuals as a result of oil and gas operations would be expected to be unavoidable.

(a) Cumulative Analysis

1) Effects of Disturbances

a) Aircraft and Vessel Disturbance

Future oil and gas development and production in the NPR-A, expected to be essentially roadless, is likely to require substantial fixed-wing aircraft, helicopter, and occasional barge support during periods when eiders are present. Exploration is expected to occur primarily during winter months when eiders are absent. Roadless developments such as Alpine and Badami require substantial air support for construction, development, and production, although most construction has been done during winter months, as would be expected for any NPR-A development. Construction of these two projects required an estimated 300 to 600 helicopter roundtrips/month for 1 to 2 years; if two projects were to overlap at this level of air support, 30 to 40 roundtrips per day could occur. This could represent a significant increase in air traffic above that annually required for aerial surveys and transportation. Development of these projects required an estimated 28 to 56 roundtrips/month, and production an estimated 12 to 28/month, representing substantial increases that would continue through the nesting season. Offshore development at Northstar required 2,480 aircraft (all types) per winter season extending approximately 30 November-20 April or about 18 flights per day. Cumulative air traffic activity in the Prudhoe Bay area, Kuparuk River, Point McIntyre, Northstar, and Alpine fields is likely to represent the greatest source of disturbance for eiders from currently developed areas.

Regardless of attempts to mitigate effects by adjusting routes, continued activity at this level to support developing fields and future development in and around the NPR-A would be likely to result in some low-altitude flights over nesting, brood-rearing, staging, or migrating eiders. Such disturbance would be expected to cause excessive short-term energy use by disturbed individuals and displacement of eiders from the vicinity of routinely used air corridors. The latter would be similar to eider responses observed during low-level aerial bird survey overflights where individuals either run or take flight, depending on species and circumstances. Such disturbance could flush females from nests, resulting in lower productivity if eggs are lost to predators or exposure to low temperatures, or could cause displacement of females with broods from preferred foraging areas during brood rearing, or any individuals during preparation for migration. Long-term displacement (1 year or more) from the vicinity of heavily used corridors and onshore facilities could result in fewer young produced and somewhat lower survival of adults and young. For example, helicopter pipeline inspection flights during production could displace some eiders from within at least 1 km (0.62 mi) of a pipeline, whether a regional pipeline or Trans-Alaska Pipeline System. Although such flights would occur frequently, they would be intermittent, thus some individuals might tolerate this level of disturbance and nest, rear their broods, or forage within the pipeline corridor. However, because of the relatively low density of eiders nesting in the NPR-A, disturbance resulting from support aircraft noise and visual presence would be likely to be temporary, with effects lasting less than an hour.

If aircraft were to frequently overfly open-water areas in spring, some eiders would be likely to be displaced from this essential habitat. Because there is so little open water available in spring, access to such areas is likely to be more restricted than in the postbreeding period. This could increase competition for the food available during the stressful period following spring migration and could result in decreased survival or breeding success. Beginning in early summer, nonbreeding individuals, failed breeders, molting individuals, and males could be feeding in nearshore areas. Helicopters flying over these areas 15+ roundtrips per day could cause birds to move away from routinely used flight paths, increasing the stress of preparing for migration in some individuals and decreasing chances for survival.

Marine docking facilities potentially could be located in Peard Bay, Barrow, or Dease Inlet, although initial development projects could be staged out of Prudhoe Bay and materials transported by vehicle in winter or barge in summer. Displacement of eiders from the vicinity of vessel transportation corridors could last through an entire open-water season, depending on the number of concurrent projects and the stage of development, which determines trip frequency. Because numbers of vessel roundtrips (10/summer + 1/month) for a project are forecast during construction period, and supply vessels are likely to follow established routes, the actual area disturbed would be limited. The area would increase--and potentially the numbers of individuals affected--if concurrent projects at different locations were to be developed. Vessel traffic occurs during the open-water season and, although numbers of birds displaced could be substantial depending upon the season of occurrence (tens or hundreds of individuals, particularly during fall migration), alternate foraging and staging habitat would be available away from probable routes.

The presence of onshore facilities could cause eiders to avoid the immediate vicinity for variable periods up to the duration of such presence. This potentially could result in lowered productivity, although adequate nesting habitat is not likely to be a limiting factor in the NPR-A.

b) Vehicle Disturbance

Although most future oil and gas developments in NPR-A are expected to be isolated from existing road systems, production pads would be connected by roads several miles long and would have an associated airstrip approximately 1 mi long. Gravel transport would be assumed to occur during winter. Summer traffic, though expected to be relatively low volume, could disturb nesting or brood-rearing eiders in the immediate vicinity of pads and roads throughout the life of the field. Early season snowmelt in dust shadows of roads or pads could attract eiders.

c) Other Disturbance Factors

Human presence, construction and drilling activities, spill cleanup, and predators attracted to oil and gas development areas vary considerably in how much disturbance they cause. The presence of unconcealed humans, whether associated with oil and gas, hunting, or recreational activities, is disturbing to eiders, especially during nesting and brood-rearing periods. Common experience confirms that such presence generally causes birds to move from the immediate area of disturbance and may displace them for several hours or longer. Cumulative effects of such disturbance, with several activities occurring in the same period or one after the other through the summer season, could cause decreased production and survival of young or recruitment into the population. Attracted predators and hunting, of course, may cause direct mortality. Predators such as foxes attracted to nesting areas could cause losses up to total failure for the season. Most such disturbance associated with commercial activities could be controlled by mitigation. Although it is likely that behavioral effects resulting from disturbance associated with oil and gas development would be additive to naturally occurring disturbances, there is no evidence for synergism, in which the combination of effects from natural and/or development-related factors would be greater than their additive effects.

2) Effects of Habitat Alteration

Future oil and gas development is expected to occur with a much smaller disturbed area (footprint) than has occurred in Prudhoe Bay-Kuparuk area. For example, the total area covered by roads/pads/airstrips for the Badami and Alpine developments is about 182 acres plus 89 acres of gravel mines (USDOI, MMS, Alaska OCS Region, 2002b:tbl V-3). Presumably, the effect on bird populations of facilities for future projects, though additive, would be substantially less severe because of the smaller areas involved. Effects from dust fallout, thermokarst, and hydrologic change (USDOI, MMS, 1998) would be restricted to much smaller areas and, thus, result in smaller habitat loss. Comparison of gravel mine areas alone indicates that Alpine and Badami developments disturbed 0 and 5.9 percent (respectively) of that altered by Prudhoe Bay region development. Withdrawal of freshwater from lakes during winter for construction of ice roads and pads would be expected to have almost no effect on tundra-nesting eiders. Water used for this purpose is replaced rapidly by snowmelt runoff in spring; therefore, it would not be likely that waterbodies depleted somewhat in winter would later present decreased foraging opportunities for eiders. Also, eiders are present at such low density on the coastal plain that it would be unlikely that more than a very few individuals would by chance attempt to nest at lakes used as winter water sources.

Low-flying eiders could collide with onshore buildings or structures (or offshore drilling structures) under conditions of poor visibility (darkness, fog). Because structures cumulatively represent relatively small obstructions on the landscape, and birds encountering them when visibility is good would be expected to see and avoid them, bird mortality from collisions would be expected to be low. However, there is little information on which to base a projected mortality estimate.

3) Effects of Other Factors

Subsistence harvesting is estimated to remove hundreds of spectacled eiders from the Alaskan population annually (58 *FR* 27474). Programs currently are underway by the FWS and the NSB to inform hunters of harvest closures on these two species in an effort to decrease this source of mortality (USDOI, FWS, 2002, pers. comm.). Effects of the other factors (e.g., fishing-net entanglement, bioaccumulation of toxins in the food chain) on the spectacled eider population currently are undetermined. The effects of these activities on Steller's eiders are also undetermined. Another factor that could potentially affect the population is improper containment or disposal of refuse at onshore support camps, which could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders.

4) Effects of Natural Events

On August 10, 2000, a violent windstorm occurred in the Beaufort Sea producing extreme wave action that eroded coastlines and restructured barrier island habitats. The storm was followed by several days of subnormal temperatures and 1.5 inches of snow (Divoky and Mendenhall, 2000). Such an event could cause considerable mortality of juvenile eiders and those staging or migrating through the area.

5) Effects of a Large Oil Spill

Although the magnitude of oil spill effects is uncertain, if the one large spill of 500 bbl (pipeline) or 900 bbl (at a gravel pad) estimated in the oil spill analysis (the most likely number of spills is 0, Table IV-17) were to occur in or enter the marine environment during the life of oil and gas projects in Northwest NPR-A (assumed about 28 years) substantial losses could result--potentially tens to low hundreds of individuals--if released during the summer/fall season when flocks of eiders could be present. Using average estimated spectacled eider density in the central Beaufort Sea area calculated from FWS survey data, and average severity of spill-trajectory paths (and thus exposure of birds to oil), a FWS model estimates an average of only 2 eiders would be exposed to a large spill (5,912 bbl) within 30 days in July (see details in Stehn and Platte, 2000). However, in late July one group of 144 individuals was observed, suggesting a potential for much higher mortality. Also, most eiders observed during FWS aerial surveys in 2001 from Point Barrow east were located along the northern Northwest NPR-A boundary. It is likely that mortality resulting from oil spills would be additive to naturally occurring mortality. In addition to direct contact losses, any declines of prey populations in foraging areas contacted by oil from a spill at any time of year could result in secondary impacts to eiders, affecting productivity and/or survival. Likewise, negative effects of a spill on shoreline and coastal marsh habitat and water quality could affect eiders adversely when moving from onshore brood-rearing areas to the marine environment, or in subsequent years.

A large onshore spill released during the summer season could cause losses of molting and brood-rearing eiders--in addition to smaller numbers of nesting eiders--if it were to enter a heavily used lake/river system or coastal habitat.

Spills from a regional pipeline or the Trans-Alaska Pipeline System would not be expected to cause substantial losses of eiders, since there are relatively low densities so far to the east on the ACP, and Steller's eiders would not be expected to be present in this area. Some habitat in the immediate vicinity of the pipeline contacted by oil would become unsuitable for nesting, brood-rearing, or foraging by eiders. Oil entering freshwater aquatic habitats could spread more widely, including into river deltas and nearshore marine habitats, and result in death of individuals contacted and/or a larger area unsuitable for the above activities.

A tanker spill of North Slope crude oil in the Gulf of Alaska could cause substantial losses of Steller's eiders if it were to move west to the Cook Inlet-Kodiak Island-Alaska Peninsula area where many individuals spend the winter--although these represent a relatively small proportion of the total population. Oil produced by development of Northwest NPR-A projects would be expected to contribute only a small fraction of future spills of arctic oil (considered to be unlikely events) from Trans-Alaska Pipeline System tankers (0.32 spills or about 3.3% of 9.72 total estimated tanker spills, Table App 9-14). There is a possibility that future tanker spills of North Slope oil--which could include NPR-A oil--could cause losses of Steller's eiders wintering in the Gulf of Alaska. In these instances, the contribution of oil from Northwest NPR-A to overall effects is expected to be proportional to its percentage in the particular shipment.

The principal example for estimating potential effects in Prince William Sound and the northern Gulf of Alaska are those resulting from the *Exxon Valdez* oil spill, an unusually large spill (Table App 9-03). Following the *Exxon Valdez* spill, more than 30,000 dead oiled birds were collected, most of them outside Prince William Sound (Piatt et al., 1990). The actual toll probably was 3 to 10 times this number. No Steller's eiders were recovered. Recovery of any bird species from an event of this magnitude requires a lengthy period and is complicated by factors operating before and after the spill that increase mortality and/or decrease production of offspring.

A more realistic projection of the risk from tanker spills is indicated by the average estimated size of tanker spills (Table App 9-15) that was calculated from tanker spill records (Table App 9-03). Most spills (6 of 9) are expected to average 4,000 bbl or less. Of these, half likely would occur in ports with readily available containment and cleanup equipment. When the effects have been studied, at-sea spills of this size have not been found to cause serious effects on bird populations. Also, they would not be expected to reach large areas of Steller's eider wintering habitat until the oil would have been rendered much less harmful by weathering and dispersion in the water. This suggests that for spills of this size, mortality would be relatively low and recovery periods could be relatively short, except for species whose populations are declining and/or have a low reproductive rate (e.g., Steller's eider).

In the unlikely event that a large spill of oil produced by cumulative arctic oil development were to occur along the tanker route in the Gulf of Alaska, Steller's eiders could be affected. According to spill simulations by LaBelle and Marshall (1995), a large tanker spill assumed to occur 100 to 200 mi offshore would not be expected to contact sensitive coastal bird habitats for more than 30 days. Model spills 80 to 100 mi offshore contacted shore in 30 days). In either case, the probability of eider contact in winter would be less than 0.5 percent, and the oil would have dispersed as weathered patches. In addition, eider densities generally are quite low in nearshore winter habitats. Although the effect of such a spill on the eider population wintering in the Gulf of Alaska is likely to be substantial, this represents a relatively modest proportion of the world population.

Small spills, whether from field pipelines or spills of refined products, are expected to be contained on gravel pads and/or cleaned up before substantial losses could occur. However, some mortality could result from the cumulative effects of the numerous small spills projected (130 crude-oil and 323 refined-oil spills, which are assumed to be 3 bbl or less than 1 bbl, respectively, Table App 9-06) for the 28-year production life of prospects considered in this analysis.

6) Summary

The effects on spectacled and Steller's eiders of various cumulative factors would be likely to be substantially greater than for any single activity or activities associated with any individual oil and gas lease sale. Disturbance of some individual eiders as a result of both onshore and offshore oil and gas operations would be likely to be unavoidable over the long term. The effects from typical activities associated with cumulative exploration and development of oil and gas prospects on the North Slope, including the Northwest NPR-A and adjacent marine areas, may include small declines in local nesting or loss of small numbers of spectacled eiders, and potentially Steller's eiders, through disturbance effects on survival and productivity, predation pressure enhanced by human activities, and collisions with structures.

Declines in fitness, survival, or production of young could occur where eiders are exposed frequently to various disturbance factors, particularly helicopter traffic. Human presence that would disturb nesting or brood-rearing eiders, or attract predators, could result in predation of unprotected eggs or young. Because of smaller disturbed areas, the effects of future project infrastructure on eider populations--although additive to natural effects--would be expected to be less severe than with previous arctic developments. The frequency of such disturbance is expected to be highest in the vicinity of primary support facilities. Disturbances often would last less than an hour, but could continue for extended periods in the case of summer drilling operations. Overlap between cumulative project developments could increase disturbance effects. Eider populations--currently declining at a non-significant rate (spectacled) or unknown rate (Steller's)--could be slow to recover from small losses or declines in fitness or productivity. No significant overall population effect would be expected to result from small losses. However, for species such as the spectacled eider that are experiencing a population decline, recovery from any short-term losses associated with oil and gas development could be hindered by lowered productivity resulting from natural occurrences.

If a large oil spill were to occur in or reach the marine environment during high-use periods, some mortality of eiders would be possible; any substantial loss of eiders could represent a significant effect and an important obstacle to full population recovery. Mortality resulting from the cumulative effects of oil and gas projects would be additive to natural mortality and would interfere with the recovery of these species' ACP populations. Recovery from substantial mortality would not be expected to occur while the population exhibits a declining trend, but determination of population status could be obscured by natural variation in population numbers and difficulty in obtaining precise survey data. Onshore spills (also considered unlikely to occur) would be expected to be contained and cleaned up; however, a spill entering a lake could cause some loss of brood-rearing eiders, plus smaller losses of nesting individuals. Any tanker spill in the Gulf of Alaska could result in the loss of wintering Steller's eiders that use ACP habitats during the breeding season.

The overall contribution of proposed activities in the Planning Area to the cumulative effects on spectacled and Steller's eiders is likely to be limited to occasional disturbance from aircraft overflights resulting in temporary, nonlethal effects. None of the management or industrial activities discussed above are likely to cause significant population effects across the eiders' range. Other factors (e.g., subsistence hunting and bioaccumulation of lead from buckshot) may be more important in determining recovery of eider populations.

(b) Conclusion

Cumulative disturbance and other factors associated with continuing oil and gas and other routine activities--particularly air, vehicle, and human traffic--may cause small declines in numbers of eiders nesting in local areas, or loss of small numbers of eiders through adverse effects on productivity, enhanced predation, or collisions with structures. Overlap between cumulative project developments could increase these effects, resulting in decreased fitness and slower recovery from threatened status, particularly when populations are experiencing a decline such as the spectacled eider. None of the management or industrial activities discussed are likely to cause significant population effects. However, an oil spill reaching marine areas could result in substantial eider mortality, a significant effect that would interfere with recovery of these species.

I. Economy

(1) Cumulative Analysis

(a) Background

Even with the activities considered in the cumulative effects scenario described in Section IV.F., the onshore and offshore oil industry in and near Prudhoe Bay is anticipated to decline. An authoritative source, DOE's Energy Information Administration (U.S. Dept. of Energy, 2001a), projects North Slope oil production to decline from 1.084 million barrels per day (MMbpd) in 2005 to 0.208 MMbpd in 2034 (Table IV-01). This decline would encompass oil exploration, development, and production and its associated direct employment. Associated indirect employment in South Central Alaska, Fairbanks, and the North Slope Borough (NSB) and revenues to the Federal, State, and NSB governments are also anticipated to decline. Fluctuations in Alaska's economy from 1975-1995 directly tracked fluctuations in oil prices and other industry factors (McDowell Group, Inc., 1999). Even though the Alaskan economy currently is not nearly as dependent on the oil sector as it was in the mid-1980's (when the major crash in the Alaska economy occurred), the activities described in Section IV.F. would generate employment, economic opportunity, and benefits to the cash economy of Alaska.

The oil and gas industry--with interests in and near Prudhoe Bay and the Trans-Alaska Pipeline System (TAPS)--has strong interest in using the pipeline system for many years into the future. The pipeline system represents a tremendous capital investment. Extending the useful life of the pipeline would allow society to receive returns from its investment farther into the future than would be the case if oil development on the North Slope were to cease.

The oil and gas industry has reduced the costs of drilling wells and bringing new fields into production. This has made it more economic to develop fields that require more miles of pipeline (both onshore and offshore) to connect to the existing pipeline system. Examples of this are the onshore pipelines that in recent years have extended eastward and westward from Prudhoe Bay to the Badami and Alpine prospects, respectively. These onshore pipelines--and other possible future extensions proximate to the Beaufort Sea coast--make it more economically feasible to develop offshore prospects. This can be done by extending pipelines northward to the offshore, including the OCS.

The following analysis assesses the cumulative effects on the economy in terms of 1) current conditions, described in Section III.C.1; 2) economic effects from the Preferred Alternative described in Section V.B.12 ; and 3) activities considered in the cumulative effects scenario described in Section IV.F.

The final EIS for the renewal of the TAPS right-of-way (USDOI, BLM, 2002) evaluated the continued use of the TAPS for 30 years. The amount of North Slope oil assumed to be produced in the future is virtually the same as projected in this EIS. However other aspects of the TAPS EIS are different than the cumulative case in this EIS and it therefore analyzes effects in several ways that are different than in this EIS. The TAPS EIS analyzes effects on the State as a whole for employment, combines oil and gas employment with hard rock mining employment, combines revenues to local governments along the TAPS right of way as opposed to just the NSB, and uses a projection model structured differently than the one used for this EIS. The analysis of effects in the TAPS EIS is therefore useful as a point of comparison, but for the reasons outlined above, is not the same as in this EIS.

The effects below are expressed (in most cases) in annual averages for the sake of simplicity. However, the effects generally would be higher in the early years and lower in latter years, corresponding to the decline in production. The projected effects for the future (generally a decline) are in comparison to the baseline defined in Section III.C.1 (briefly summarized below), and are all based on the assumption of $30/bbl of oil and $4.27/tcf for gas.

(b) Effects on State and Local Revenues

The Northwest NPR-A Preferred Alternative would generate the following revenues:

- $1 million revenue average annual to the North Slope Borough;
- $89 million average annual to the State; and
- $33 million average annual to the Federal Government.

The Northeast NPR-A Planning Area alone would generate considerable revenues in the future. According to the *Final EIS for the Northeast National Petroleum Reserve-Alaska Integrated Activity Plan* (USDOI, BLM, and MMS, 1998), oil from the NPR-A at $18/bbl could generate additive annual revenues of:

- $28 million as the State and North Slope Borough share of royalty receipts;
- $3 million as property tax to the State;
- $48 million as severance tax to the State; and
- $28 million as the Federal share of royalty receipts.

For purposes of analysis, the $28 million royalty receipts are assumed to be divided so that the State receives $13 million and the Borough $15 million.

Not counting the Northeast NPR-A, other components of the cumulative effects could generate the following additive annual revenues:

- $15 million as the State share of royalty receipts;
- $7 million as State income tax;
- $4 million as State spill and conservation tax;
- $41 million as the Federal share of royalty receipts; and
- $56 million as Federal income tax.

In total, the cumulative effects would generate the following additive average annual revenues:

- $16 million to the North Slope Borough;
- $108 million to the State; and
- $158 million to the Federal Government.

This is in comparison to the year 2000 revenues for the NSB of $245 million, year 2001 State operating budget of $4.3 billion, and year 2001 Federal receipts of all types of $1.7 trillion.

(c) Effects on Employment and Personal Income

The cumulative gains in direct employment would include additive jobs in petroleum exploration, development, and production, plus oil-spill cleanup activities. The direct employment would generate indirect and induced employment and associated personal income for all the workers. The cumulative effects are projected to generate additive employment and personal income increases as follows:

- 232 jobs annual average for NSB residents during development, declining to 40 during production. These include direct oil industry employment, indirect, and induced employment.
- $16.3 million in total average annual personal income for workers residing in the NSB during development, declining to $3.7 million during production.
- 7,480 jobs annual average during development, declining to 3,750 during production. These jobs are for workers on the North Slope who reside in Southcentral Alaska and Fairbanks. These include direct oil industry employment and indirect and induced employment.
- $443 million in total average annual personal income for workers residing in Southcentral Alaska and Fairbanks during development, declining to $240 million during production.
- 60 to 190 jobs for 6 months for cleanup of unlikely oil spills in the Beaufort Sea.

The above information is derived from Section IV.C.12 of this IAP/EIS, Section V.C.11 of the Liberty Final EIS (USDOI, MMS, Alaska OCS Region, 2002b), and Section V.C.10 of the Beaufort Sea Sales 186, 195, and 202 Draft EIS (USDOI, MMS, Alaska OCS Region, 2002c). In addition to the North Slope workers who reside in South central Alaska and Fairbanks, additional workers commute to residences outside the State. Approximately 30 percent of current North Slope workforce in the classification of oil and gas workers commutes to locations outside the State (Hadland, pers. comm., 2002; Hadland and Landry, 2002). However, the workers commuting to residences outside the State would not generate economic effects of indirect and induced employment or expenditure of income in the State and would have a negligible effect on the economy of the rest of the U.S. Total NSB employment exclusive of oil workers in 1998 was 4,651 (Table III-11). The projected employment for workers on the North Slope residing in Southcentral Alaska and Fairbanks is in comparison to 1998 NSB employment in mining (assumed to be all oil employment) of 4,753. Of these, 70 percent (3,329) reside in the rest of Alaska outside the NSB, primarily in Southcentral Alaska and Fairbanks. Employment projections can also be compared to the total number of workers in Southcentral Alaska and Fairbanks in 2002 (284,000, see Table III-10).

Aggregate personal income in 1999 was $200 million for the NSB and $13.2 billion for Southcentral Alaska and Fairbanks.

(2) Conclusion

In total, the cumulative effects would generate the following additive average annual revenues:

$16 million to the NSB; $108 million to the State; and $158 million to the Federal Government.

The cumulative effects are projected to generate additive employment and personal income increases as follows:

- 232 jobs annual average for NSB residents during development, declining to 40 during production. These include direct oil industry employment, indirect and induced employment.
- $16.3 million in total average annual personal income for workers residing in the NSB during development, declining to $3.7 million during production.
- 7,480 jobs annual average during development, declining to 3,750 during production. These jobs are for workers on the North Slope who reside in South Central Alaska and Fairbanks. These include direct oil industry employment and indirect and induced employment.
- $436 million in total average annual personal income for workers residing in South Central Alaska and Fairbanks during development, declining to $240 million during production.
- 60 to 190 jobs for 6 months for cleanup of unlikely oil spills in the Beaufort Sea.

(a) Multiple Sales

The effect of multiple sales for the Preferred Alternative is projected to be approximately two times that of the first sale for this alternative. This would be in addition to the other effects projected for the cumulative case above.

(b) Effects Along the Transportation Route

In the unlikely event of a spill of 250,000 barrels of oil in the Gulf of Alaska, activities associated with cleaning it up would employ about the same number of workers as associated with the *Exxon Valdez* spill. About 10,000 cleanup workers worked for 6 months in the first year with the number declining to zero by the fourth year following the spill. Price inflation above 25 percent occurred during the first 6 months of the cleanup operation. These workers may be temporary additive workers--workers that would otherwise be unemployed or underemployed. If skilled workers (e.g. boat captains and helicopter pilots) and unskilled workers are attracted away from thier normal jobs by the temporary high compensation, some temporary adverse effects may occur to thier original or dependent fields of employment. In either case, a net increase in income to the communities and the State would be expected. A very large oil spill may also represent temporary lost opportunity for certain fields of employment (e.g., commerical fishing). See also Section IX.B.3.k of the Liberty Final EIS (USDOI, MMS, Alaska OCS Region, 2002b) for details. The same economic effects could occur whether the spill was in the Gulf of Alaska or farther south along the Canadian or U.S. west coast bordering on the Pacific Ocean.

(c) Effects of Subsistence Disruptions on the North Slope Borough's Economy

The cumulative effect of disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents, mainly through the loss of some part of those resources. See Section IV.F.8.n for effects on subsistence-harvest patterns.

m. Cultural Resources

(1) Cumulative Analysis

While oil and gas exploration and development in the Northwest NPR-A (as described for Alternative A Section IV.C.13 and the Preferred Alternative Section V.B.13) are the primary contributing activities in terms of cumulative effects analysis of cultural resources in the Planning Area, there are other contributing factors that, in some cases, may be of greater magnitude. These include permitted activities such as non-oil and -gas-related overland moves, scientific data gathering, recreational use by the public, and activities ancillary to BLM's management of the area. Activities outside the Planning Area would not be expected to have any impact on cultural resources within the Planning Area, though the effects on cultural resources across the North Slope would be additive for a greater overall cumulative result.

Cultural resources are not ubiquitous across the North Slope, as are (for example) soils, habitat, and wildlife. Because of the circumstances associated with their creation, the presence/location of cultural deposits--the physical remains of past human activity--are predictable only to a limited degree. As a result, most of the locales where they are present remain unknown. Therefore, it is difficult to assess what the cumulative impacts to the resource might be. Obviously, the more oil and gas associated activities that would occur, the more area that would be potentially impacted, and the greater the chance that locales of cultural resources would be impacted.

Generally speaking, cultural resources, because of their surface or near-surface stratigraphic contexts, are vulnerable to any surface or subsurface-disturbing activity. Unlike many paleontological deposits, cultural resources on the North Slope are not so deeply buried that they are well protected by nature. Because of this, cultural resources would be more likely to be impacted as the result of exploration than from development activities. This is because basic exploration activities such as seismic work, ice road and pad construction, and overland travel impact a much greater surface area than does the construction associated with development. Although snow cover and frozen ground may offer some protection to cultural deposits, they also disguise the surface, making cultural manifestations difficult to recognize and avoid. This circumstance is further complicated by the fact that most exploration-related operations occur in the low light conditions of winter. This points up the advisability of engaging in surveys of proposed activity areas and overland travel routes during the snow-free months preceding the initiation of winter exploration activities.

(a) Effects of Gravel Extraction

A significant potential impact to cultural resources would be the excavation of gravel for well pads, roads, and airstrips associated with development. Most prehistoric and historic sites are--for obvious reasons in a region that often seems to be more water than land--located on well-drained ground. On the North Slope, well-drained ground equates with gravel deposits, which are not common in the northern NPR-A. As a result, a gravel deposit that has some degree of surface exposure would likely have a cultural resources site associated with it. Therefore, the more gravel deposits that are excavated for the construction of permanent facilities associated with development, the more chances that significant impacts to cultural resources would occur.

(b) Effects of Natural Events

Most cultural deposits on the North Slope are revealed as the result of natural processes. Usually this occurs as a result of a locale having only a thin layer (or the absence) of organic soil, resulting in sparse vegetation and making the locale susceptible to wind erosion. In most cases this type of natural impact is viewed as positive rather than negative, as it reveals the presence of sites and usually generates no significant adverse effects. The action of flowing water, seasonal freezing and thawing (cryoturbation), thermokarsting, and solifluction can also reveal cultural deposits but can often cause significant negative impacts as well.

(c) Effects of a Large Oil Spill

The effects of a large terrestrial oil spill on a cultural deposit would be directly related to the time of year and the context of the resource. If the spill were to occur during the non-snow/unfrozen surface months, then the potential level of impact would be significantly higher. In an unfrozen context, surface or near-surface cultural resources could be easily impacted, primarily by being contaminated so that radiocarbon and other elemental assays would be valueless. In this case it is assumed that the majority of the impacts would occur as the result of the cleanup rather than the actual spill. During the frozen months, both a spill and the resulting cleanup would be considerably less impacting.

(2) Conclusion

The cumulative effects of oil and gas exploration and development within the Planning Area and across the North Slope would be expected to impact cultural resources to some degree. However, because of the nature of cultural deposits, (i.e., their generally unpredictable location and context on surface or near-surface), the magnitude of the impact is difficult to estimate. However, it is expected that if current procedures for survey and inventory before exploration and development activities were to be continued, the impact to the resource would be minimal. Cultural resources, like paleontological resources, are nonrenewable. Once they are impacted through displacement or contamination their value may be greatly compromised.

n. Subsistence-Harvest Patterns

(1) Cumulative Analysis

In addition to multiple sales under Alternative A, other activities that may affect subsistence resources and subsistence-harvest patterns on Alaska's North Slope include oil and gas development in the Northeast NPR-A, Federal and State offshore oil development, State onshore oil development, and oil and gas transportation by pipeline.

Future cumulative development in the NPR-A could include one or more of the three following scenarios:

1. Offshore Scenario--Development of an oil field in the Smith Bay-Dease Inlet area;
2. Central and Southern NPR-A Scenario--Development of potential oil fields inland; and
3. Kuukpik/ASRC Lands Scenario--Development of a field on Kuukpik lands near Nuiqsut. Under this scenario, development along the Colville River would increase over that associated with the Alpine and Fjord projects.

Because little baseline biological, habitat, or subsistence-harvest data has preceded oil development on the North

Slope, it would be difficult to disassociate the cumulative effects of oil development in the region from the relatively recent processes of extreme local social change. Proper assessment of cumulative effects on the North Slope is critical, but separating the effects of an oil-development project from those of general social change can be difficult.

Northwest NPR-A Planning Area exploration and development itself could affect subsistence resources because of potential oil spills, noise and traffic disturbance, or disturbance from construction activities associated with ice roads, pipelines, and landfalls. Noise and traffic disturbance might come from building, installing, and operating production facilities and from supply efforts. Impacts from oil and gas activities outside the NPR-A are additive to those within it.

Activities associated with exploration, facility construction, operation and maintenance, and oil spills have both disturbance and habitat impacts on terrestrial mammals, freshwater and marine fish, birds, bowhead whales, and beluga and other marine mammals. Direct effects include delay or deflection of resource populations' movements and mortality; indirect effects include destruction or degradation of habitat and changes in productivity.

Access to subsistence-hunting areas and subsistence resources--and the use of subsistence resources--would change if oil development were to reduce the availability of resources or alter their distribution patterns. Major factors considered in the effects analysis of subsistence-harvest patterns of the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut are: 1) heavy reliance on caribou, fish, birds, and bowhead whales in the annual subsistence harvest; 2) the overlap of subsistence-hunting ranges for many species harvested by these Native communities; and 3) subsistence hunting and fishing are central cultural values in the Inupiat way of life. Chronic cumulative biological effects to subsistence resources would affect their harvests. Potential effects from oil spills and noise disturbance could affect 1) seal hunting during the winter; 2) whale, seal, bird, and caribou hunting in spring; and 3) whale, seal, bird, walrus, and caribou hunting during the open-water season.

Cumulative effects to bowhead whales are a serious concern. If increased noise were to cause whales to deflect from their normal migration route, they could be displaced from traditional hunting areas, and the traditional bowhead whale harvest could be adversely affected. Ideally, ongoing seismic operations would be seasonally timed and monitored to prevent conflicts with the migration and the subsistence hunt. Most projected reasonably foreseeable development projects would be expected to be close to shore and away from traditional bowhead whale migration and harvest areas.

Any actual or perceived disruption of the bowhead whale harvest from oil spills and any actual or perceived tainting anywhere during the bowhead's inmigration, summer feeding, and fall migration could disrupt the bowhead hunt for an entire season, even though whales still would be available. Tainting concerns also would apply to polar bears, seals, fish, and birds. Biological effects on other subsistence resources might not affect species' distributions or populations, but disturbance could force hunters to make more frequent and longer trips to harvest enough resources in a given season. For beluga whales, more traditionally flexible hunting patterns could reduce the effects of noise and disturbance. Hunters can take belugas in ice leads and open water at various times from early May to late July. This seasonal flexibility could constitute possible mitigation against noise and disturbance effects. In the unlikely event that a large oil spill were to occur, it could cause potential short-term (but significant) adverse effects to long-tailed ducks and king and common eider populations. Subsistence-bird resources might only experience short-term, local disturbance, but such disturbance could cause waterfowl to avoid productive subsistence-hunting sites. For the spring subsistence-waterfowl harvest, cumulative loss of habitat from development activities and population losses from oil spills could significantly disrupt harvests. An onshore pipeline spill that contacted rivers and streams could kill many fish and affect these fish populations. Although polar bears are most often hunted opportunistically by North Slope subsistence hunters while in pursuit of more-preferred subsistence resources, a potential loss of polar bears from oil-spill effects could reduce their availability locally to subsistence users.

Limited monitoring data limit effective assessment of cumulative subsistence-resource damage; resource displacement; changes in hunter access to resources; increased competition; contamination levels in subsistence resources; harvest reductions; and increased effort, risk, and cost to hunters. Effects cannot be properly projected without monitoring harvest patterns and the effectiveness of mitigating measures, and any effective monitoring regime must include serious attention to traditional Inupiat knowledge of subsistence resources and practices. Development already has caused increased regulation of subsistence hunting, reduced access to hunting and fishing areas, altered habitat, and intensified competition from nonsubsistence hunters for fish and wildlife (Haynes and Pedersen, 1989). These trends show why it is vital to monitor subsistence resources and harvests. In a case study by Pedersen et al. (2000), they recommended that government, industry, and local subsistence representatives collaborate in assessing the interaction of subsistence patterns and the expansion of industrialized areas on the North Slope. They believed this coordination should include: 1) meaningful and increased participation by local subsistence representatives from affected Inupiat communities in leasing, exploration, development, and production activities; 2) direct involvement of local subsistence representatives and locally trained staff in the development of protocols to implement monitoring, assessment, and evaluation of the effectiveness of subsistence protection plans and mitigation; 3) a commitment to long-term collection of times series data on the quantitative, temporal, and spatial dimensions of household subsistence harvest activities in affected Inupiat communities to provide effective measures for monitoring, assessing, and evaluating effects on subsistence activities; and 4) more and better coordinated studies between industry and local subsistence representatives on the cumulative impacts on subsistence resource productivity, harvest activities, and harvester access.

(a) Native Views Concerning Cumulative Effects on Subsistence-Harvest Patterns

Cumulative effects from oil development have been, and continue to be, paramount concerns for North Slope residents. The North Slope Borough has articulated its concerns about potential effects to subsistence hunting and "about the cumulative impacts of all industrial and human activities on the North Slope and its residents. Consideration of these impacts must take into account: industrial activities occurring offshore and at existing oil fields to the east; scientific research efforts; sport hunting and recreational uses of lands; and the enforcement of regulations governing the harvest of fish and wildlife resources by local residents. To date, no agency has addressed the concerns of Borough residents over how cumulative impacts might affect life on the North Slope" (North Slope Borough, 1997).

Former Barrow Mayor Ben Nageak spoke at public hearings for the Northeast NPR-A IAP/EIS in Barrow in January 1997. He said one of the key issues in developing the Reserve was to identify "a mechanism for recognizing and mitigating the potential cumulative impacts of multiple industrial operations" (Nageak, as cited in USDOI, BLM, 1997b). At a Liberty Development Project information update meeting in November 1999, Ron Brower, head of the Inupiat Heritage Center in Barrow, asked about future leasing and development plans and noted that MMS seemed to be doing projects piece by piece when instead it should be studying cumulative impacts. He believed new data and new development projections were needed and wanted to see a "new blueprint [for development] from aerial flights to underwater impacts" (Brower, as cited in USDOI, MMS, 1998). At the same meeting, Maggie Ahmaogak, Executive Director of the Alaska Eskimo Whaling Commission, asked that MMS take into account cumulative risks.

Cumulative effects from oil development have been and continue to be paramount concerns to North Slope residents. Kaktovik resident Michael Jeffrey, testifying at hearings for the first offshore oil and gas lease sale, perceived early on a social impact from government actions, stating that there was a cumulative effect on the villagers from having to participate in hearings and meetings. People knew that the issues were important, so they had to take time off from working and hunting to attend. Jeffrey believed the documents to be too technical, and to facilitate villagers' familiarity with them, he suggested that timelines and schedules be extended in non-English-speaking communities so that there was enough time to translate documents (USDOI, MMS, 1979b). Sam Taalak, Nuiqsut's Mayor in 1982, saw the onslaught of cumulative activity 18 years ago: "We presently live at Nuiqsut and for the moment we're hemmed in from all sides by major oil explorations, even from the coast front" (Taalak, 1983, as cited in USDOI, MMS, 1983). Leonard Lampe, another former Mayor of Nuiqsut, noted that the village has begun to consider the long-term effect of oil development on their subsistence lifestyle and

Inupiat culture: "It's time to look at things seriously and ask if it's worth it. That's what the town is asking itself" (Lavrakas, 1996).

Thomas Napageak, Nuiqsut Native Village President and Chairman of the Alaska Eskimo Whaling Commission, has clarified some of these concerns. In a January 10, 1997, meeting with MMS in Anchorage over a possible Nuiqsut Deferral for OCS Lease Sale 170, Mr. Napageak explained that the people of Nuiqsut have begun to focus on cumulative effects because they are concerned that when the Northstar Project proceeds, it will be out there and affecting the community and its ability to harvest subsistence resources for 15 to 20 years. Such development directly affects Nuiqsut. Mr. Napageak wanted OCS Lease Sale 170 stipulations to deal with cumulative effects from the sale, and from other projects, and clear language about cumulative effects in the EIS. He wanted to see protective language developed for leases in the OCS Lease Sale 170 area that would extend to, and bind lessees with, leases from past sales. He believed such language would cover Nuiqsut's concerns about cumulative effects from other projected activities (Casey, 1997, pers. comm.).

At a scoping meeting in Nuiqsut for the Northeast NPR-A IAP/EIS, Mr. Napageak noted again the importance of assessing cumulative effects on subsistence resources and harvests, especially the cumulative and indirect effects of existing and potential oil development on Nuiqsut. He remarked, "Federal leasing cannot be examined in isolation as though none of this other development and potential development were going on" (USDOI, BLM, 1997a). At a BLM symposium on the NPR-A held later the same month, he reaffirmed this concern: "Accumulated impact effects that would hinder the community and the socioeconomics of the community, how it will be affected by Alpine and presumably by NPR-A, these...really need to be considered" (Napageak, as cited in USDOI, MMS, 1997b). At an information update meeting in November 1999 for the Liberty Development Project, Elders Ruth Nukapigak and Marjorie Ahnupkana reaffirmed local concern for ongoing effects from oil development, saying that Eskimo traditions of long ago were going away with the oil companies coming in (Ahnupkana, as cited in USDOI, MMS, Alaska OCS Region, 1999).

Without some mechanism to ensure subsistence hunters access to and through development areas and a protocol for defining "no-fire" zones around development sites, the overall ability to reach subsistence-harvest areas by local subsistence hunters would potentially be restricted. No ongoing monitoring efforts assessing subsistence-resource damage, resource displacement, changes in hunter access to resources, increased competition, contamination levels in subsistence resources, harvest reductions, increased hunter effort, increased hunter risk, and increased hunter costs have been established. Without a process in place for monitoring harvest patterns and the effectiveness of current mitigation measures, that would necessarily include serious attention to traditional Inupiat knowledge of subsistence resources and practices, no truly informed projection can be made about cumulative effects on subsistence on a systematic and regular basis. The need for an ongoing monitoring effort already has been demonstrated, as initial research has already shown that North Slope oil development has produced more regulation of local subsistence pursuits, reduced access to hunting and fishing areas, altered habitat, and intensified the competition by nonsubsistence hunters for fish and wildlife (Haynes and Pedersen, 1989).

In a forty-page, March 2002 letter to the U.S. Army Corps of Engineers, Nuiqsut's Kuukpik Corporation, the Native Village of Nuiqsut, the City of Nuiqsut, and the Kuukpikmiut Subsistence Oversight Panel voiced strong opposition to Phillips Alaska's proposed development of the Fjord and Nanuq satellite fields near the Alpine development project. They called for the COE to prepare an EIS to address the multitude of potential impacts they believe will occur from this expansion, particularly a proposed north-south connecting road in a development scenario that had been promoted as "roadless." They also want the COE and Phillips to address broken agreements and permitting lapses with Kuukpik over: (1) exceeding employment ceilings and aircraft flights at Alpine and winter drilling activity on the Colville Delta, (2) the proposed building of additional vertical support members (VSM's) for satellite developments when existing VSM's were supposed to be adequate, (3) yet to be delivered studies on caribou in the Colville River Delta and the Alpine Sociocultural Study report, and (4) poorly projected and analyzed drilling activity and pipeline impacts from the Tarn and Meltwater Projects. In its letter to the COE, Nuiqsut concluded: "In essence, this whole letter is about cumulatively significant impacts, ranging from the manner in which Alpine impacts have exceeded projections..." (Kuukpik Corporation et al., 2002).

Comprehensive subsistence-harvest and resource studies, monitoring, and stipulations are needed for assessing impacts on subsistence resources and hunter access to those resources. The innovative SAP formed under the leasing effort for the Northeast NPR-A Planning Area is made up of BLM, State, and local community representatives and has held a number of meetings since 1999. The group investigates conflicts between subsistence hunters and oil exploration and development activities, verifies the level of conflict, and proposes actions to the lessee and BLM for resolution. It is this type of group that may resolve some of the on-going monitoring, mitigation, and enforcement concerns with subsistence.

Any local or more extensive interconnecting road system could bring impacts from increased access to subsistence resources. More specifically, increased access could increase hunting pressure and increase competition for subsistence resources from both subsistence and nonsubsistence hunters. Increased harvest levels could potentially make game scarcer near the road proper. Reduced abundance and distribution of caribou and other terrestrial mammals would be expected along the road corridor from hunting, trapping, recreation, and tourist traffic associated with an interconnecting road. Increased hunting pressure in areas of high goose concentration could lead to declines in bird use of these areas. As a result of increased hunting pressure and reduced abundance, hunts could take longer as hunters would have to travel farther from the road corridor to successfully reach game or be forced to hunt in nontraditional areas. On the other hand, access could be diminished for subsistence hunters if the same problems were to arise in unitized oil fields where subsistence access has been curtailed near development sites by enforced no-fire zones.

(b) Cumulative Effects of Disturbance and Oil Spills on Subsistence Resources

The following is a summary of effects on subsistence resources from oil spills, disturbance, and habitat loss.

Terrestrial Mammals: Cumulative oil and gas development on the North Slope could result in a long-term displacement and/or functional loss of habitat for CAH, TLH, and WAH caribou over the life of the sales. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oil fields. Future State oil-lease sales on the Arctic Slope between NPR-A and ANWR, and in the foothills of the Brooks Range would increase the amount of activity associated with oil exploration and development within the CAH range. Future State offshore leases in the Beaufort Sea could expose TLH and CAH caribou to additional activities related to oil and gas development through onshore facilities to support offshore leases.

The alteration of more than 8,000 acres of tundra habitat in the Prudhoe Bay area has not had any apparent effect on the distribution and abundance of other terrestrial mammals, with the possible exception of arctic foxes that apparently have increased near the oil fields. Muskoxen have continued to expand their range westward across the North Slope from an introduced population in the ANWR. There are no apparent effects on grizzly bears, wolves, and other terrestrial mammal populations associated with this development.

Cumulative impacts to caribou could be reduced by not allowing leasing in the most sensitive areas; by consolidating facilities (especially reducing the number of roads); by reducing the footprint of development; by prohibiting roads between fields; and by restricting surface and air traffic, humans on foot, and other activities during the calving season.

Freshwater Fish: Wide-ranging increases in impacts to arctic fish populations found on the North Slope would not be anticipated based on the cumulative analysis. Also, synergistic impacts to fish from disturbance related to oil and gas production in this plan would not be anticipated. Countervailing effects related to extraction at gravel sites would be possible in certain situations. Past reclamation of deep pits that have been mined has proved beneficial when new habitat for arctic fish species has been established.

Marine Fish: The additional effect of seismic surveys and construction-related activities above those expected from Alternative A would be anticipated to be proportional to the number of future activities. Effects on marine fish populations could be greater if there were insufficient time for full recovery between these activities. Offshore cumulative case oil spills would be expected to have mostly sublethal effects on marine fish populations. Spills that might enter coastal waters would be expected to affect a greater percentage of fish than estimated for Alternative A. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill would be expected within 3 to5 years.

Birds: Overall cumulative effects of oil industry activities on birds potentially could be substantial in the case of loon species and king eider, and significant in the case of long-tailed duck and king and common eiders--primarily as a result of mortality in the unlikely event a large oil spill were to occur. Although the chance of oil-spill occurrence is relatively small, the potential would be highest for contact with bird concentrations in the vicinity of primary support facilities. Also, as a result of the apparent decline in populations of some species (for example, several sea duck species), and the challenge of recovering spilled oil, particularly in broken-ice conditions, there is uncertainty as to the ultimate effect of any spills on bird populations. Disturbance could cause some small loss of productivity and lowered fitness or survival of birds occupying areas with high levels of industry activity, but these effects would not be expected to be significant. Effects resulting from oil and gas development activities likely would be additive to naturally occurring effects or those occurring as a result of other activities in Northwest NPR-A.

Bowhead Whales: Overall, exposure of bowhead whales to noise from oil and gas operations would not be expected to kill any bowhead whales, but some could experience temporary, nonlethal effects. Whales exposed to spilled oil likely would experience temporary, nonlethal effects although prolonged exposure to freshly spilled oil could kill some whales. The incremental contribution of effects from any Northwest NPR-A oil and gas development added to the overall effects under the cumulative case would not be likely to result in an adverse effect on the bowhead whale population.

Beluga Whales and Other Marine Mammals: In the Beaufort Sea, noise and disturbance from on-ice seismic surveys during any one year would affect breeding ringed seals in that area for no more than 1 year, because only a small fraction (less than 1%) of the population would be likely to be exposed to and potentially be disturbed by the operations. Subsequent surveys in other areas during other years have disturbed different seals and would be expected to in the future. A few pups could be lost because mothers might abandon maternity lairs or because seismic vehicles might destroy snow lairs along the shot line. Past seismic exploration on the sea ice over several years might have killed some pups and displaced some seals locally very near seismic lines (within 150 m) during operations for that ice season. However, these additive effects probably were not significant to the seal population above changes in distribution associated with changes in sea ice.

Noise and disturbance effects on seals, walrus, and beluga and gray whales in the Beaufort Sea from an estimated total of more than 450 helicopter round trips per month and at least 200 vessel round trips per month should last only a few minutes to less than an hour for any one disturbance event. Disturbance reactions of seals, walrus, and beluga and gray whales would be brief; they would return to normal behavior patterns and distribution shortly after the boat or aircraft had left the area. Effects would not be expected to be additive or synergistic because disturbance reactions most likely would involve different animals and occur in different areas. Seals and walrus also could get used to aircraft and vessels, if they were to encounter them routinely.

Ringed and bearded seals, walrus, and beluga and gray whales have been exposed to oil-exploration activities in the Beaufort Sea, including seismic surveying, drilling, air and vessel traffic, dredging, and gravel dumping. Activities in the Beaufort Sea--as well as barge traffic to the North Slope, and some icebreaker activity to support oil exploration--might increase in the future. These activities could affect how seals are distributed near the activity for 1 season (or less than 1 year) during high levels of activity. However, some seals would habituate to marine and air traffic, industrial noise, and human presence. Displacement from cumulative industrial activities would not be likely to affect the overall abundance, productivity, or distribution of ringed and bearded seals, walruses, and beluga whales in Alaska's Beaufort Sea.

Cumulative noise sources that could affect beluga and gray whales would be from seismic activities and drilling (and other noise associated with exploration, development, and production operations); vessel and aircraft traffic; construction; and oil-spill cleanup. Underwater industrial noise, including drilling noise measured from artificial gravel islands, has not been audible in the water more than a few kilometers away. Because the beluga whale's migration corridor is far offshore of the barrier islands, seismic exploration, drilling, development, and production noise from most development in the nearshore area would not be likely to reach many migrating beluga or gray whales. Noise also would be unlikely to affect the few whales that could be in lagoon entrances or inside the barrier islands because of the rapid attenuation of industrial sounds in a shallow-water environment. Because island and pipeline construction would occur during the winter and be well inside the barrier islands, it would not be likely to affect beluga or gray whales.

An important habitat for marine mammals is the active-ice, or ice-flaw, zone. Seals, walrus, and beluga whales would be most vulnerable to spills contacting this zone; polar bears would be most vulnerable to spills contacting the flaw zone or the coast. Offshore spills would obviously pose a higher risk to marine mammals than onshore spills, but along the coast of the Planning Area, some aggregations of seals and walrus and a small number of polar bears could be contaminated by onshore spills that reach marine waters and could suffer lethal or sublethal effects. The most noticeable effects of potential oil spills from offshore oil activities would be through contamination of seals, walrus, and polar bears, with lesser effects on beluga whales. Losses from an estimated 1 to 3 oil spills of 1,000 bbl could be: < 1,000 seal pups and adults, < 1,000 walrus calves and adults, and < 30 polar bears (out of a population of 2,272 to 2,500 bears). These losses would be likely to be replaced within one generation or less (with a generation of about 5 years for ringed seals and at least 7 years for polar bears). Beluga whales would be likely to suffer low mortality < 10 whales), with population recovery expected within 1 year.

(c) Cumulative Effects on Habitat

The gradual and continual loss of habitat associated with oil and gas development on the North Slope has been documented in a number of studies (Walker et al., 1986; Walker, 1986; Walker et al., 1987; Walker, Cate, Brown, and Racine, 1987; Walker and Walker, 1991). Walker et al. (1987), in a geobotanical mapping study, concluded that by 1986 the Prudhoe Bay oil field occupied about 500 km^2 between the Kuparuk and Sagavanirktok Rivers that included 359 km of roads, 21 km^2 of tundra covered by gravel, and 14 km^2 that had been flooded by road and gravel-pad construction. Growth since 1968 had proceeded at a constant rate, and it was noted that construction at the Kuparuk Field was proceeding at a similar rate, thus doubling the total rate of development. Walker et al. (1987) considered these to be major landscape impacts and recommended that the implications to wetland values, wildlife corridors, and caribou calving grounds be addressed. It was suggested that such studies (which are necessary for assessing cumulative impacts in the region) would be hampered by the lack of baseline information at Prudhoe Bay prior to development. Nevertheless, methods needed to be developed to assess cumulative impacts so as to foster better comprehensive regional planning on Alaska's ACP. Although recent innovations in the oil industry have reduced the size of an oil field "footprint" (Robertson, 1989), habitat loss must continually be assessed and such information used to keep track of cumulative effects to wildlife populations, subsistence resources, and subsistence harvests.

Development has directly covered about 7,000 acres through the construction of 350 mi of roads, 90 pads, and 14 gravel mines (Table IV-09). The mines cover more than 1,500 acres. Development in the Prudhoe Bay and Kuparuk areas has directly affected about 9,500 acres because of gravel excavation and filling, and indirectly affects many adjacent acres of vegetation. The total affected acreage is a small part of the ACP, and cumulative effects probably are not significant to the overall productivity of tundra plants in this area. It is important to remember that ongoing oil development projects--such as Alpine, Badami, and Northstar--have required a much smaller acreage footprint than existing and past projects on the North Slope.

Alterations from offshore production platform-island construction, trench dredging, and pipeline burial would be expected to affect some benthic organisms and some fish species within 1 km for less than 1 year or season. These activities also could temporarily affect the availability of some local food sources for these species up to 1 to 3 km (0.62 to 1.9 mi) distance during island construction, but these activities would not be expected to affect food availability for seals over the long term. The effect of future onshore facilities siting (dust fallout, thermokarst, and hydrologic change) on bird populations, though additive, would be significantly less severe, because they would be restricted to much smaller areas and result in less habitat loss. Pads, gravel quarries, pipelines, pump stations, and gravel roads that cross much of the Central Arctic herd's calving range actually have destroyed only about 3 to 4 percent of the tundra grazing habitat for caribou.

An increase in abundance of deciduous shrubs (less favorable caribou forage), especially birch, and a decline in the abundance of grasses/sedges such as Eriophorum vaginatum (an especially important food of calving caribou) would be predicted if a significant increase in average temperature were to occur in the Arctic--an effect that could reduce the productivity of caribou habitats on the Arctic Slope (Anderson and Weller, 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests)--a less favorable habitat for tundra mammals and some bird species--thereby adversely affecting their populations (Anderson and Weller, 1996).

(d) Effects along the Transportation Route

Statistically, the most likely number of spills from TAPS tankers is 9 (Table App9-15). In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mi Economic Exclusion Zone boundary except in the north central Gulf of Alaska, where the transportation route leaves Prince William Sound. Oil spilled along most of this route would tend to move parallel to the Alaska Peninsula and the Aleutian Islands, rather than toward the coast, where vulnerable resource populations could be contacted. Oil spilled from a tanker after exiting Prince William Sound could contact the Kodiak and Alaska Peninsula areas.

Ongoing tanker transportation of oil from Valdez to the West Coast could cause serious and long-term, cumulative effects on some subsistence resources in Prince William Sound and the Gulf of Alaska, especially on marine and coastal birds, sea otters, and harbor seals, with less severe effects on river otters and brown and black bears. Economic losses could be expected for 2 years to the commercial-fishing industry, and a serious loss to the subsistence fishery also would be expected. Effects on species along the tanker transportation route south of the Gulf of Alaska would be expected to be about the same or less than those described above because there are few and limited subsistence harvests of any species along this corridor outside Alaska. The threat of an oil spill to subsistence fisheries, particularly salmon, in the Pacific Northwest and the small subsistence gray whale hunt of the Makah tribe on the Washington coast along the tankering corridor appears to be limited.

(e) Arctic Climate Change and Global Warming

The Council on Environmental Quality (CEQ) bases its guidance on the NEPA regulations which mandate that all "reasonably foreseeable" environmental impacts of a proposed federal action have to be considered in the NEPA assessment. The CEQ considers that there is adequate scientific evidence (for example, in the Second Assessment Report by the International Panel on Climate Change) indicating that climate change is a "reasonably foreseeable" impact of greenhouse gas emissions (CEQ, 1997; IPCC, 2001).

In and of itself, greenhouse gas emissions from exploration, development, and production in NPR-A are unlikely to significantly contribute to Arctic climate change nor is NPR-A infrastructure likely to bear the brunt of any significant climate change effects; nevertheless, these activities remain part of the long-term and additive phenomena of North Slope and Arctic oil development that will continue to play a fundamental role in the changing ecosystem of the Arctic (NRC, 2003).

1) The Greenhouse Effect

Trapped radiation from the sun warms the lower part of the Earth's atmosphere. Some of this warmed air radiates energy up and out of the atmosphere, and some radiates down to the Earth's surface; in this way, the Earth is kept hotter than it would be without this process. This is referred to as the "greenhouse effect." Climate change concerns have arisen over the increased release of greenhouse gasses by human-produced sources over natural beneficial levels and their increasing concentrations in the atmosphere. Because greenhouse gasses prevent heat from escaping into space, they have contributed to artificially higher global air temperatures. A warming atmosphere and ocean make a great deal of extra energy available for the creation of weather. World weather has seen an increase in the severity of storms, droughts, rainfall, and heat waves, and such weather anomalies are expected to continue (AMAP, 1997; Kerr, 2001; EPA, 1998; MMS, 2003).

2) Greenhouse Gasses

The main greenhouse gas contributors are carbon dioxide from the burning of fossil fuels and deforestation; methane from rice paddies, farm animals, wetlands and the production of natural gas; nitrous oxide increases from the global use of fertilizers; ozone; and man-made chlorofluorocarbons (CFC's) (harmful to the ozone layer). The main drive behind climate change is the increasing amount of carbon dioxide in the atmosphere. Its level has risen by a third since the industrial revolution started in the 1760's, and methane concentrations have more than doubled since pre-industrial times. Recent studies suggest that anaerobic decay at the bottom of man-made reservoirs could be responsible for up to a fifth of global methane emissions. If decomposition of tundra exceeds primary production, large carbon pools in tundra soil could add to atmospheric carbon dioxide and climatic warming; in fact, some experts believe that this source of stored carbon, if released "could increase the atmospheric concentration of carbon dioxide by more than the cumulative contribution from fossil fuels through 1995" (AMAP, 1997; EPA, 1998; MMS, 2003).

3) Global Warming

If nothing is done to curb emissions of carbon dioxide, the amount in the atmosphere could double pre-industrial levels by the end of the 21st century. At current rates of release, average global temperature could raise from 2.5 to 10 °F (1.4 to 5.8 °C) by the year 2100. This rate of warming appears to be greater than any observed over the past ten millennia. General predictions of an increasing greenhouse effect are: 1) sea level rise between 15 and 95 cm (5 to 3 ft) by 2100 and 2) more extremely warm days and fewer extremely cold days. These factors would predicate an increase in floods and droughts. Models predict that coastal regions will become wetter and interior regions will become drier. Some areas will likely experience greater effects and other areas less, but prediction models are not sophisticated enough at the present time to make accurate regional predictions of such effects (AMAP, 1997; Kerr, 2001; EPA, 1998; USGCRP, 2000).

The Arctic is considered one of the most extreme environments on the planet and because sea ice, snow cover, glaciers, tundra, permafrost, boreal forests, and peat areas are all sensitive indicators of change, global climate models indicate that global warming will have its most acute impacts in polar regions (Center for Global Change, 2003). In Alaska, air temperatures have increased 4 °F since the 1950's and 7 °F in the Interior in winter. Over the past 30 years, air temperatures have increased the greatest in winter and spring in the interior of Alaska and north of the Brooks Range. Summer sea ice has decreased 3 percent per decade since the 1970's and multi-year sea ice has decreased 14 percent since 1978 and thinned 4 inches per year from 1993 to 1997 (Groat, 2001; ADN, 1999). Breakup begins 40 days earlier in Barrow than it did 50 years ago, and permafrost has warmed by about 3.5 °F since the 1960's (Schneider, 2001).

In 1995, 2,000 scientists, experts, and government officials of the United Nations sponsored Intergovernmental Panel on Climate Change (IPCC) concluded: "The balance of evidence suggests that there is a discernible human influence on global climate." In 2001, they stated that "most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations... and is unlikely to be entirely natural in origin." The U.S. alone pumps out a quarter of the world's carbon dioxide emissions. Under-developed nations have even advanced the concept of being paid climate compensation help them cope with the inevitable impacts of climate change from the First World nations who produce the greatest greenhouse gas emissions to (New Scientist, 2002). Concern about increased global temperature has fueled recent scientific research and political debate over "global warming" and its causes and effects. Even British Petroleum's chief executive, John Browne, has acknowledged that the oil industry is a responsible contributor to global warming; he has pledged $15 million to fund the 10 year Carbon Mitigation Initiative that will research how BP can better capture its carbon emissions (Kerr, 2001; Spiess, 2000; BP, 2001).

4) Sea Ice and Snow Cover

Another factor of global climate change is its uneven distribution on the planet. Models indicate the atmosphere heating faster at the poles than other places on the planet. In the northern part of the northern hemisphere the largest temperature rises are predicted, and they would occur in winter. Global warming would be felt most acutely in the Arctic because diminishing sea ice and snow cover—that normally cool the climate by reflecting solar energy back to space—would cause the greatest relative temperature increases. Since the 1950's, the extent of sea-ice in the northern hemisphere during spring and summer decreased by about 10 to 15 percent, and a decline of 40 percent in Arctic sea-ice thickness during late summer and early autumn has occurred during the past several decades. In the Beaufort Sea, the loss of ice has been dramatic. In 1996, there was 300,000 km^2 of open water; this rose to 700,000 km^2 in 1997 and 970,000 in 1998 (Talbott, 2000). Changes in ice and snow cover would, in turn, affect local weather, cloud distribution, and ocean circulation (AMAP, 1997; ADN, 1999). Polynyas could become bigger and their numbers increase. With more open water, more moisture would be lost to evaporation and cloud cover would increase. Increased cloud cover could decrease the amount of solar energy reaching the earth and actually slow down the warming trend. In September 2003, the Arctic's largest ice shelf showed its first signs ever of breakup, and a study by NASA has actually predicted that the Arctic Ocean will be completely devoid of summer ice before the 21st century has ended (Mason, 2003; NASA, 2002). These Arctic alterations would then be expected to affect global climate although the models and mechanisms for predicting actual global consequences are still not clearly understood. Are observed temperature changes in the Arctic directly related to global warming? The answer is not clear because data often are not known for extensive time periods, and when data are available, often they are not comparable. To separate trends due to global warming from those due to normal climatic variation is difficult although recent studies report that warming trends and the decrease in ice cover over the last two decades cannot be explained by natural processes alone (AMAP, 1997; EPA, 1998; Vinnikov et al., 1999; Johannessen et al., 2002).

Ice also serves as a barrier to wind and wave action and limits their effects. Less Arctic ice means more wave action that can cause more erosion on Arctic shores. Later ice freezeup and earlier melting would further increase active wind and wave action. Less ice and warmer air could increase cloud formation and alter regional weather patterns although predicting the influence of clouds and large scale weather changes are still very problematic with present modeling. In terms of carbon dioxide exchange from the ocean into the air, ice is a limiting factor. Ice also limits the penetration of light into water; extensive sea ice changes and increased light could influence the production of sea algae (see section on ultraviolet radiation below) (AMAP, 1997; EPA, 1998).

5) Observed Arctic Effects

Besides sea-ice effects, observed Arctic changes include: 1) increased snowfall; 2) drier summers and falls; 3) forest decline; 4) reduced river and lake ice; 5) permafrost degradation; 6) increased storms and coastal erosion; 7) cooling in the Labrador Sea (associated with increased sea ice melt); and 8) ozone depletion. Precipitation in the Arctic has increased 15 percent in the past 40 years, and there is a trend toward an earlier spring melt (AMAP, 1997). Permafrost degradation and thermokarsting will continue to cause forest damage, roads and buildings to sink, riverbanks to erode, and alterations in tundra vegetation. IPCC studies show that Arctic warming trends are allowing boreal forests to expand northward at about 100 to 150 km/°C of average temperature increase, and, although forests may be expanding northward, warming has increased the incidence of forest fires and damage from insect infestations. Extremely warm temperatures sparked widespread wildfires in the Canadian Arctic during the summer of 1995—the hottest June in Canada's recorded history—forcing the evacuation of Tulita, a small MacKenzie Basin community (Peterson and Johnson, 1995). Warmer temperatures on Alaska's North Slope are promoting the growth of dwarf birch, alder, and willow shrubs (Schneider, 2001). A very visible recent impact of climate change on boreal forests is the destruction since 1987 of nearly 4 million acres of mature white spruce on Alaska's Kenai Peninsula by the spruce bark beetle. Temperature increases have allowed the beetle to flourish. Increased freshwater runoff from Arctic rivers is making seawaters fresher while the salinity of equatorial waters is increasing. Many climate experts believe this increased precipitation and ice melt in the north and increased evaporation in the south marks a true change in climate. This process could also contribute to the greenhouse effect because as warming reduces ice formation, currents could slow, less water could be transported, and less carbon dioxide taken out of the atmosphere (AMAP, 1997; EPA, 1998; USGCRP, 2000; Groat, 2001; Environment Canada, 1997).

6) Ozone Depletion

Ozone is an atmospheric gas that blocks harmful ultraviolet radiation (UV) from reaching the Earth. At present, the stratospheric concentrations of ozone are decreasing, and the highest rates of reduction are occurring in the polar regions. The emission of CFC's is the major culprit in depleting the ozone layer although a general downward trend in ozone depletion measured at 8 percent per decade in the winter and spring has been documented. In addition, ozone reductions change the atmosphere's temperature regime, and temperature changes produce alterations in climate. Such climate change may actually feed ozone depletion in the Arctic by cooling the stratosphere and changing circulation patterns that bring low-ozone air northward. This general ozone depletion raises concerns about the overall light environment and potential health effects to humans, as well as Arctic plants and animals (AMAP, 1997; EPA, 1998).

7) UV Radiation

Potential human health effects from UV radiation stem from the fact that Arctic snow cover reflects back up to 90 percent of the UV radiation; also cloud layers can reflect UV radiation back to the snow, and this back and forth reflection process can increase the UV effect even more. In general, UV exposure is doubled by snow cover. Increased incidents of snow blindness could occur and increase the risk to eye diseases. For each 1 percent decrease in ozone, the risk of skin cancer increases 2.5 percent (in a white population), but by adding reflected light to the process, the risk rises to 3.2 percent. Normally, indigenous Arctic peoples are less at risk because of their darker skin and the extent to which they wear protective clothing. UV radiation also been shown to suppress the immune system in the skin which can lead to skin cancer. Clouds can shield UV exposure as can man-produced emissions of sulfur dioxide that form the UV blocking sulfate aerosols in Arctic haze (AMAP, 1997; Cahill and Weatherhead, 2001).

Increased UV radiation produces a variety of effects on Arctic flora; likely long-term changes would be UV tolerant species gaining a competitive edge on those species less tolerant and an overall alteration in the composition of the floral community. UV exposure can slow down decomposition of plant matter, and increased UV radiation in the Arctic could slow the entire plant nutrient cycle. UV radiation stresses plankton growth in freshwater ecosystems and makes it less digestible to zooplankton. The growth of marine algae can be reduced by increased UV radiation, but current research cannot predict overall regional productivity changes. Zooplankton can be very sensitive to UV radiation, and UV increases would likely impact the more sensitive species the most, causing reductions in abundance and alteration in food webs. Fish that produce eggs or larvae in shallow waters in the spring or marine species that have eggs floating close to the sea surface could be particularly vulnerable to UV radiation. Larger marine and terrestrial mammals have not been adequately studied as to UV effects, but potential harm could come from the exposure of eyes and skin areas unprotected by fur or feathers (AMAP, 1997; Cahill and Weatherhead, 2001).

There is mounting speculation that increasing UV radiation could actually increase carbon dioxide production in rivers, lakes, wetlands, and marine waters that could lead to an increased concentration of carbon dioxide in the atmosphere. Such an increase on carbon dioxide would exacerbate the greenhouse effect (AMAP, 1997).

8) Infrastructure

Permafrost thawing will continue to damage roads, buildings, and contribute to eroding coastlines and increase building and maintenance costs. Already the cost of shifting buildings, broken sewer lines, buckled roads, and damaged bridges causes $35 million worth of damage in Alaska annually. In Kotzebue, the local hospital had to be relocated because it was sinking into the ground (ARCUS, 1997). Sea-level rise and flooding will threaten buildings, roads, and powerlines along low Arctic coastlines, and combined with thawing permafrost, it can cause serious erosion. Kaktovik's 50-year-old airstrip has begun to flood because of higher seas and may need to be moved inland (Kristof, 2003). Shore erosion in Shishmaref, Kivalina, Wainwright, and Barrow in Alaska and Tuktoyaktuk at the mouth of the MacKenzie River in Canada has become increasingly severe in recent years, as sea-ice formation occurs later, allowing wave action from storms to cause greater damage to the shoreline. Eventually some of these communities will be forced to relocate. The duration of ice road usefulness in the Arctic has already diminished by weeks and has led to an increased need for more permanent gravel roads. But gravel roads are more prone to the effects of permafrost degradation, thermokarst, and consequent settling that increases maintenance costs. Gravel roads also contribute to the fragmentation of landscapes and habitats that can lead, through time, to reduced species' productivity. Such an impact on species is a threat to subsistence livelihoods. Oil companies have reported that warming Arctic temperatures make the operation of oil field compressors less efficient and reduce oil production. Unstable permafrost could affect undersea pipelines; sea-level rise could compromise the effectiveness of gravel production islands and submerge barrier islands that afford protection to nearshore production sites; an increase in storm severity combined with longer periods of broken ice could also increase the threats to these facilities and add difficulty to oil-spill cleanup. More positive effects from Global warming include the possibility of an ice-free shipping route through the Northwest Passage; shipping products from Japan to Europe would save 10 to 15 days. In addition, less sea ice would likely facilitate oil exploration and extraction (NRC, 2003; Smith, 2000; Brown, 2003; Schneider, 2001; Crary, 2002; BLM 2002; Hopkins 2003; New Scientist, 2001;ADN, 2002; UNEP, 2002; ADN, 1993; EPA, 1998; USGCRP, 2000; Groat, 2001; Vorosmarty et al., 2001; Environment Canada, 1997; IPCC, 2001).

9) Subsistence Resources

Arctic resource systems are extensive but also extremely sensitive and, therefore, quite vulnerable to climate change (Berner, 2002). Continuing permafrost thawing and sea ice melting will continue to threaten important subsistence habitats and species. Increased salinization and coastal erosion from storm surges will produce profound changes to river deltas, often the most productive areas for subsistence hunting and fishing.

Reduced sea ice threatens the survival of polar bears, and because ice now forms later in the fall, bears find it increasingly difficult to reach sea ice to hunt seals and den at the proper time. Reduced sea ice means loss of habitat for other marine mammals, including ring seals, walrus, and beluga whales; habitat impacts could affect their population numbers and distribution.If the ice edge melts past the continental shelf, walrus will find the water too deep to dive to the sea floor for food, and sea-level rise could inundate marine mammal calving and pupping haulouts. A diminishing ice pack might actually increase the range of certain whales, such as the bowhead; alternatively, this same situation could diminish phytoplankton production, which would lead to declines in key cetacean prey species, such as copepods and plankton feeding fish that are preferred food for narwhals and beluga whales. A reduced ice pack also could expose whales to increased Arctic ship traffic (Burns, 2000). The timing and sequence of whale migration may also be a function of ice cover and could negatively affect the feeding and reproduction of ice-associated cetaceans, such as bowheads and belugas. Changes to polynyas and ice leads, important in the distribution and migration of bowheads in winter and spring, could have a major impact on bowhead behavior (Lowry 2000; Parson et al., 2001; NRC, 2003; EPA, 1998; USGCRP, 2000; Environment Canada, 1997; IPCC, 2001; BESIS, 1997).

Increasing temperatures will favor the spread of birch forests and reduce important tundra caribou forage. If warming produces increased precipitation, the snowpack may actually increase and spring breakup may be delayed. This delay could change the availability of caribou food sources. Also, a deeper snowpack makes travel and digging through it for forage more difficult. Because female caribou calve at specific times and locations, weather and snowpack changes become added stressors. Observations from Banks Island in the Canada's Northwest Territories see caribou migrations changing based on of changes in sea ice freeze-up and breakup. Increased temperatures also increase the likelihood of mosquito harassment of caribou. Many populations of seabirds, wildlife, and marine mammals have already been displaced or reduced, and present sea ice changes have been linked to declining health and birthrates in polar bears (Parson et al., 2001; NRC, 2003; EPA, 1998; USGCRP, 2000; Environment Canada, 1997; IPCC, 2001; BESIS, 1997; Russell, 1993).

With a longer ice-free season, water will warm in Arctic lakes and ponds, leading to possible higher productivity for water life forms. Changes in fish species composition and productivity in ocean fisheries could also be expected. Global warming may be behind plummeting herring and salmon populations, especially in the Yukon River where a warm water parasite has infected fish; global warming has altered the timing for some salmon runs and this stresses salmon survival; in other areas of the Arctic, the salmon's range seems to be expanding (Borenstein, 2003; Parson et al., 2001). One study singles out Arctic habitat as the most vulnerable to climate change and estimates that 20 percent of the existing species could die off by the end of the century due to habitat loss (Lawless, 2000; Schneider, 2001). The Canada Country Study has called these potential climate change impacts "ecosystem shifts outside the limits of historical experience" (Crary, 2002).

If the present rates of climate change continue, changes in diversity and abundance to Arctic flora and fauna are likely to be significant, but at the same time these impacts "cannot be reliably forecast or evaluated" and "positive effects such as extended feeding areas and seasons in higher latitudes, more productive high latitudes, and lower winter mortality may be offset by negative factors that alter established reproductive patterns, breeding habitats, disease vectors, migration routes, and ecosystem relationships" (IPCC, 2001).

10) Subsistence Practices

Continuing sea ice melting and permafrost thawing will threaten subsistence livelihoods. Typically, Arctic peoples have settled in particular locations because of their proximity to important subsistence food resources and dependable sources of water, shelter, and fuel. Northern peoples and subsistence practices will be stressed to the extent (1) settlements are threatened by sea ice melt, permafrost loss, and sea-level rise, (2) traditional hunting locations are altered, (3) subsistence travel and access difficulties increase, and (4) as game patterns shift and their seasonal availability changes. Large changes or displacements of resources are likely, leaving little option for subsistence communities: they must quickly adapt or move (Langdon, 1995; Callaway, 1995; New Scientist 2001; Parson et al., 2001; AMAP, 1997, ADN, 1997; Weller et al., 1998; IPCC, 2001). Great decreases or increases in precipitation could affect local village water supplies, shift the migration patterns of land mammals, alter bird breeding and molting areas, affect the distribution and abundance of anadromous and freshwater fish, and limit or alter subsistence access routes (particularly in spring and fall) (AMAP, 1997). Changes in sea ice could have dramatic effects on sea mammal migration routes, and this would, in turn, impact the harvest patterns of coastal subsistence communities and increase the danger of hunting on sea ice (Callaway, 1999; Bielawski, 1997). Between 1980 and 2000 three sudden ice events caused Barrow whalers to abandon their spring whaling camps on the ice lead (George et al., 2003; USGCRP, 2000; Groat, 2001).

Because polar marine and terrestrial animal populations would be particularly vulnerable to changes in sea ice, 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 would be expected

(IPCC, 2001; NRC, 2003).

11) Traditional Knowledge on Arctic Climate Change

a) Russia

Chukchi Natives from Chukotka have experienced for the first time in memory the Chukchi Sea being ice free in winter. Others have seen the tundra dry up and reindeer starve; they have cut open salmon and found unknown insects inside. Willows have begun to grow in places they never did before. Fresh gray whale meat smells rancid "like medicine" and sled dogs refuse to eat it (McFarling, 2002).

b) Canada

Observations by Canadian subsistence hunters and biologists of skinnier, weaker seal pups are presumed to be related to temperature and timing of ice melt (Tynan and DeMaster, 1997). Canadian Natives on Banks Island, Northwest Territories, report that travel for hunting has already become more difficult because of melting permafrost and its effects on terrain (Raygorodetsky et al., 1997).

Freezing rain and less snow in spring have also made hunting more difficult. Hunters speculate that changes in cloud conditions are affecting visibility and hunting ability. Thinner sea ice means impeded access and increased danger to those hunting or whaling offshore, yet thinner, later forming and earlier melting sea ice also expands the season for open water hunting (Freeman, 1994; Hom, 1995). There are documented cases of cetacean range changes related to temperatures in 1980's, and recent Native observations of distribution changes of killer whales, bowheads, belugas, narwhals, and bearded and ring seals thought to be related to climate change (Northern Climate Exchange, 2003).

Canadian Inuit have observed the impacts of thinner ice on moose travel and survival, and other Natives have noted that species such as mule and white-tailed deer, elk and cougar are expanding their range northward in the Yukon (Tynan and DeMaster, 1997; York, 1995). Banks Island Natives attest to muskoxen being born earlier and polar bears coming out of dens earlier and believe this behavior is because of an earlier onset of spring. Data from Banks Island, Northwest Territories indicates that changes in timing of sea ice freeze-up and break-up are interfering with annual caribou migrations (Raygorodetsky et al., 1997). Long-term data set using information from hunters in the Mackenzie River District (1970-1991) correlates spring melt with breeding success of geese (Maarouf and Boyd, 1997). In Nunanvut, Canada, the Inuit have begun to call the weather "uggianaqtug"—like a familiar friend acting strangely (McFarling, 2002).

Sheila Watt-Cloutier, president of the Inuit Circumpolar Conference, lives on Baffin Island in Canada's high Arctic. She observed: "The ice is thinning and people are falling through it." She has seen Inuit families find themselves bogged down in mud form melting permafrost, following early thaws. Sea ice is breaking up earlier and seals are harder to reach for hunters and bears. Watt-Cloutier observes: "A threat to our country food isn't just a threat to our health and well-being; it's a threat to our cultural survival" (Armstrong, 2003).

Observation from Peter Ernerk from Rankin Inlet, NWT relates: "The sun seems to be stronger than it used to be, especially this past spring when I noticed its strength during my big circle travel by snowmobile from Rankin Inlet to Baker Lake, Gjoa Haven, Spence Bay, Pelly, Repulse, Chesterfield Inlet and return. Lypsal [lip protection] didn't seem to have its usual strength..." (Enerk, 1994).

Norma Kassi, of the Vunut Gwich'in people from Old Crow in the Yukon Territory, reflects their dependence on the Porcupine caribou herd: "Our people are directly affected by global climate change... there are no compromises we can make. There are no changes we can make in these old ways. We cannot be compensated for any damages that might occur to our land, the birds, animals, water, fish... We have no alternatives to our way of life. This is the only one we know. Without this way of life, we will disappear... " (Kassi, 1993).

Rosemarie Kuptana, an Inuit from Sachs Harbour, states: "We've had hunters fall through the ice because it looks different from what our parents taught us" (Jaimet 2000). She continues: We don't know when to travel on the ice and our food sources are getting further and further away...Our way of life is being permanently altered...We now have sand flies here for the first time." New species of birds, including robins and barn swallows, have also been spotted and bird behavior is changing, she says. Snow geese stay for a shorter time in the spring, while some small birds which traditionally migrated, now stay the entire winter (Knight 2000).

John Lucas, Sr., also from Sachs Harbour related: "Never saw salmon here before. People here have been setting nets for quite a while. That is the first time I ever seen that. Even herring [least Cisco] for that matter. It is kind of changing around here for us. I really find a difference with the fish that they are catching. Chars are getting bigger then we used to catch" (Jolly et al., 2002).

Naalak Nappalak, an elder from Kangiqsujuaq in Canada's Arctic talks about fluctuations in the weather and temperature: "Before we knew by looking at the sky whether there would be storms or if it would be calm...Nowadays just when you think you know how the weather will be, they can change in an instant..." (Nelson, 2003).

c) Alaska

In Alaska, more humpback whales have been seen at Gambell in the Bering Sea; bowhead whales have been seen near Deering in Kotzebue Sound and fewer bearded seals are seen there; populations of some bird species (e.g., oldsquaws, sandpipers) have declined in some areas; multi-year ice floes no longer drift south through the Bering Strait to St. Lawrence Island in the fall. At Barrow, the break up of sea ice is much earlier than it used to be, occurring now in June rather than July; sea water freezes only from the top rather than also on the bottom as it used to. (Bottom-forming ice brings sediments and nutrients to the surface when it breaks free and floats.) Physical effects have been observed also: sandy beaches are disappearing on St. Lawrence Island, as erosion increases because there are more storms and less sea ice to protect shorelines in the fall (Huntington, 2000).

Inupiat in Barrow have had ice cellars drip water for the first time in memory, and in Kaktovik**,** a robin built its nest in town in 2003; there is no word in the Inupiat language for robins). Along the Okpilak River ("Okpilak" means "river with no willows") is now crowded with willows. Salmon a re arriving to Kaktovik where there were almost no salmon a generation ago. Ninety two-year-old Nora Agiak observes: "The weather is different, really different...We're not getting as many icebergs as we used to. Maybe the world moved, because it's getting warmer" (AMAP, 1997; Groat, 2001; Kristof, 2003).

In Barrow, Eugene Brower, President of the Barrow Whaling Captains Association related: "Last year the ice went over the horizon and stayed over the horizon all summer. We would have to go over 20 or 30 miles just to hunt seals" (Talbott, 2000). In June of 2000, Barrow experienced its first thunderstorm ever (Lowy, 2001).

Usually Bowheads hunting begins in early April, but one Wainwright elder noted that the bowheads are "slowing down" and have not been appearing until late April, or even May. Over the past few years, residents have noted that on furbearing animals, specifically the wolverine, the fur is not as thick as it used to be. This change is attributed to unusually warm fall and winter seasons. In recent years, late sea ice formation has left many polar bears trapped on land. Unable to venture out onto ice in search of seals, many polar bears appear to be starving (Kassam, 2001).

Charlie Tuckfield, Sr. from Point Lay relates: "A lot of moose come here this summer [1997]. That's kind of unusual. The last few years, they've been coming in. I never saw moose in my lifetime until the last couple of years" (Gibson and Schullinger, 1998).

Hannah Mendenhall from Kotzebue stated: "The thing that I notice when I walk out on the tundra--now I can hear it crackle when I walk on it, and it's dry. Whatever is out there is dried up. We didn't get blueberries this year, last year, and the year before. I used to be able to find blackberries in abundance, and now I have to really search" (http://arcticcircle.uconn.edu/NatResources/Globalchange/globalindex.html).

Hunter and elder, Caleb Pungowiyi, from Kotzebue reflects: "We see our hunters taking chances by going out in weather conditions that put their lives at risk. There are economic costs as the hunters travel greater distances to harvest game, expending more fuel and time. There are times when hunters will return empty-handed because the game was not there or out of reach...We are resilient people, and we adjust quite readily to change, but if that change is too rapid, too disruptive, it will cause social chaos, hardship, and suffering" (Schneider, 2001). He continues: "When the earth starts to be destroyed, we feel it" (McFarling, 2002).

In another interview Pungowiyi stated: "There's plenty of animals out there now. The problem is accessibility. If the ice is further away, we have to go further. Our access to them, our ability to harvest them, and our success rate is being affected. There is a potential for hardship. If the sea ice continues to retreat further and further north, villages that used to depend on marine mammals will see their lives turned around and they'll have to rely on something else" (Arctic Science Journeys, 2001).

Roswell Lincoln Schaeffer, Sr. also from Kotzebue said that "The changes that we've seen these last few years are that it's been very warm in the winter time. We do have exceptions. Say, three or four years ago, we had our fall start in September, and winter occurred September 15th. We had a real early freeze... Generally, I think our temperatures have really warmed up" (Gibson and Schullinger, 1998).

Pete Schaeffer from Kotzebue observes: "Winter storms seem to be much more violent, than what I recall as typical. For example, about four years ago we had a western blizzard that was kind of like a wall of weather that showed up...it went from zero to about 65 miles an hour in ten minutes. That was really unusual I guess. I think the severity of the wind has picked up in the last twenty years. I think that sort of poses, along with thinner ice and different snow conditions, another set of circumstances weather wise, to have to get accustomed to than what we had to deal with in the past" (Gibson and Schullinger, 1998).

Gilbert Barr from Deering remarks: "It seems to me that winters are not as cold as they used to be. Maybe that's due to the lack of precipitation. I've been involved with the City Council off and on for the last twenty or so years, and guess a good indication would be our financial report for the public road maintenance that we do. Normally that program was always running into the red because of snow removal. For the last couple of years – and I don't know if this is good or bad – we've been operating in the black. It's good for the finances of the city, but not for hunting. Last year there were more caribou than I've ever seen or heard of in my life here, but the guys couldn't go out hunting due to lack of snow. I guess it probably could be done, if you wanted to really hurt your snowmachine. But you'd have to weigh whether the cost of parts for your snowmachine would be worth the effort of getting the caribou while they're this close to us" (Gibson and Schullinger, 1998).

Also from Deering, Gibson Moto mentions: "It's harder to hunt for some sea mammals that can't get on the ice. For some odd reason, the ugruks that we hunt are further out there. There's lots of clean ice and there's no ugruks or seals on it. Maybe because of the walrus coming around. Hundreds of walrus. They kill the ugruks and the seals" (Gibson and Schullinger, 1998).

In Shishmaref, Esther Iyatunguk remarks in relation to the erosion happening there: "The ocean is eating our land;" Robert Iyatunguk continues: "Our winter storms have been more frequent. We expect them in November but they're coming in October" (Schneider, 2001).

Stanley Oxereok from Wales relates: "The ice used to be five-six feet thick. The last couple of years it's been four, four and a half feet. That's a foot, a foot and a half, and that's a pretty substantial difference...One year we were hunting in our boats in January. We've never done that before. It was the first time I could remember in my life seeing us boating in January when the water is usually frozen. Break up seems to come quicker. Sometimes a couple of weeks, sometimes as much as a month sooner...Freeze up was as much as a month late" (Gibson and Schullinger, 1998).

In a series of interviews made with Native Whalers in Gambell, Wales, Point Hope, Wainwright, and Kaktovik in 2000-2001, climate change and global warming emerged as a major concern in all villages as potential cause for the changes they had seen in sea ice, weather patterns, and sea mammal distributions. Whalers in Kaktovik voiced a concern about global warming impacts on krill production (Harritt, 2001).

In Savoonga, according, to John Kulowiyi, Sr., an Elder and whaling captain "When I was younger, we used to go out on the ice. It was real solid. But as the years go by, the ice started getting thinner and thinner." He continued: "I was at camp about six years ago, I guess. There is a camp named after my last name, Camp Kulowiyi. One day I went fishing with my fish net and my boys and my grandkids and we caught some kind of strange fish right there. We usually get trout, river trout and here we see chum salmon, king salmon and humpbacks, humpys. That's strange for us. We never used to get those around here. I don't know why they are coming here but it must be the warming climate" (Gibson and Schullinger, 1998).

Jerry Wongittilin, Sr., also from Savoonga, observed: "There have been a lot of changes in the sea ice currents and the weather. Solid ice has disappeared, and there are no longer huge icebergs during fall and winter. The ice now comes later and goes out earlier, and it is getting thinner. The current is stronger, and it is windier on the island. We had a bad hunting season with lots of high winds. Our elders tell us that our earth is getting old and needs to be replaced by a new one" (Craver, 2001).

In recent years Yup'ik hunters have noticed that winters are warmer, walrus are looking thinner, and their blubber is less nutritious; they have to go further from shore to find the ice pack where they hunt seals (USGCRP, 2000).

Tom Kasayulie, an elder from Akiachak, noted that there is less water from rain and snow on the tundra now and this has caused lakes to dry out...and "The warmer weather and higher temperatures are ruining the fish drying on fish racks. We catch less salmon in the river..." (Bradley, 2002).

Edward Shavings from the village of Mekoryuk on Nunivak Island related: "I have seen changes taking place today. About two years ago a lot of murres were dying out there. They would get very weak, swim very slowly. A lot of them were dead; I don't know the cause of their dying off—probably a shortage of food. There have been changes in the weather. In the spring the ice and snow is starting to melt very fast. We used to get very thick ocean ice, but I believe the area is getting warm. We seem to have long sun or daylight hours that melt the snow and the ice to the bottom; and we have early break-ups now" (Merculieff, 2002).

Athabascan elder, Jonathon Solomon, speaking at the Alaska Native Fish, Wildlife, Habitat, and Environment Summit in Anchorage in 2002 declared: "I have seen changes in my homeland in the Yukon Flats. Our rivers are so low that people can't fish. There are lakes that are going dry; the permafrost is melting—there's no more fish. We're lucky to see ten caribou at one time" (Merculieff, 2002).

Dune Lannkard, of the Eyak preservation Council remarked: "We have not had very much snow for the last decade. Lots of precipitation. The ocean currents have become warmer, lots of interesting changes in the ocean. Last but not least, the glaciers have been receding and melting at an alarming rate" (Alaska Native Oil and Gas Working Group, 2003).

(2) Conclusion

Cumulative effects on subsistence-harvest patterns include all the effects from Alternative A or the Preferred Alternative (multiple sales development) and all other past, present, and reasonably foreseeable projects on the North Slope. Sources that could affect subsistence resources include potential oil spills, seismic noise, traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. Based on potential cumulative, long-term displacement and/or functional loss of habitat to CAH, TLH, and WAH caribou over the life of the Northwest NPR-A sales and from other oil and gas developments on the North Slope, this important subsistence resource could become unavailable, undesirable for use, or experience long-term population and productivity effects for a period longer than 5 years--a significant adverse effect. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources, could diminish if oil development were to reduce the availability of resources or alter their distribution patterns. The communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut would be most affected.

A 175-mi-long road would produce more regional (thus, more profound) effects on the habitat and movement of subsistence resources, and on hunter access. Bridging the many productive rivers from Nuiqsut west would make these watercourses more vulnerable to siltation and fuel-spill contamination. Of primary concern would be 1) the lack of any reliable process for assessing and monitoring changes to subsistence-harvest patterns, 2) changes to hunter access, and 3) enforcement of the regulations that would need to be enacted to mitigate the profound and widespread effects such an artery would bring with it.

In general, caribou, fish, birds, and other terrestrial mammals would be expected to experience greater and more continuous disturbance and contamination effects from a road, with those nearest the road experiencing the greatest local disturbance and displacement. In the absence of restrictive regulations, local non-oil- and gas-related activities--including inevitable non-subsistence hunting (and the eventual pressure for increased sport hunting)--would be expected to have adverse effects on subsistence resource populations and subsistence-harvest patterns.

In the unlikely event that a large oil spill were to occur and contaminate essential whaling areas, major additive, (though not synergistic) significant effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together.

o. Sociocultural Systems

(1) Cumulative Analysis

Cumulative effects on sociocultural systems include: effects of multiple lease sales in the Northwest NPR-A Planning Area; additional sales in the remainder of the NPR-A; other ongoing or planned projects on the North Slope that would include Federal and State offshore lease sales; State and private activities expected to occur in the future; and the transportation of oil and gas by pipeline.

(a) Social Organization

In the cumulative case, effects on social organization could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns, social bonds and cultural values. Issues such as these exert stress on social systems (see Impact Assessment Inc., 1990a,b,c; Human Relations Area Files, Inc., 1994; Alaska Department of Fish and Game, 1995b). These effects would be similar to those described for Alternative A, but the cumulative level of effects would increase because, collectively, activities would be more intense. More air traffic and non-Natives in the North Slope region could increase the interaction and (perhaps) conflicts with Native residents. In the past, non-Native workers have stayed in enclaves that kept interactions down. However, recent activity in the Alpine field has brought non-Natives directly into the Native village of Nuiqsut, and this has added stresses in the community. These workers have already made demands on the village for more electrical power and health care. This potential remains for the community of Barrow as well.

Increases in population growth and employment could cause long-term disruptions to: 1) the kinship networks that organize the Inupiat communities' subsistence production and consumption, 2) extended families, and 3) informally derived systems of respect and authority (mainly respect of elders and other leaders in the community). Offsetting such effects are strong efforts by the North Slope Borough (NSB), the Alaska Eskimo Whaling Commission, regional and tribal governments, local governments, and village corporations to institutionally foster and protect Inupiat cultural traditions. Cumulative effects on subsistence-harvest patterns (which also would be long term) would affect Inupiat social organization through disruptions to kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence-task groups could break down family ties and threaten the communities' well-being, creating tensions and anxieties that could lead to high levels of social discord. The NSB, the Alaska Eskimo Whaling Commission, and local whalers have set precedents for negotiating agreements with the oil industry to protect subsistence-whaling practices. Such cooperation is expected to continue. Negotiated agreements exist for development effects onshore at the Alpine Unit north of Nuiqsut. The BLM has convened a Subsistence Advisory Panel (SAP) for the Northeast NPR-A IAP/EIS. It consists of BLM officials and tribal members from local communities. This group is tasked with investigating conflicts between subsistence activities and oil exploration and development, verifying the levels of conflict, and proposing actions to the lessee and the BLM for resolution. It is too soon to know how effective this panel will be in resolving such conflicts.

(b) Cultural Values

Cumulative effects on cultural values also could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for Alternative A, but at higher levels. Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing, and subsistence as a livelihood, and increasing individualism, wage labor, and entrepreneurship. Long-term effects on subsistence-harvest patterns also would be expected. Chronic disruption could affect subsistence task groups and displace sharing networks, but it would not displace subsistence as a cultural value. Sociocultural cumulative effects of changing norms and values would be expected to affect all five social institutions (family, polity, economics, religion, and education), but the NSB's institutional infrastructure, the Alaska Eskimo Whaling Commission, community whaling organizations, regional and tribal governments, regional and village corporations, and the SAP work diligently to develop programs to protect these cultural values (Impact Assessment Inc., 1990a,b,c, 1998; Human Relations Area Files, Inc., 1994; Alaska Department of Fish and Game, 1995b).

(c) Other Issues

As a result of cumulative activities, there could be an increase in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide. The NSB already is experiencing problems in the social health and well-being of its communities, and additional development (including offshore oil development) on the North Slope would disrupt them further. Historically, more income in these communities has connected somewhat to the abuse of alcohol and increased violence. Sources show increases in dysfunctional behavior during the peak of the commercial-whaling era and then again during the height of the fur trade. Drinking and violence seem to ebb when incomes decline. Recent evidence of the effects of employment during and just after World War II loosely supports these views. Although this evidence is not clear, it can still be assumed that onshore oil development has resulted in large cash flows that have led to significant social changes. These social changes on the North Slope are likely to have influenced the extremely high rate of suicide among the Inupiat (90.8 per 100,000 for the Inupiat versus 35 per 100,000 among the Yup'ik [Travis, 1989]).

In terms of cumulative effects, long-term effects could displace social systems; however, the NSB is vigilantly protecting the rights and culture of the Inupiat. Health and social services programs have tried to respond to alcohol and drug problems with treatment programs and shelters for wives and families of abusive spouses, in addition to providing greater emphasis on recreational programs and services. These programs, however, sometimes do not have enough money, and NSB city governments cannot help as much now that they get less money from the State. Tribal, city, and the Borough governments in partnership may be able to provide programs, services, and benefits to residents. All communities in the NSB have banned the sale of alcohol for many years, but the possession of alcohol is not banned in Barrow, and many communities are continually under pressure to bring the issue up for a local referendum (North Slope Borough, 1998).

The relationship of oil and gas development to aberrant behavior and social pathologies might be seen more clearly in terms of social change and associations than in direct causality. Oil and gas development has affected all communities in Alaska, and for this reason, finding control communities is difficult; yet these impacts to communities are important to understand, and more cumulative-effects studies need to be conducted. In a general sense, the accumulation of effect occurs as modernization occurs. As change happens, these alterations spread through the social fabric. Such change can be both negative and positive and can be measured to an extent with objective indicators of the opportunity structure or the stratification system such as education, income, occupation, social networks, and social mobility (created through income, education, etc.) (Cluck, 2000, pers. comm.).

Within this change--produced by the trends of modernization--the "rational choice" of individuals being affected by this change must be considered. Individuals make decisions--sometimes negative, sometimes positive--and stress or fear of change can reinforce a situation of internal conflict that can lead to negative social pathological effects. At the same time, positive impacts may come from higher incomes (e.g., ability to purchase better equipment for subsistence), better health care, and improved educational facilities. Yet what may be seen on the surface as having positive impacts may, at the same time, produce negative effects by producing a state of apathy toward or disinterest in older cultural norms known as anomie. An example of this would be an increased use of the Internet coincident with a reduction in listening to elders. Certain negative effects from social change are inescapable. As technology and opportunity develop, younger individuals readily accept these changes. This is easily seen in less developed countries where rapid change is evident or in the desertion of rural America by young people (Cluck, 2000, pers. comm.).

Both positive and negative impacts from oil and gas development exist in the NSB. Whether they are the more positive ones of increased funding for infrastructure or education or more negative ones associated with a lack of interest by younger people in traditional ways, both have added to social change. Oil and gas development has been one catalyst for such cumulative change on the North Slope; though it needs further study, it is not the single causal agent (Cluck, 2000, pers. comm.).

Stress created by the fear of an oil spill also is a distinct impact-producing agent within the human environment. Stress from this general fear can be broken down to the specific fears of:

- being inundated during cleanup with outsiders who could disrupt local cultural continuity;
- the damage that spills would do to the present and future natural environment;
- drawn out oil-spill litigation;
- contamination of subsistence foods;
- the lack of local resources to mobilize for advocacy and activism with regional, State, and Federal agencies;
- the lack of personal and professional time to interact with regional, State, and Federal agencies;
- retracing the steps (and the frustrations involved) taken to oppose offshore development;
- responding repeatedly to questions and information requests posed by researchers and regional, State, and Federal outreach staff; and
- the need to employ and work with lawyers in drafting litigation to attempt to stop proposed development.

An Alaska Department of Fish and Game social-effects survey administered by the Division of Subsistence Management in 1994 in Nuiqsut included questions on effects from outer continental shelf development. About 60 percent of the respondents did not believe a small oil spill could be contained or cleaned up, and 80 percent did not believe a large oil spill could be contained or cleaned up. An overall study on 21 Alaskan communities concluded that impacts from the *Exxon Valdez* oil spill on subsistence use and the social and cultural system that subsistence activities support persist to this day (Fall and Utermohle, 1995; Impact Assessment, Inc., 1998; Field et al., 1999).

Impacts in the first year following the spill included dramatic declines in harvest levels, reduced diversity of resources used, reduced sharing, and disruption in opportunity for young people to participate and learn the cultural values associated with subsistence. Fear of contamination of food resources was identified as a major factor in these reductions. In the following 3 years, harvest levels, sharing, and subsistence involvement rebounded, though not uniformly across and among communities. By 10 years after the spill, the authors conclude that subsistence uses have largely recovered to previous levels, but that some long-term changes remain, notably in fish species making up a larger portion of total subsistence, while marine mammals, marine invertebrates and birds are a smaller part than before the spill. Resource scarcity is now cited as the reason for changes rather than fear of contamination cited just after the spill. Hunters also reported that additional effort is required to achieve desired harvest levels because some resources are more scarce (Fall and Utermohle, 1999). The Impact Assessment, Inc. study adds additional consideration of psychological and identity impacts from the spill. These authors emphasize that for Alaska Natives, the early impacts of the spill were compounded by the sense of "fear" about resource safety, and the "alienation" from culturally valued activities this causes. These authors also note that continuing litigation contributes to continuing psychological impacts of the spill (Impact Assessment, Inc., 2001). While their review does not include new data from the 10 year, post-spill time period, some of the reported impacts will have been mitigated by the general recovery in subsistence harvest practices.

(d) Effects of Oil-Spill Cleanup on Social Systems

In the unlikely event that a large oil spill were to occur, cleanup activities for the spill could generate many cleanup and response jobs. Based on the *Exxon Valdez* spill experience, Alaska Native residents employed in cleanup work could stop participating in subsistence activities, have a lot of money to spend, and tend not to continue working in other, lower-paying community jobs. In the case of a large spill, these dramatic changes could cause tremendous social upheaval (Human Relations Area Files, Inc., 1994; Alaska Department of Fish and Game, 1995b; Impact Assessment, Inc., 1990c, 1998). Many North Slope village men have been trained in cleanup procedures and have said that they want to be part of any cleanup response (Lampe, 1999). The NSB would play a large part in structuring any spill response and cleanup (North Slope Subarea Contingency Plan, Environmental Protection Agency, U.S. Coast Guard, and Alaska Department of Environmental Conservation, 1999).

(e) Effects along the Transportation Route

Oil produced from Northwest NPR-A Planning Area development is expected to contribute about 3.3 percent to the total North Slope production. Statistically, the most likely number of spills from TAPS tankers is 9 (Table App 9-15). In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mi Economic Exclusion Zone boundary except in the north central Gulf of Alaska, where the transportation route leaves Prince William Sound. Oil spilled along most of this route would tend to move parallel to the Alaska Peninsula and the Aleutian Islands, rather than towards the coast, where vulnerable resource populations could be contacted. Oil spilled from a tanker after exiting Prince William Sound could contact the Kodiak and Alaska Peninsula areas.

Ongoing tanker transportation of oil from Valdez to the West Coast could cause serious and long-term cumulative effects on some subsistence resources in Prince William Sound and the Gulf of Alaska. Economic losses to the commercial-fishing industry could be expected for 2 years following the spill and a serious loss to the subsistence fishery would also be expected. Effects on sociocultural systems along the tanker-transportation route south of the Gulf of Alaska to West Coast ports would be expected to be less than those described above, primarily because Native subsistence cultures south of Alaska have historically been marginalized by the dominant culture, and there are few Native communities that continue to practice a subsistence way of life.

(2) Conclusion

Because of the primary dependence of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut on the subsistence caribou harvest from the CAH, TLH, and WAH caribou, cumulative effects could potentially chronically disrupt sociocultural systems in the community for a period longer than 5 years--a significant effect. Effects from industrial activities, changes in population and employment, and the accompanying changes in subsistence-harvest patterns, social bonds, and cultural values would be expected to disrupt community activities and traditional practices for harvesting, sharing, and processing subsistence resources, but they would not be expected to displace sociocultural institutions, social organization, or sociocultural systems.

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, polar peoples would be expected to experience fundamental cultural stresses as well as major impacts on population, employment, and local infrastructure. If subsistence livelihoods are disrupted, Arctic 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; ARCUS, 1997). As stated by Parson et al. (2001): "It is possible that projected climate change will overwhelm the available responses." It is also realistic to expect that some general assistance can be found to mitigate the losses of nutrition, health, and income from diminished subsistence resources, but such assistance "would likely have little effect in mitigating the associated social and cultural impacts" (Parson et al., 2001).

See the discussion of Arctic climate change and global warming at Section IV.F.8.n.1.e in the Subsistence-Harvest Patterns cumulative effects section.

p. Environmental Justice

(1) Cumulative Analysis

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough (NSB), the area potentially most affected by activities in the Northwest NPR-A Planning Area under Alternative A and other activities associated with cumulative projects on the North Slope. Environmental Justice effects on Inupiat Natives could occur because of their reliance on subsistence foods, and potential effects could impact subsistence resources and harvest practices. Potential cumulative effects from noise, disturbance, and oil spills on subsistence resources and harvest practices and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the NSB.

(a) Effects on Subsistence Resources, Activities, and Communities

As described in Section III.C.3, subsistence activities in the Planning Area are important in providing dietary sustenance to North Slope residents. As a consequence, the cumulative activities that could have a disproportionately high adverse effect on minority and low-income populations correlate directly to impacts on subsistence resources and access to those resources. Actions identified in the ANILCA 810 analysis in Appendix 5 as having a potentially significant impact on subsistence also would have a significant impact on minorities and low-income populations and communities. Those stipulations and other protective measures that help to mitigate impacts on Inupiat Natives are the same as identified in the subsistence and sociocultural analyses in Section IV.C.14 and C.15 for Alternative A and Section V.B.14 and B.15 for the Preferred Alternative.

In 1993, the NSB conducted the North Slope Borough Census of Population and Economy. It found that of the 6,538 borough residents, 4,941 identified themselves as Native and 1,597 identified themselves as non-Native. For the NSB as a whole in 1993, the population was 74 percent Inupiat and 26.1 percent non-Inupiat; in 1998, the population was 72.24 percent Inupiat and 27.76 percent non-Inupiat (North Slope Borough, 1995, 1999). The 2000 Census counted 7,385 persons resident in the North Slope Borough; 5,050 identified themselves as American Indian and Alaska Native for a 68.4 percent indigenous population (USDOC, Bureau of the Census, 2000).

The 1993 figures show that, of the Inupiat population, 81.60 percent of the North Slope Borough population resided in the five communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut (North Slope Borough, 1995); 49.2 percent lived in Barrow. In 1998, 61.4 percent of the North Slope Borough population resided in Barrow; 81.80 percent lived in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut (North Slope Borough, 1995, 1999).

In the potentially affected communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut, there are no significant "other minorities." In Point Lay "other minorities" comprised 2.8 percent of a total population of 246 in 1998, in Wainwright 1.3 percent of a total population of 649, in Atqasuk 3.4 percent of a total population of 224 in 1998, and in Nuiqsut 1.4 percent of a total population of 420. In Barrow in 1998, "other minorities" constituted 16.8 percent of the total population of 4,641, but the Inupiat minority population is the only minority population allowed to conduct subsistence hunts for marine mammals. "Other minorities" are not allowed to participate in the subsistence marine mammal hunt and do not constitute a potentially affected minority population (North Slope Borough, 1999).

With the North Slope Borough's homogenous Inupiat population, the identification of a "reference" or "control" group within the potentially affected geographic area--for the purposes of analytical comparison to determine if the Inupiat are affected disproportionately--is not possible. This is because a nonminority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope.

North Slope Borough income figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. When figured for ethnicity, the average Inupiat household income was $44,551 and for non-Inupiat it was $74,448. The average Inupiat per capita income was $10,765 and the non-Inupiat per capita income was $29,525. Of all the households in the NSB surveyed, 23 percent qualified as very low-income households, and another 10 percent qualified as low-to-moderate-income households. As 66 percent of the total households surveyed were Inupiat, it would appear that a large part of the households falling in the very low- to low-income range are Inupiat. Poverty-level families in the borough numbered 88, or 6 percent of all households. Poverty level thresholds used by the North Slope Borough were based on the U.S. Bureau of the Census, March 1996 Current Population Survey; low income is defined by the U.S. Census Bureau as 125 percent of poverty level (North Slope Borough, 1995; North Slope Borough, 1999).

The North Slope Borough 1998/99 Economic Profile and Census Report showed household income increasing from $54,645 in 1993 to $63,884 in 1998. The average Inupiat household income increased by an average of $11,685, from $44,551 to $56,236. The average Inupiat per capita income rose from $10,765 in 1993 to $12,550 in 1998. One hundred five households qualified as poverty level, and 37 qualified as very low income. This translates into a total of 381 individuals living below the poverty level--an increase of 12 individuals since 1993 (North Slope Borough, 1999). The 2000 Census found an average per capita income of $20,540 and a median household income of $63,173. The 2000 census found 132 families (8.6% of a total 1,538 NSB families) in poverty status in 1999 (397 individuals 18 years and over) (USDOC, Bureau of the Census, 2000).

Sources for cumulative effects include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with drilling, production facilities, pipelines, and landfalls. In addition, habitat reduction, and increased local population pressure have combined as cumulative factors that continue to challenge the survival of many traditional subsistence practices.

Potential effects focus on the Inupiat communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut within the North Slope Borough. The sociocultural and subsistence activities of these Native communities could be affected by disturbance to key subsistence species that leads to disruption, displacement, or long-term changes in species' populations. Communities could also be affected by accidental oil spills. Possible oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Interestingly, after the *Exxon Valdez* spill, testing of subsistence foods for hydrocarbon contamination from 1989-1994 revealed very low concentrations of petroleum hydrocarbons in most subsistence foods. In fact, the U.S. Food and Drug Administration concluded that eating food with such low levels of hydrocarbons posed no significant risk to human health (Hom et al., 1999), though they recommended avoiding shellfish, which accumulate hydrocarbons. Of course, human health could be threatened in areas affected by oil spills but these risks can be reduced through timely warnings about spills, forecasts about which areas may be affected, and even evacuation of people and avoidance of marine and terrestrial foods that might be affected. Federal and State agencies with health-care responsibilities would have to sample the food sources and test for possible contamination.

(b) Additional Aspects of Environmental Justice Cumulative Impacts

The BLM acknowledges the cumulative sociocultural impacts on the North Slope and that Inupiat culture has undergone significant change. The influx of money (from wage employment) has added many benefits and raised the standard of living, but these influences have also given rise to an array of social pathologies, including increased alcoholism. Although on- and offshore cumulative effects are difficult to separate, most cumulative effects, by far, result from onshore development.

Any realistic analysis of cumulative effects on the North Slope needs to consider both onshore and offshore effects. Although no adequate monitoring or comprehensive baseline data gathering have ever been undertaken onshore by responsible Federal and State agencies and industry, the most obvious cumulative effects have occurred and continue to occur onshore as the oil patch spreads outward from Prudhoe Bay/Deadhorse. Most of the stress factors mentioned by local stakeholders can normally be associated with onshore impacts.

Based on Native stakeholder concerns about cumulative impacts, BLM and the Research Monitoring Team are considering a study proposal that would better assess the cumulative impacts of petroleum exploration and development on subsistence activities of local communities across the North Slope. The SAP would be consulted as to the variables and the process for measuring them. For further discussion of Environmental Justice effects, see the cumulative effects analyses for subsistence-harvest patterns and sociocultural systems (Sec. IV.F.8.n and Sec. IV.F.8.o).

Ongoing and proposed MMS studies also address Environmental Justice concerns pertinent to NPR-A development and will provide valuable data for the assessment of cumulative impacts of oil and gas activities. Monitoring efforts for the Northstar and Liberty Projects (such as the 14-year aerial Monitoring of the Distribution of Arctic Whales Project), will provide long-term information on areawide and cumulative effects of oil and gas activities on the fall migration of the bowhead whale and will help in the development of mitigation measures to protect this pivotal Inupiat subsistence resource. A top priority, 5-year, $3.7 million ANIMIDA study was established in response to Inupiat requests to gather long-term monitoring data that will provide a basis for evaluating potential effects from upcoming development and production activities in the Beaufort Sea. A portion of this study will assess the historic and ongoing subsistence use of the area surrounding Cross Island by working with local whale hunters. The ongoing *Sociocultural Consequences of Alaska OCS Activities: Data Analysis/Integration* study is a cooperative agreement with ADF&G, Subsistence Division to analyze and integrate subsistence, socioeconomic, and sociocultural time-series data from previous MMS-sponsored projects in order to assess the occurrence and implications of sociocultural change from OCS activities.

The *Exxon Valdez Oil Spill, Cleanup, and Litigation: A Community-Based Collection of Social-Impacts Information and Analysis, 1989-2001* produced an analytical tool (from a synthesis of the *Exxon Valdez* literature) that assists Department of the Interior (DOI) analysts in NEPA-document preparation; designing mitigation measures; facilitating the review of oil-spill-contingency plans; and paves the way for a dialogue with coastal communities regarding the DOI's offshore programs. The *Quantitative Description of Potential Effects of OCS Activities on Bowhead Whale Hunting Subsistence Activities in the Beaufort Sea* study was developed in response to concerns raised by the AEWC and the NSB. This study involves a systematic analysis of residents' observations and perceptions about how their lives--and especially subsistence whale hunting activities--have been (and might be in the future) affected by oil industry activities and other forces of modernity. An MMS study titled *Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow: Past and Present Comparison* will map geographic patterns of subsistence use near important North Slope communities. MMS will use this comparative time series information to assess cumulative sociocultural effects in the Beaufort Sea region.

The ongoing Alaska Marine Mammal Tissue Archival Project (AMMTAP) field sampling and long-term storage of frozen tissues archive has provided a wealth of information on contaminants. Another ongoing study called *The Alaska Marine Mammal Health and Contaminants Database* will make this tissue archival information available to management agencies and subsistence villages that by necessity must make timely decisions about the safety of the environment and their subsistence foods. The *North Slope Borough Economy, 1965 to Present* study will provide a comparative basis for assessing potential economic effects of upcoming offshore oil and gas activity to better understand potential cumulative effects of offshore oil and gas development.

On April 5-6, 2001, MMS held The Bowhead Whale Subsistence Hunt and Outer Continental Shelf Oil and Gas Activities Research Design Workshop in Anchorage. This workshop was requested by NOAA Fisheries and the AEWC to focus scientific research on the cumulative effects of OCS activity on bowhead whales and their migration, as well as the sociocultural dimensions of the subsistence whale hunt. Recommendations from the workshop identified: 1) the need for extensive funding to effectively study the complex relationship between OCS and onshore socioeconomic effects; 2) that effective monitoring is necessary to document and analyze industry and whaling activities and the many factors of change in local communities; 3) that defining and disaggregating (on- and offshore) cumulative social effects will be a difficult process; and 4) that defining the relative causal effect of any given factor--such as OCS oil and gas activity--on social issues is problematic. Participants agreed that available resources would better be applied to researching means of prevention, intervention, and treatment of social problems in North Slope Native communities.

The National Academy of Sciences conducted a multi-year *Cumulative Environmental Effects of Alaskan North Slope Oil and Gas Activities Study*, under the direction of Dr. David Policansky. The committee of national, state, and local experts reviewed information about oil and gas activities (including exploration, development, and production) on Alaska's North Slope. Based on the review, the committee assessed the known and probable cumulative impacts of oil and gas activities from the early 1900's to the present (including cleanup efforts) on the physical, biological, and human environments of Alaska's North Slope (including the adjacent marine environment). It provided an assessment of potential future cumulative effects, based on likely changes in technology and the environment and a variety of scenarios of oil and gas production--all in combination with other human activities, including tourism, fishing, and mining. The committee described and documented its methodology for assessing cumulative effects and identified gaps in knowledge and made recommendations for future research needed to fill those gaps. The BLM and other Federal and State agencies conducting oil activities on the North Slope are working to implement the recommendations of this study that specifically advocates for "a slope-wide, jurisdictionally coordinated framework for wildland evaluation, mapping, ranking, impact analysis, and planning [that] would help decisionmakers identify conflicts, set priorities, and make better-informed decisions" (NRC, 2003). Specific research needs and approaches indentified by the NRC study include: 1) targetting how much oil and gas activities are associated with rising levels of sociocultural change; 2) conducting more culturally and locally cooperative research by incorporating more traditional and local knowledge into research study designs; 3) focusing on translating theoretical research "concepts and values into concrete terms" that can better be used in environmental assessment; and 4) better identifying the physical, psychological, cultural, spiritual, and social human-health effects of oil and gas development on North Slope residents (NRC, 2003).

While these research and monitoring efforts in themselves will not resolve the larger problems of ongoing cultural challenge to Inupiat traditions from increasing development in the region--and from such powerful influences of modernity as cable television, the Internet, and an increasing dependence on a wage-based economy--they will provide processes for information sharing and opportunities for mutual decision-making and remediation of cumulative social and subsistence impacts.

(c) Effects along the Transportation Route

Oil produced from Northwest NPR-A Planning Area development is estimated to contribute approximately 3.5 percent of the total North Slope oil resources. Statistically, the most likely number of spills from TAPS tankers is 9. In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mi Economic Exclusion Zone boundary except in the north central Gulf of Alaska, where the transportation route leaves Prince William Sound. Oil spilled along this route could cause serious and long-term cumulative effects on some subsistence resources in Prince William Sound and the Gulf of Alaska. Economic losses could be expected for 2 years following the spill to the commercial-fishing industry, and a serious loss to the subsistence fishery would also be expected. Such losses would represent disproportionate, high adverse effects to Native subsistence resources and harvests in the region.

(2) Conclusion

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by Northwest NPR-A exploration and development and other past, present, and reasonably foreseeable projects on the North Slope. Environmental Justice effects on Inupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects may affect subsistence resources and harvest practices.

Potential effects would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. Based on potential cumulative, long-term displacement and/or functional loss of CAH, TLH, and WAH caribou habitat over the life of the Northwest NPR-A oil and gas lease sales and from other oil and gas developments on the North Slope, this important subsistence resource could become unavailable, undesirable for use, or experience long-term population and productivity effects for a period longer than 5 years, a significant adverse effect. Such impacts would be considered disproportionately high adverse effects on Alaska Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources could change if oil development were to reduce the availability of resources or alter their distribution patterns.

Because potential climate change impacts on marine and terrestrial ecosystems in the Arctic would cause significant impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the Arctic would be expected to experience disproportionate, high adverse environmental and health effects. See the discussion of Arctic climate change and global warming at Section IV.F.8.n.1.e in the Subsistence-Harvest Patterns cumulative effects section.

In the unlikely event that a large spill were to occur and if it contaminated essential whaling areas, major effects could result from the combined factors of shoreline contamination, tainting concerns, cleanup disturbance, and disruption of subsistence practices. Such impacts would be considered disproportionately high adverse effects on Alaska Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health.

Any potential effects on subsistence resources and subsistence harvests would be expected to be mitigated substantially, though not eliminated. For a detailed discussion of Environmental Justice effects, see Section IV.C.16 and the cumulative effects analyses for subsistence-harvest patterns and sociocultural systems in Sections IV.F.8.n and IV.F.8.o.

q. Coastal Zone Management

(1) Cumulative Analysis

Activities associated with the cumulative effects on Alaska's North Slope include: those occurring under projected for Alternative A; oil and gas development in the Northeast NPR-A; Federal and State offshore oil development; State onshore oil development; and oil and gas transportation. The activities associated with exploration, facility construction, operation and maintenance, and oil spills are the most important elements for the cumulative analysis because of their disturbance and habitat impacts.

Although cumulative effects could lead to changed levels of effects, the ACMP statewide standards and NSB enforceable policies that are relevant to the analysis in Alternative A remain relevant for the cumulative case. Although the level of effects could increase for the cumulative case, the scenarios assumed for the analyses in this EIS would not be expected to conflict with the statewide standards or the district policies. Activities that would occur outside the boundaries of the NPR-A, but within the NSB (including the coastal zone), would require permitting and approval from the NSB before those activities proceed. Those activities would not be approved by the Borough until certain they do not conflict with the coastal management program enforceable policies.

(a) Energy Facilities (6 AAC 80.78), Transportation and Utilities (6 AAC 80.080), and Habitats (6 AAC 80.130)

The effects of pipelines, roads, and facilities installation and construction are magnified in the cumulative case. However, the analyses indicate that the potential additive effects would not significantly alter or interfere with the habitats, species, and activities that these standards address. Cumulative effects are not anticipated to increase the potential for conflict with these statewide standards. Siting of energy facilities, transportation, and utilities outside the boundaries of the NPR-A (but within the boundaries of the NSB and the coastal zone) would require NSB permitting and approval. The NSB policies would be addressed through this approval process and permitting would be dependent upon adherence to these policies.

(b) Subsistence

Access to subsistence-hunting areas and subsistence resources and the use of subsistence resources could change if development were to reduce the availability of resources or alter their distribution patterns. Sources that could affect subsistence resources and access include noise and traffic disturbance, disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, supply efforts, and the unlikely event of a large oil spill and associated cleanup efforts. Of these, the unlikely event of a large spill is the only source that could significantly interfere with access to subsistence resources. If a large spill were to occur and essential harvesting areas were contaminated, increased effects could result from the combined factors of shoreline contamination, tainting concerns, cleanup disturbance, and disruption of subsistence practices.

The other impacting factors either would not be expected to have more than local, short-term impacts or could be effectively addressed through the proposed suite of stipulations and required operating procedures (ROP's). The proposed mitigation measures (stipulations and ROP's), existing regulations and management practices, and the use of future conditions placed on permits for future projects would serve to assure that the timing and monitoring of potential sources of disturbance would prevent conflicts with subsistence activities. Activities addressed for cumulative effects would not be likely to result in conflict with this statewide standard or with the district enforceable policies.

(2) Conclusion

Effects on access to subsistence hunting and subsistence resources would offer the greatest opportunity for conflict with the statewide standards and the NSB policies related to these concerns. Increase in noise and disturbance from cumulative oil development could have localized, short-term effects on some subsistence resources and access to some resources. Noise and disruption could be effectively addressed through stipulations and ROP's, existing regulations and management practices, coordination, and through future permitting processes including Federal, State, and local processes as applicable. Federal regulations require and implement strict oil-spill prevention standards and a large spill would be considered unlikely. In addition, the stipulations and ROP's would address prevention and response relative to small and large spills. The potential for conflicts arising from the cumulative effects would be the same as those discussed in Alternative A. Conflicts with statewide standards of the ACMP and the policies of the NSB are not inherent in the scenarios assumed for this EIS.

r. Recreation Resources and Wilderness

(1) Cumulative Analysis

In addition to the impacts described under Alternative A, the construction of additional long-term or permanent facilities such as power lines, permanent roads, gravel pads, material sites or other structures not necessarily related to oil and gas development would result in cumulative impacts to solitude, naturalness, or primitive/unconfined recreation. Short term or transient loss of the area's naturalness and solitude from such impacts as green pads/trails and noise from aircraft and equipment would not accumulate as would impacts from permanent facilities. In that respect, their contribution to the cumulative impacts would be "momentary."

Under Alternative A, long-term impacts would be expected to affect an area of approximately 325,000 acres. Considering past, present and future development across the North Slope, total cumulative impacts could affect an area three to five times greater. Even so, a vast area of the Arctic Coastal Plain would remain relatively untouched. However, the types of development anticipated would not be uniformly distributed across the Planning Area or the North Slope, nor would recreational and wilderness values be perceived to be uniformly dispersed. Cumulative impacts along popular rivers such as the Colville will be seen as far more significant than impacts elsewhere.

(2) Conclusion

Short-term impacts such as green trails and disturbance from noise and other activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines and gravel pads would accumulate and would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation. This could be locally significant.

s. Wild and Scenic Rivers

(1) Cumulative Analysis

Existing land use plans have been developed for the Arctic National Wildlife Refuge (ANWR) and for the Northeast NPR-A. Neither of these plans identified any river segments flowing into the Arctic Ocean as suitable for inclusion in the National Wild and Scenic River (WSR) System. The only existing WSR north of the Brooks Range is the portion of the Ivashak within ANWR; the designation ends approximately where the river flows from the Brooks Range onto the coastal plain. The Record of Decision (ROD) for the Northwest NPR-A IAP/EIS will complete Federal land use planning for the North Slope. If the ROD finds no suitable rivers within the Northwest NPR-A Planning Area, then the entire northern coast of Alaska--roughly 1,000 mi of coastline--will have been examined pursuant to § 5(d)(1) of the Wild and Scenic Rivers Act without identifying one river system worthy of designation.

The Colville River riparian area is managed by the State of Alaska and the Arctic Slope Regional Corporation. These entities could authorize improvements such as airstrips, lodges, cabin sites, or storage facilities in the riparian area that would impact the scenic quality and roadless nature of the river, which would make it very difficult to maintain the nondegredation standard of management if the Colville River adjacent to the Planning Area were found suitable for designation as a wild river area.

(2) Conclusion

There would be no cumulative impacts to WSR because there are currently no designated WSR's. However, projected oil and gas development activities would have local impacts on the free-flowing, unpolluted waters and the outstandingly remarkable values of eligible rivers.

t. Visual Resources

(1) Cumulative Analysis

In addition to the impacts described under Alternative A or the Preferred Alternative in the multiple sales scenario, other activities associated with oil and gas development that may cumulatively affect visual resources along the North Slope of Alaska include: oil and gas development in other areas of NPR-A; Beaufort Sea oil and gas development; and other development of oil and gas reserves through Federal or State leases. Activities associated with exploration, and development including facility construction with operations and maintenance and transportation of oil and gas would also impact cumulatively the visual resources of the North Slope. Other alternatives analyzed would have somewhat less impact than Alternative A on visual resource values and would thus have less cumulative impacts than those described below.

Cumulatively, the non-oil and gas activities are the same described as under the No Action Alternative. However, green trails and temporary camps would increase as a result of or in support of oil and gas development. For example, field activities associated with archeological site clearances (such as camps, excavations, and aircraft activity) all likely would increase.

Although the amount of supplies and materials transported by winter overland moves could increase cumulatively, these moves generally follow the same routes. New trails could be developed to reach new staging areas and pump stations, however once the route was identified, numerous trips over the route could occur without additional impacts. New green trails could be expected to double in mileage of visible vegetative change. The natural recovery time for this type of impact would be less than the 15 to 20 years being used for the cumulative case analysis.

Cumulatively, seismic-survey work would continue and would increase in the number of operations each winter season. Green trails resulting from these operations could increase several fold over Alternative A, with hundreds of miles of intermittent green trails visible from the air during any one summer season. The natural recovery time for this type of impact would be less than the 15 to 20 years being used for the cumulative case analysis. As production of fields increased, seismic work would tend to decrease and green trails would reduce in number and recover naturally.

Past development and production of oil and gas has, at one time or another, impacted around 10 percent of the North Slope area. Present development and production could impact less than 1 percent of the North Slope, while reasonably foreseeable future development could impact around 1 percent of the total North Slope area. However, remediation of old drill sites is ongoing and many of the impacts have a natural recovery rate of less than the 15 to 20 years being used for this analysis. Ring effect from old well sites would also naturally recover in less than the 15 to 20 years being considered under this analysis. Exploration wells would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This would be essentially a permanent impact, though almost unnoticeable from several hundred feet away.

A road from the Dalton Highway across the Colville River to Nuiqsut would impact visual resoruces along its route, but would not have impacts to the visual resources of the Northwest NPR-A Planning Area. The scenic quality along the route would be affected by the removal of native vegetaion and the use of gravel, sand, and other road material where they are not naturally located. The development of material sources (e.g. gravel pits) may have an impact on the visual quality of the adjacent area. Traffic along the route would impact the visual quality from the surrounding area.

(2) Conclusion

There would be a small increase in the short-term impacts to visual resources from non-oil and gas activities. Short-term impacts, such as green trails and ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads and pits would accumulate and would result in the long-term loss of scenic quality.

Long-term impacts from production sites, staging areas and pumping stations with a possible life span of over 30 years would affect the visual resources for the North Slope, however these impacts would be expected to be greatest within a 1/2-mi radius of each site. Pipelines could be elevated above ground level. Except during construction and repair of pipelines, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond about a half-mile.

u. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared a comprehensive impact analyses on those areas within Northwest NPR-A Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section IV.F.8.g)

Human-caused impacts are expected to be additive in nature; no synergistic or countervailing impacts are anticipated. The areal extent of such impacts would constitute a very small fraction of the total North Slope acreage. Global climate change could alter the species composition, increasing deciduous shrubs and decreasing sedges and grasses.

Soils (Section IV.F.8.a)

Oil and gas exploration and development and other activities on the North Slope have and will impact a very small fraction of the soils of the area.

Water Resources (Section IV.F.8.c)

Water use by North Slope villages and oil and gas activities will continue to draw from local surface water sources. Water is abundant on the North Slope and impacts are likely to be localized and minimal.

Freshwater Quality (Section IV.F.8.d)

Oil and gas activities may produce short-term local impacts to water quality. Oil spills can create short and long-term impacts to surface water. A crude oil spill from a tanker could cause short-term water quality impacts to saltwater along the tanker routes south of Valdez.

Estuarine Water Quality (Section IV.F.8.e)

The types of impacts would be similar to those described for the Planning Area under Alternative A, but would occur in a more widely dispersed area of the North Slope witnessing oil and gas activities. The effects of regulated discharges would be negligible. The effects of gravel-island construction and buried-pipeline construction would probably be temporary and minor, especially for facilities along the naturally turbid Beaufort Sea coast. Short docks and causeways would probably not affect hydrologic conditions, but long causeways with inadequate breeches have and in one case would probably continue to have measurable, long-term impacts on hydrologic conditions. If a 500- or 900-bbl spill occurred during the ice-covered season, the effects would be minor. If it occurred during the open-water or broken ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of a spill.

9. Incremental Contribution of Alternatives to Cumulative Effects

For this cumulative analysis, the incremental contribution of an alternative to cumulative impacts is assumed to be proportional to the projected level of activities for that alternative. In general, the likelihood of interaction between oil and gas activities and surface resources is related to the number of activities that occur.

Short-term activities do not contribute to overall cumulative impacts on resources, except in a "momentary" sense. The incremental contribution of these types of activities to cumulative impacts would be zero.

Non-oil and gas activities do contribute to overall cumulative impacts. The specific non-oil and gas activities considered in the cumulative case will influence the overall cumulative level of impacts and the contribution attributed to each alternative. Non-oil and gas activities could be limited to those that occur in the Planning Area or in the entire NPR-A. Non-oil and gas activities could be expanded to include activities and development such as non-oil and gas-related transportation infrastructure, municipal airports, and private vehicle emissions. The larger the "pool" of non-oil and gas activities, the smaller the contribution of the activites under any alternative.

The incremental contribution of the alternatives also depends on the geographic area that is considered under the cumulative scenario. The cumulative impact area could encompass the Northwest NPR-A Planning Area, the NPR-A, the Arctic Coastal Plain, or the entire North Slope. For some resources, only activities in the immediate area have effects. For example, well drilling many miles from the nearest river would likely not have any effects on the wild and scenic rivers. For some resources, activities in a broad area could have a cumulative effect. For example, caribou migrate long distances and activities in any part of their range could affect them.

In addition, the factors (variables) being considered in the cumulative analysis determine the "percentage" that would be attributed to a given alternative. As stated above, the incremental contribution of an alternative to cumulative impacts is assumed to be proportional to the projected level of activities for that alternative. But which activities or factors are to be considered? Some of the variables that could be used are: number of wells drilled; number of production pads; amount of oil produced; length of pipelines or roads; areal extent of impacts; risk of spill occurrence; estimated number or volume of spills; and revenues generated.

The incremental contribution to cumulative effects would be greatest under the Alterative A multiple-sales scenario because the highest levels of activities and the greatest volume of production are projected under that scenario. Alternative A would also make the most area available for leasing. With consideration of the variables and factors above, Alternative A is projected to contribute 10 to 20 percent to the overall cumulative impacts to the resources addressed in this IAP/EIS.

Under the Alternative B multiple-sales scenario, about 16 percent fewer wells are projected to be drilled, 20 percent fewer fields are projected to be developed, and about 14 percent less oil is projected to be produced than under Alternative A. It is assumed, therefore, that the incremental contribution to cumulative effects would be about 14 to 20 percent less under Alternative B than under Alternative A.

Under the Alternative C multiple-sales scenario, about 98 percent fewer wells are projected to be drilled than under Alternative A, no fields are projected to be developed, and no oil is projected to be produced. It is assumed, therefore, that the incremental contribution to cumulative effects would be about 98 percent less under Alternative C than under Alternative A.

Under the Preferred Alternative multiple-sales scenario, about 16 percent fewer wells are projected to be drilled, 20 percent fewer fields are projected to be developed, and about 14 percent less oil is projected to be produced than under Alternative A. It is assumed, therefore, that the incremental contribution to cumulative effects would be about 14 to 20 percent less under the Preferred Alternative than under Alternative A. This is comparable to the incremental contribution of Alternative B. The BLM believes that although the projected level of activities is the same for both the Preferred Alternative and Alternative B, the incremental contribution of the Preferred Alternative would be less than that under Alternative B because of the additional protection to resources provided by the Preferred Alternative lease stipulations and ROP's.

Under the No Action Alternative, none of the BLM-administered lands would be made available to oil and gas leasing, exploration, and development; no wells would be drilled; and no oil would be produced. Non-oil and gas activities and winter seismic surveying activities would continue to occur. These activities are considered part of the existing cumulative impacting activities in the Planning Area and surrounding area. Thus, the No Action Alternative would have no incremental contribution to cumulative effects.

10. Cumulative Effects outside of the Planning Area from the Transport of Northwest NPR-A-Produced Oil

The BLM recently analyzed the impacts of operating TAPS over the next thirty years in the *Final Environmental Impact Statement Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right-of-Way* (TAPS EIS: see particularly Sections 4.3 and 4.4.) The TAPS EIS assessed most impacts of the pipeline as small, localized, and commonly short-term. Vegetation and soils would be disturbed in very small areas along the 800-mi-long pipeline and the risk of adversely affecting paleontological or cultural resources was assessed as very remote. Impacts on subsistence and human health would be small, though over the course of the next thirty years the EIS estimated that there may be 6 fatalities and less than a hundred time-loss injuries to workers. Impacts on air, water, fish, birds, and mammals would all be small, except in the event of an unlikely large spill. Oil spills could create temporary public health risks to people in the immediate vicinity. Large oil spills could have substantial impacts on groundwater, surface water, and the marine environment. A large spill into certain waterbodies could, depending on the circumstances, cause severe and possibly long-term impacts to fish. A very large spill--or one that contaminated a crucial habitat--would also be the only means by which impacts to bird or mammal populations are anticipated.

The cumulative effects of transporting Alaska North Slope oil (which would include that oil produced from the Northwest NPR-A) by tanker from the Port of Valdez to the U.S. west coast and Asian markets were evaluated in the *Liberty Development and Production Plan Final Environmental Impact Statement*, which is incorporated by reference (USDOI, MMS, Alaska OCS Region, 2002b). The analysis estimated the number of cumulative tanker spills to be 9, including 6 spills with an average size of 3,000 bbl (4 of which occur in port and 2 at sea), 2 spills with an average size of 13,000 bbl (both of which occur at sea), and 1 spill of 200,000 bbl (at sea in the Gulf of Alaska). The estimated 6 spills at sea and the 1 larger spill are not expected to occur within the same location or contact the same resources before recovery of the affected resource. In-port spills, where contingency measures are in place, would be cleaned up relatively quickly. Spills originating 80 to 100 mi offshore would have a 5 to 10 percent chance of contacting the shore within 30 days. Weathering and dispersion of the oil during this time would reduce effects. When effects have been studied, spills of 13,000 bbl or less at sea have not been found to cause serious effects on birds, fish, and marine mammal populations. A spill along the route to Asian markets would be expected to move parallel to the Alaska Peninsula and the Aleutian Island chain. Production from the Northwest NPR-A would account for approximately 3.5 percent of the total reasonably foreseeable volume of oil moved to port via the Trans-Alaska Pipeline System.

The analysis found few, if any, effects to threatened and endangered species from a tanker spill. For example, bowhead whales and their habitat are far removed from the tanker routes; spectacled eiders do not occur in the area that could be contacted by oil; and an oil spill would be unlikely to reach either the densely populated Steller's eiders wintering area or northern sea otters and their habitat along the Alaska Peninsula or Aleutian Island chain. Potential effects to salmonoids and other fish species--including the tidewater goby, Sacramento splittail, Pacific hake, white abalone and black abalone--appear limited. An oil spill in Prince William Sound or the Gulf of Alaska could have potential cumulative effects on sea otters in those areas and local effects on harbor seals.

Only the large, 200,000-bbl spill could cause serious effects to marine and coastal birds in the Gulf of Alaska. An oil spill in Prince William Sound could have local, cumulative effects on river otters and brown and black bears in the area. A spill could adversely affect lower-trophic level organisms, such as plankton, algae, and seaweed that experienced contact. A 200,000-bbl spill could affect commercial fishing and result in an economic loss ranging from 37 to 64 percent per year for 2 years in the area affected by the spill. Smaller oil spills would not be expected to have measurable effects on fish species (including anadromous species) or result in measurable effects on sport fishing. If oil contact were to occur, wetlands in Prince William Sound and along west coast routes to Seattle, San Francisco Bay, and Los Angeles could experience local, cumulative effects from contact and damage caused by cleanup operations. Subsistence harvest for residents of Cordova and Yakutat, Alaska, could be reduced or altered, especially if the 200,000-bbl spill contacted and caused serious, long-term effects to sea otters, coastal birds, and harbor seals. Similarly, economic losses to the commercial fishery described above would also represent a serious loss to the subsistence fishery. A spill of that magnitude would also cause serious institutional stress and disruption to associated sociocultural systems in Cordova that could last 4 years, with lesser effects on Yakutat. These effects would be similar to those experienced by these communities as a result of the *Exxon Valdez* oil spill. Archaeological resources in an area contacted by oil spills could be affected by cleanup activities, oil contamination, and vandalism--although protocols are in place to identify sites and minimize impacts from cleanup. A 200,000-bbl spill could result in creation of 10,000 cleanup-related jobs for 6 months in the first year, declining to zero by the fourth year following the spill, along with local price inflation up to 25 percent during the first six months following the spill. Under environmental justice, a tanker spill would not be likely to result in disproportionate high adverse effects to Alaska Natives from this project alone.

Water-quality effects would vary with the location and size of the spill. Generally, the concentration of hydrocarbons in the water column would be high during the first several days following the spill, decreasing over time to background levels. While overall air-quality effects from tanker transportation would be considered low, an oil spill could result in localized increases in ambient volatile organic compounds concentrations caused by spill evaporation.

The potential effects of a 200,000-bbl oil tanker spill along the TAPS tanker route were analyzed in the *Gulf of Alaska/Yakutat Planning Area Oil and Gas Lease Sale 158 Environmental Impact Statement* (USDOI, MMS, 1995c). The *Northeast NPR-A Final IAP/EIS* (USDOI, BLM and MMS, 1998:Vol. 2, Appendix B) used that information to analyze tanker spills occurring from production in the Northeast NPR-A. That analysis affirms the conclusions (summarized above) of the Liberty EIS and is incorporated here by reference.

G. Unavoidable Adverse Effects

This section summarizes the unavoidable adverse effects that would occur under the alternatives considered in this IAP/EIS. Under the alternatives, the land allocations for oil and gas leasing range from making all BLM-administered lands in the Planning Area available for leasing (Alternative A and the Preferred Alternative) to making no lands available for leasing (No Action Alternative). Unavoidable adverse impacts would be expected to occur during oil and gas exploration, development and production operations. Many of the adverse effects identified in Sections IV and V of this IAP/EIS would occur only if a large oil spill were to occur; however, such an event is unlikely to happen. While the majority of the identified adverse impacts are either negligible or minor, in some cases there may be moderate to significant impacts as summarized below.

1. Soils

While small in area in relation to the overall area of the Northwest NPR-A Planning Area under consideration, the impacts to soils through disturbance or removal from exploratory drilling would be unavoidable and permanent. Development activities--such as the construction of permanent gravel pads, roads, airstrips, staging areas, or docks--may cause damage or loss of soil over the area affected. Construction of any oil and gas pipelines or the use of a gravel mine site will also permanently disturb or destroy soil in the immediate vicinity of the project. If a crude- or refined-oil spill occurs, the resultant impact to soils could extend beyond the immediate work area.

2. Paleontological Resources

Because paleontological resources are nonrenewable, any adverse effect would produce impacts. The significance of these impacts would depend on the importance of the paleontological deposits impacted. The deposits that are the least frequently occurring may have less risk of being impacted but may also represent unique information. For example, Cretaceous deposits, which could be argued in the world-view to be the most significant of the NPR-A's paleontological resources, are probably among the least likely to be impacted by activities in the Northwest NPR-A Planning Area. Invertebrate fossil remains are probably the most common component of the regional paleontological continuum, yet probably the least likely to be impacted. Quaternary-age remains are less common, yet given the contexts within which they are found, they are the most likely to be impacted. If surveys and inventories in areas of proposed oil and gas exploration and development activities are conducted before work begins and avoidance of potential paleontological resource sites is possible, then the incidence of impact would be greatly reduced and the impacts that do occur would be minimal or at a more acceptable level.

3. Water Resources

Activities from road and pad construction could produce unavoidable adverse effects on water resources. For example, culvert and bridge work in streams and lakes could disturb stream banks or shorelines; blockages of natural channels and floodways could disrupt drainage patterns; and removing gravel and water from riverine pools and lakes under Alternative A, Alternative B, or the Preferred Alternative could increase erosion and sedimentation. Because roads pose the single most significant impact to water resources from the diversions, impoundments, and increased sediments runoff they could create, limiting the length of the roads would be the most effective way of reducing impacts to water resources.

The short-term effect of construction would be some subsidence of the ice-rich permafrost along stream banks and lakeshores, especially in areas where the waves would accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost would increase sediment erosion and the changes to stream channel and bed morphology.

Water removal from pools and lakes may have short-term effects on water and other resources. Under Alternative A, Alternative B, or the Preferred Alternative, removing water from riverine pools may have much greater effect than removing water from lakes, since the seasonal fluctuation of river water depth makes it significantly harder to determine safe amounts of water removal from isolated deep pools within the largely frozen rivers.

4. Freshwater Quality

Unavoidable adverse effects on water quality could occur from the construction of ice roads and gravel pads, air strips, and roads. Construction disturbances would be permitted (approved) after subsequent environmental reviews and, impacts, therefore, could be minimized or avoided.

5. Estuarine Water Quality

Unavoidable adverse effects on estuarine water quality would occur from offshore ice-road and ice-pad construction. The construction would have very local, short-term effects on estuarine water quality.

Unavoidable adverse effects on estuarine water quality would occur from the construction of coastal staging facilities. Construction disturbances would be permitted (approved) after subsequent environmental reviews and, impacts, therefore, could be minimized or avoided. The construction would have very local, short-term effects on estuarine water quality.

Estuarine water quality could be affected also by the transport of supplies through estuaries--such as Admiralty Bay and Dease Inlet--to coastal supply bases. Diesel fuel would be shipped with the supplies. Oil spills are accidental events, so when they occur they are unavoidable. A diesel-fuel spill in an estuary such as Admiralty Bay or Dease Inlet could measurably degrade estuarine water quality and contaminate shorelines, in spite of proposed spill responses (Section IV.C.4.b (2)). The largest estimated area that might be affected would be slightly smaller than the area of a typical estuary like Admiralty Bay, and approximately equal to half the total Admiralty Bay coastline.

6. Air Quality

The Northwest NPR-A Planning Area activities would cause small, local increases in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration (PSD) Class II limits and National Ambient Air Quality Standards.

7. Vegetation

All of the direct impacts to vegetation described for Alternatives A, B, and C and the Preferred Alternative are unavoidable, given the occurrence of the activities causing them. However, not all of these impacts can definitely be judged as adverse, while some of those that are adverse would have effects for a short period. Seismic activities, overland moves, and exploratory drilling would occur during the winter when the ground is frozen and snow-covered. Such activites can cause impacts that linger into the following summer--or longer--in the form of vegetation that appears greener than surrounding areas and shallow water tracks and ponding. Impacts caused by oil/gas field development--such as burial of vegetation under gravel fill and contamination by oil spills--would have direct adverse effects. Placement of gravel drilling pads, roads, airstrips, staging areas, and docks, as well as construction of oil and gas pipelines and the use of a gravel mine site, will permanently disturb or destroy soil and vegetation. However, a change in plant composition--such as snowdrift and dust accumulation--account for about 65 percent of the area impact by oil/gas field development. These types of impacts would have an adverse effect on the original plant community and its associated fauna, but a beneficial, or countervailing, effect on the plant communities and fauna that colonize those areas.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Unavoidable adverse effects on freshwater and anadromous/amphidromous fish would include short-term avoidance behavior and stress related to seismic vibration activity; loss of habitat and reduced productivity created by gravel excavation in spawning, rearing, and overwintering areas; degradation and loss of habitat and mortality of fish eggs and larvae from erosion and sedimentation in streams and lakes; and lethal and/or sublethal effects to fish from oil spills. Oil-spill cleanup activities may compound adverse impacts to fish habitat; however, the effects are not likely to measurably impact fish populations in the region.

b. Marine Fish

Unavoidable adverse effects on marine fish would occur as a result of seismic surveys, construction in or near marine waters, marine vessel traffic, and oil and fuel spills. Seismic surveys located above or near overwintering areas may have lethal effects on some juvenile fish overwintering there. The construction of a coastal docking facility to offload supply barges adjacent to the Planning Area would adversely affect the movement of some coastal marine and migratory marine fish. The severity of the effects of such a docking facility would depend on its location, size, design characteristics, and whether the facility required an offshore access causeway. Marine vessel traffic used to support onshore industrial activities may temporarily disturb fishes. A very large spill (120,000 bbl) is estimated to adversely affect 5 to 20 percent of the marine fish population in the immediate area with an estimated 3 to 10 years for recovery.

9. Birds

Some disturbance of nesting, staging, or migrating birds by routine activities and oil and gas development is considered unavoidable. The main cause of disturbance would involve aircraft traffic (such as aerial wildlife surveys and aircraft support of camps or oil and gas activities), although the presence of camps and other human presence potentially could contribute. Fixed-wing and helicopter aircraft could fly over nesting areas at various altitudes, causing temporary disturbance effects such as movement of females off their nests or away from their broods, potentially allowing predators greater access to eggs or young. A small amount of disturbance of birds present in coastal and/or marine environments during the open water season by helicopters is considered unavoidable when routine or oil and gas activities are occurring. Because alternate habitat areas for foraging and staging are available and disturbance effects would be temporary and minimized through compliance with mitigation measures, effects from these factors on birds are likely to be negligible.

10. Mammals

a. Terrestrial Mammals

Some disturbance and disruption of caribou and some habitat alterations from oil development under Alternatives A through C are unavoidable. Displacement or reduced habitat use by the TLH, WAH, and CAH of caribou is likely to be local (within 3 to 4 km [1.86 to 2.48 mi] of oil field roads and pipeline corridors) and long term (>1 generation), and could persist over the life of the oil fields. Some noise and disturbance of other terrestrial mammals would be unavoidable but would be short term and local and would not significantly affect mammal populations.

b. Marine Mammals

Provisions under the Marine Mammal Protection Act require lessees to obtain Letters of Authorization that direct them to avoid disturbance to polar bear dens and require the use of nonlethal means to avoid human-bear interactions. Seismic surveying; air, vessel, and ice road traffic; and construction activities would unavoidably disturb small numbers of seals and perhaps a few polar bears, but this effect would be very brief and not affect seal and bear population abundance or overall distribution in the NPR-A. If an accidental fuel or crude-oil spill were to occur onshore near Dease Inlet/Admiralty Bay and if spilled oil were to reach the marine environment, such a spill could perhaps result in the unavoidable loss of a small number of seals and polar bears, with recovery of the population likely to occur within 1 year.

11. Endangered and Threatened Species

Bowhead whales are not usually found within the Northwest NPR-A Planning Area boundary. However, some disturbance from noise produced by marine vessel traffic supporting oil and gas activities in the Planning Area may be unavoidable if bowheads are migrating past the northern Planning Area boundary. This would be particularly true if the whales' migration route were closer to the offshore barrier islands near Point Barrow than is typical (median migration distance offshore = 32.5 km). Because vessel noise alone is likely to result in only minor changes in whale behavior (Richardson, 1999), disturbance from such vessel activity would probably not preclude whale migration or disrupt feeding activities on a long-term basis.

Some disturbance of nesting, staging, or migrating spectacled and Steller's eiders by routine activities associated with oil and gas exploration and development is considered unavoidable. The main cause of disturbance would be aircraft traffic (such as aerial wildlife surveys and aircraft support of camps or oil and gas activities), although the presence of camps and other human presence potentially could contribute. Fixed-wing and helicopter aircraft could fly over eider-nesting areas at various altitudes, causing temporary disturbance effects such as movement of females off their nests, potentially allowing predators greater access to eggs. Because alternate habitat areas for foraging and staging are available and disturbance effects would be temporary and minimized through compliance with mitigation measures, effects from these factors on birds are likely to be negligible to minor.

The BLM expects most disturbances of endangered and threatened species associated with routine activities to be minimized or avoided through compliance with mitigation measures developed through the Endangered Species Act Section 7 consultation process.

12. Economy

Most economic effects of oil and gas leasing, exploration, developement, and production in the Northwest NPR-A Planning Area would be considered positive effects by many people. Increases in employment and associated personal income would occur over the life of the exploration, development, and production activities. Revenue increases to the NSB, and to the State and Federal Governments would occur during production years. However, these increases would be short-term (less than 30 years)--occurring only for the duration of the activities. Development activity would establish infrastructure that could enhance the future productivity of oil and gas exploration, development, and production.

13. Cultural Resources

Cultural resources are nonrenewable, so any adverse effect can be viewed as having some significance. Because the exact locations of cultural resources sites are unknown, their disturbance cannot be entirely avoided. There are sites or occurrences within the Northwest NPR-A that relate to the entire span of human occupation of the region. This probably includes locales relating to the first humans to enter the Western Hemisphere. The least frequently occurring sites can reasonably be considered the most important because they represent circumstances about which little is known--either in terms of a cultural group, exploitation of an area, or an activity engaged in. By the same token, if they are rare, their occurrence on the landscape is low and the probability of their being impacted is greatly reduced. If surveys and inventories of areas of proposed oil and gas exploration and development activity are conducted before the work begins, then the incidence of impact should be greatly reduced and what impact does occur would be at a more acceptable level.

14. Subsistence-Harvest Patterns

Seals, polar bears, caribou, fish, birds, and especially bowhead whales are important subsistence resources. Noise and disturbance from seismic, exploration, and development and production, should it occur, could effect subsistence resources periodically in the communities of Barrow, Wainwright, Point Lay, Nuiqsuit, and Atqasuk. Additionally, disturbance could cause potential short-term but adverse effects to long-tailed ducks and some eider populations. No harvest areas would become unavailable for use.

Overall, while noise and traffic disturbance and oil spills would produce chronic, short-term impacts on subsistence species, none of these losses would lead to elimination of any subsistence harvest. Disturbance and displacement effects on caribou could lead to an unavoidable reduction in the total annual caribou harvest by making their pursuit more difficult for subsistence hunters. Other effects on other species and harvests from noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing the overall level of effects from these sources. If oil and gas infrastructure is located in subsistence hunting areas, some restrictions on subsistence hunters' access would be unavoidable.

15. Sociocultural Systems

The inability to harvest sufficient quantities of bowhead whales due to disturbance could cause unavoidable effects on Inupiat traditional practices of harvesting and sharing. Disturbance effects on caribou, could disrupt sociocultural systems for an entire season or more and create disruption to institutions and sociocultural systems; nevertheless, these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing resources. Federal, NSB, and community-supported social programs with adequate funding would mitigate many of the sociocultural consequences of oil and gas development in the Planning Area. There is a potential for unavoidable repercussions to the communal practice of sharing of subsistence resources.

16. Environmental Justice

The Environmental Justice E.O. includes consideration of potential effects to Native subsistence activities. The only substantial source of potential unavoidable environmental-justice-related effects on Native communities from oil and gas exploration and development in the Planning Area would occur from long-term population and productivity effects to the Teshekpuk Lake herd (TLH) of caribou as a result of exploration and development in critical insect-relief areas. The Native communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut all harvest caribou from the TLH. Noise and disturbance from routine activities would be unavoidable, but is not expected to produce disproportionate, high adverse Environmental Justice impacts on the Alaskan Native minority populations in these communities.

17. Coastal Zone Management

The scenarios assumed for this EIS, specifically the No Action Alternative and Alternative A, are neither expected to result in unavoidable adverse effects related to major changes in land use nor to result in conflicts with the ACMP, including the NSB Coastal Management Program. To the extent that facilities would be sited and designed to minimize disturbance and the effects of an oil spill on the environment, conflicts with the statewide standards and the NSB policies are avoidable. It is expected that activities generally will conform to existing policies of local, State, and Federal land use plans and coastal management programs.

18. Recreation Resources and Wilderness

Adverse effects to scenic quality, solitude, naturalness, and primitive/unconfined recreation from oil and gas exploration and development are unavoidable. These effects would be a direct result of exploration and development activities and facilities such as drill pads and pipelines. Recent and future technological advances may make green trails and pads an avoidable impact.

19. Wild and Scenic Rivers

River values that would be protected by designating any of the 22 eligible streams as components of the Wild and Scenic River (WSR) System are: free-flow, unpolluted waters, subsistence, fisheries, and wildlife and cultural resources. Unavoidable adverse effects on these river values are more specifically addressed in the sections dealing with water resources, subsistence, fisheries, wildlife, and cultural resources.

Under Alternative A, Alternative B, and the Preferred Alternative, no rivers would be found suitable for inclusion in the national WSR System. Unavoidable adverse effects on river values would occur as a result of oil and gas exploration, development and production activities, but this would not affect the finding of nonsuitability.

Under Alternative C, all eligible rivers would be found suitable for inclusion in the national WSR System. Oil and gas development would be very limited under Alternative C and any development would be subject to mitigating measures that would protect, to the extent possible, the free-flowing, unpolluted waters and the remarkable values of subsistence, fisheries, wildlife, and cultural resources. As a result, under Alternative C, unavoidable adverse impacts to these river values would be less likely.

20. Visual Resources

Unavoidable adverse effects to visual resources (i.e., the viewsheds and naturalness of the landscape), would occur from oil and gas exploration and development. These effects would be a direct result of oil and gas exploration and development activities and facilities such as drill pads, roads and pipelines. Recent and future technological advances may make green trails and pads an avoidable impact.

21. Wetlands and Floodplains

Wetlands and floodplains include those resources within the Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Biological resources that would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope include: vegetation; soils; water resources; freshwater quality; and estuarine water quality.

Please refer to the discussions in this section for each of these resources regarding information on unavoidable adverse affects on wetlands and floodplains.

H. Relationship between the Local Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity

This section discusses the short-term effects of the potential use of portions of the Planning Area for oil and gas exploration and development activities versus the maintenance and enhancement of potential long-term productivity of the Planning Area's environmental resources.

Short-term refers to the total duration of oil and gas exploration and production activities, whereas long-term refers to an indefinite period beyond the termination of oil and gas production. The specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Initial activities, such as seismic surveying and exploration drilling, result in short-term, localized impacts. Development drilling occurs sporadically throughout the life of an oil or gas field, but also results in short-term, localized impacts. Activities during the production life of a field may result in chronic impacts over a longer period of time (25 to 35 years), potentially punctuated by more severe impacts as a result of accidental events. Platform removal is also a short-term activity with localized impacts; the impacts of site clearance may be longer lasting. Over the long term--several decades--natural environmental balances are expected to be restored.

Until more reliable data become available, the long-term effects of chronic of major spills of hydrocarbons cannot accurately be projected. In the absence of this data, it must be assumed that the possibility of decreased long-term productivity exists, if chronic spills or a major large oil spill were to occur.

1. Soils

Soils potentially affected by exploration practices cover very small areas (< 1 acre total under Alternative A). Onshore construction activities and oil spills could result in local damage or destruction of soils. Replacement of soils after well abandonment may allow soils to eventually re-establish. While the formation of soils is a very slow process, projected short-term uses have very small long-term effect. Soils lost through permanent facilities have little opportunity under current technique for maintenance or recapture of their values and the loss is essentially permanent.

2. Paleontological Resources

Because paleontological resources are nonrenewable, there is no difference between short-term and long-term impacts. The resource cannot recover from some types of adverse impacts. Once disturbed, the materials and information of paleontological deposits may be significantly and permanently compromised. Any destruction of paleontological sites would represent long-term losses. Any discoveries of paleontological resources as a result of surveys required prior to development of a lease would enhance long-term knowledge of the area and these resources.

3. Water Resources

The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities that disturb stream banks or lake shorelines, temporary blockages of natural channels, and removal of gravel would all cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water resources. Removal of these structures from streams and lakes after production ceases would restore drainage patterns and natural sedimentation processes. Long-term changes could occur where thermokarst erosion has caused major changes in stream banks, lake shorelines, and altered natural drainage patterns.

4. Freshwater Quality

The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities associated with road and pad construction, culvert and bridge work in streams and lakes that disturbs stream banks or shorelines, blockages of natural channels and floodways that disrupt drainage patterns, and removal of gravel would all cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water resources. Magnitude and duration of effects would vary with the type and extent of the activities.

Degradation of water quality from construction and operation of oil field(s), winter ice roads, and spills could be a long-term effect on isolated water bodies.

5. Estuarine Water Quality

There would be both short- and long-term effects on estuarine water quality. Short-term effects would include those from the construction of offshore ice roads or ice pads. Long-term effects would include those from the construction of offshore gravel docks (Sec. IV.C.5.b (1)(c)). Although most of the effects of offshore oil spills would be short term, if oil contaminated shorelines, the effects would remain longer (Sec. IV.C.5.b (2)). Spilled oil would persist on some types of shorelines for many years, and possibly for more than a decade (www.oilspill.state.ak.us/facts/lingeringoil.html).

6. Air Quality

Air pollution resulting from oil and gas exploration and development activities would be a short-term and local effect. The analysis of air-quality effects indicates that, although the pristine air quality of the Planning Area may be impaired temporarily and very locally, long-term effects for air quality would be insignificant (see Sec. IV.C.6).

7. Vegetation

The effects of management actions other than oil/gas development on vegetation would be short term. Seismic activities, overland moves, and exploratory drilling all occur during the winter when the ground is frozen and snow covered. Impacts from these winter activities can linger into the following summer--or longer--in the form of vegetation that appears greener than surrounding areas and shallow water tracks and ponding. The construction of well collars for exploration wells and the most severe impacts of vehicles during overland moves and seismic exploration would affect vegetation for the long term. All effects on vegetation of oil-field construction would be long term, though oil spills and dust and gravel spray from vehicular traffic on the gravel pads would not occur after field abandonment. The recovery time for vegetation from spills would extend briefly into the long term (Jorgenson, 1997; McKendrick, 2000), but it is not known how long changes to the plant community from dust effects would persist. Although research indicates that natural plant communities can be restored to gravel pads (McKendrick, 1997)--especially if some silt-loam soil is added to the substrate--the time until recovery of a natural canopy cover would be so long that the impacts might be considered permanent from a human perspective. As a result, the long-term productivity of these localized areas would be reduced, but these areas represent l $<$ 0.1 percent of the Planning Area. Placement of gravel drilling pads, roads, airstrips, staging areas, and docks--as well as construction of pipelines or the use of a gravel mine site--will permanently disturb or destroy soil and vegetation.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Impacts to fish resources and habitat associated with this plan would occur from oil and gas exploration and development. Most impacts are expected to be short term and confined to small segments of habitat and localized components of the fish population. Although seismic surveys, construction activities, and oil spills are of particular concern, disturbances are unlikely to result in decreased long-term productivity of fish populations. The exception would involve an oil spill in a waterbody with no migration pathways. Losses in a specific waterbody would be permanent if all individuals of a species were killed in a spill.

b. Marine Fish

Some marine fish could be lethally or sublethally affected by the Northwest NPR-A lease sale, but the number is likely to be too small to be biologically significant or measurable at the population level. These effects are likely to be relatively short term and recovery would be expected within 3 years. A hypothetical very large spill (120,000-bbl oil spill) is estimated to affect 5 to 20 percent of the marine fish in the area, and its effect would last longer. Full recovery from a spill of this size would be expected in 3 to 10 years, depending on the amount of oil reaching the nearshore area, and the amount of shoreline oiled.

9. Birds

Birds may experience short-term adverse effects from any factors or activities that disturb their normal daily and seasonal pattern of activities. Of the routine activities associated with oil and gas exploration and developement, helicopter and occasional marine support vessel traffic have the greatest potential for disturbing birds. Helicopter flights are expected to occur throughout the life of this project. Although much of the potential effect of air traffic could be avoided through compliance with the stipulations, required operating procedures, and standardized mitigation measures, aircraft may have to fly at lower altitudes and cross different parts of the coast under inclement weather conditions. Under these conditions, disturbance of birds under the flight path could occur and continue to occur throughout the life of the project.

Habitat-modification effects are likely to be short term, although loss of habitat will be a long-term effect. Nesting or brood-rearing habitat lost where infrastructure is constructed would be a long-term effect, but alternative habitat is widespread, so the effect on bird populations probably would be short term. Any substantial mortality of birds colliding with structures is likely to be long-term, particularly when their populations are in a declining status. The duration of effects resulting from mortality-causing factors (e.g., collision of birds with structures) will be determined by the magnitude of the loss and the size and status of the regional population. Small losses from populations that are currently increasing, stable, or declining at a nonsignificant rate are expected to be short term, while a substantial loss experienced by a population in significant decline--or any loss experienced by a population declining at a significant rate--is likely to be long-term. Any mortality experienced by species whose populations are very small (whether increasing or decreasing at a nonsignificant rate) may result in a long-term effect because of the population size.

10. Mammals

a. Terrestrial Mammals

Most effects on terrestrial mammals and their habitats from non-oil and gas activities and from oil and gas exploration would be short term. Short-term, localized, adverse effects on terrestrial mammals and their habitats could occur in the event of an oil spill, although oil spills in the Planning Area are expected to be small and not likely to affect a large area. Potential effects include mortality of individuals, physiological stresses in surviving individuals, reduction in the number of species or species populations in the affected area, changes in the distribution of species or individuals, and changes in behavior or migration patterns. Long-term, cumulative effects might occur if recovery from the short-term effects extended beyond the field production life. The potential effects of noise disturbance and terrestrial habitat alteration may also include short-term, localized effects such as mortality, stress, population or species decreases or redistribution, and changes in survival patterns. Effects of oil and gas development on terrestrial mammals and their habitat would be long term (beyond the production life of the field). Long-term biological productivity could be lost from those areas used as facility sites.

b. Marine Mammals

Noise, disturbance, and habitat alteration from offshore construction activities and oil spills would temporarily affect some individual marine mammals and their habitats. These effects are expected to be local. Disturbances and altered habitat may possibly result in local displacement, mortality, or stress of some species, or decreases or reductions in local abundance of some species. Effects could possibly last over the long term if recovery from the short-term effects extended beyond the field's estimated useful life.

11. Endangered and Threatened Species

Bowhead whales whose migratory path lies closer to shore than the median migration distance offshore (32.5 km, Treacy, 2002) potentially may be disturbed by noise from oil- and gas-related marine vessel traffic during the fall migration period. Aircraft traffic associated with development during the fall migration period potentially could disturb whales migrating very near shore. Since most of these activities are temporary, effects would be short term and potentially occur annually over the life of a field. In the unlikely event of a large oil spill, there could be long-term effects to the bowhead population from residual oil and continuing clean-up activities.

Spectacled and Steller's eiders may experience short-term adverse effects from any factors that disturb their normal daily and seasonal pattern of activities. During oil and gas field development, frequent aircraft (helicopter) and occasional marine support vessel traffic would cause the most disturbance. Nesting or brood-rearing habitat lost where infrastructure is constructed would be a long-term effect, but alternative habitat is widespread, so the effect on eiders probably would be short term. The duration of effects resulting from mortality-causing factors--principally collision of eiders with structures--although likely to generate minor losses, will be determined by the magnitude of the loss and the size and status of the regional population. Small losses from the spectacled eider population (currently declining at a nonsignificant rate), would be expected to be short term, while any substantial loss would be likely to be long term. The Steller's eider population, although currently stable or increasing at a nonsignificant rate, would be likely to experience a long-term effect from any loss because of the small size of the regional population.

12. Economy

Economic benefits would accrue from production of oil and gas from of Federal lands. Economic benefits--including any decrease in the Nation's dependency on foreign oil--would be short term. Increases in employment and associated personal income would occur over the life of the exploration, development, and operations activities. Revenue increases to the NSB and to the State and Federal Governments would occur during production years. However, these increases would occur only for the duration of the activities. Development activity would result in infrastructure that could enhance future productivity of oil and gas exploration, development, and production.

13. Cultural Resources

Because cultural resources are nonrenewable, there is no difference between short-term and long-term impacts. The resource cannot recover from most types of adverse impacts. Once disturbed, a cultural deposit cannot be returned to its original context. Any destruction of cultural resource sites would represent long-term losses. Any discoveries of cultural resources as a result of surveys required prior to development of a lease would enhance knowledge of the history and early inhabitants of the region.

14. Subsistence-Harvest Patterns

In the short term, the redistribution, reduction, tainting, or displacement of subsistence species could affect regional subsistence-harvest patterns. Such short-term effects on subsistence-harvest patterns would not be expected to have long-term consequences except as a source of social disruption or unless chronically imposed on the subsistence resource base of the region. Habitat destruction could cause a local reduction in subsistence species--a potential long-term impact to those communities affected by such reductions.

15. Sociocultural Systems

Increased population, industrial activity, and minor gains in revenues and employment potentially could disrupt Native communities in the short term. Short-term effects on subsistence resources would disrupt social systems if they were to occur repeatedly (chronic) over the lifetime of potential oil and gas activities (about 30 years). Habitat destruction would locally reduce or displace subsistence species--a long-term effect on the regional subsistence economy and the sociocultural and cultural institutions.

16. Environmental Justice

Any impact on subsistence resources that would have a chronic effect on the sociocultural system over the lifetime of potential oil and gas activities (about 30 years) would be considered a disproportionately high adverse effect on the Inupiat people. Such an effect would only be expected to occur in the event of long-term population and productivity effects to the TLH of caribou. The Native communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut harvest caribou from the TLH.

17. Coastal Zone Management

Land use could change along pipeline routes. If land use in parts of the Planning Area were to shift from subsistence-based activities to industrial activities, and if, after production ceased, use of the land reverted to subsistence, the effect would be short term. Long-term effects on land use could result if use of the infrastructure or facilities were to continue after the production life were over. Potential users could be other resource developers, residents and nonresidents who had become accustomed to the convenience of using existing facilities, such as roads.

18. Recreation Resources and Wilderness

Short-term use of portions of the Planning Area for oil and gas development could adversely affect the long-term use and value of recreation and wilderness resources. Rehabilitation and removal of pads, roads, and facilities could not restore the original condition of the land or its original recreation and wilderness value. If airstrips were not removed and/or rehabilitated, then recreation opportunities in that area could be enhanced by providing access. However, scenic quality, naturalness, and primitive/unconfined recreation still would be negatively impacted by the presence of the airstrip.

19. Wild and Scenic Rivers

River values that would be protected by designating any of the 22 eligible streams as components of the national Wild and Scenic River (WSR) System are: free-flow, unpolluted waters, subsistence, fisheries, wildlife and cultural resources. The relationship between short-term uses and long-term productivity on these river values is more specifically addressed in the sections dealing with water resources, subsistence, fisheries, wildlife, and cultural resources.

Under Alternatives A and B, no rivers would be found suitable for inclusion in the national WSR System. A significant short-term commitment of resources would be made to oil and gas exploration, development, and production activities. This commitment may have some impact on river values. For example, cultural resources, which are nonrenewable, might be affected in the long term. The short-term commitment of resources would not affect the finding of nonsuitability of these rivers.

Under Alternative C, all rivers would be found suitable for inclusion in the national WSR System. A limited short-term commitment of resources is made to oil and gas activities. River values would be protected by mitigating measures, and no long-term impacts to these values would be likely.

20. Visual Resources

Short-term use of portions of the Planning Area for oil and gas development could adversely affect the long-term value of visual resources. Rehabilitation, removal, and revegetation of pads, roads, and facilities would eventually cause the viewshed to resemble its original condition. However, the full value of the original scenic quality and viewshed may not be regained. Visual resources could still be negatively impacted by any remnants of oil and gas activities and by changes from the original landscape.

21. Wetlands and Floodplains

Wetlands and floodplains include those resources within the Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Biological resources that would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope include: vegetation; soils; water resources; freshwater quality; and estuarine water quality.

Please refer to the discussions in this section for each of these resources regarding information on the relationship between local short-term uses and maintenance and enhancement of long-term productivity of wetlands and floodplains.

I. Irreversible and Irretrievable Commitment of Resources

Irreversible or irretrievable commitments of resources refers to impacts or losses to resources that cannot be reversed or recovered. Examples are when a species becomes extinct or when wetlands are permanently converted to open water. In either case, the loss is permanent. The following section identifies irreversible and irretrievable commitment of resources that would occur if the leasing occurs and results in oil and gas exploration, development, and production.

1. Soils

Soils covered by gravel pads, roads, etc. are lost with respect to their value (such as a medium for the growth of vegetation) as soils. Removal of gravel pads may retrieve some soils but it is unlikely. Disturbed soils may re-establish over time, but soil development in cold climates is a very slow process. The desirable mitigation for soils is to minimize the total area lost through careful use of the surface, creative design practices and the use of shared facilities.

2. Paleontological Resources

Paleontological resources are nonrenewable, so any adverse impacts can be considered to render the resource disturbance irreversible and the integrity of the resource irretrievable. If surface or near-surface paleontological remains were to be buried by the construction of a gravel pad or road, while possibly not damaging in itself, they would likely be severely impacted upon removal of the overlying materials. Deeply buried paleontological deposits would not be affected by gravel pad/road construction or removal, but could be damaged or destroyed if encountered during development of a gravel mine site. The loss of such paleontological information would be irreversible and irretrievable.

3. Water Resources

Thermokarst erosion along gravel roads and pads could result in major changes to stream banks, lake shorelines, and altered natural drainage patterns that would last long after the life of the field(s). While there would be no irreversible or irretrievable effect on water resources, the restoration of the natural drainage could take years after the field(s) are abandoned, equipment removed, and the roads and pads rehabilitated.

4. Freshwater Quality

Thermokarst erosion along gravel roads and pads could result in degraded water quality that would last long after the life of the field(s), but the effects would not be irreversible.

5. Estuarine Water Quality

The effects with the longest time frames would be those resulting from offshore gravel docks and/or open-water oil spills that contaminate shorelines. Because full recovery is expected following either abandonment of docks or cleanup of spills, no irreversible and irretrievable commitment of resources is expected.

6. Air Quality

No irreversible or irretrievable effects to air quality would occur. All air-quality effects would be local and short term.

7. Vegetation

The vegetation communities of Alaska's North Slope evolve through several phases over periods of decades or centuries. This is especially true for the ACP, where ice and thaw lakes create a constantly changing landscape (Bergman et al., 1977). Therefore, changes in plant communities resulting from dust or snowdrift accumulations would not be considered irreversible. The burial of vegetation under gravel fill is a different situation. The potential recovery of vegetation on these pads would take such a long time that, from a human perspective, this may be considered an irretrievable commitment of vegetation resources.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Arctic fish in and near the Planning Area would be exposed to overland seismic surveys, construction-related activities, and oil and fuel spills associated with oil and gas exploration and development. A relatively small number of fish is likely to be adversely affected by these activities and the agents associated with them. Fish populations are not expected to experience any irreversible and irretrievable effects associated with activities undertaken as a result of this IAP/EIS.

b. Marine Fish

While some marine fish could be lethally or sublethally affected by the Northwest NPR-A lease sale, requiring up to 3 years for full recovery, these effects are not likely to be biologically significant or measurable at the population level. The exception would be the hypothetical 120,000-bbl oil spill discussed in the text. Depending on the amount of oil deposited in the nearshore area during summer, and the amount of actual shoreline oiled, a 120,000-bbl oil is estimated to adversely affect 5 to 20 percent of the marine fish population in the sale area (estimated 3 to 10 year recovery). Because full recovery is expected following any oil spill, no irreversible and irretrievable commitment of resources is expected.

9. Birds

Some irretrievable/irreversible loss of habitat could occur from the placement of facilities and infrastructure in bird nesting or brood-rearing habitat, particularly that occupied by waterbirds and shorebirds. Because alternate habitat areas for critical activities are available, any habitat loss would be a minor effect. Disturbance effects would last only as long as the causative activity. Loss of individual birds through collision with facilities or structures is irretrievable, however, such losses are not expected to have an irreversible effect on regional populations.

10. Mammals

a. Terrestrial Mammals

It is possible that caribou and other terrestrial mammals could be subjected to direct and indirect effects of disturbance caused by noise and movement of motor vehicles and aircraft, other human activities, oil spills, natural gas blowouts, or losses and/or deterioration of habitat because of facility developments. It is likely that such effects would lead to some permanent (irreversible) losses of these resources.

b. Marine Mammals

Seals, walruses, polar bears, and beluga whales could be subjected to direct and indirect effects of oil spills, disturbance caused by noise and movement of aircraft and vessels, and other human activities. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources.

11. Endangered and Threatened Species

For threatened and endangered species, any irretrievable or irreversible commitment of resources important to the long-term survival and recovery of that species probably would violate the intent of the ESA. Since the bowhead whale population is increasing and effects from noise are likely to be temporary, no irreversible/irretrievable losses are likely. Any deterioration of bowhead auditory environment resulting from noise-producing activities in coastal areas would last only as long as the causative activity. Some irretrievable/irreversible loss of habitat could occur from location of facilities in spectacled or Steller's eider nesting or brood-rearing habitat. Because alternate habitat areas for critical activities are available, any habitat loss would be a minor effect. Disturbance effects would last only as long as the causative activity. Any losses of individual eiders through collision with facilities or structure are irretrievable. It is possible that habitats used by endangered or threatened bird species could be irretrievably or irreversibly altered by activities associated with oil and gas exploration and development. However, as long as the area modified is not critical habitat for that species and there is sufficient alternate locations to permit recovery, any effects are expected to be local, short-term, and negligible importance for the recovery of the population.

12. Economy

Increases in employment and personal income would occur over the life of the exploration, development and operation activities. Employment in oil- and gas-related activities represents a loss of opportunity for workers to pursue employment in other fields. Investment by the lessees and operators in oil and gas exploration and development activities in the Planning Area represents a loss of opportunity to invest those monies elsewhere. Revenue increases to the NSB and the State and Federal Governments that would occur during production years would result in the irreversible and irretrievable commitment of those revenues. Development would result in new infrastructure that would be removed at the end of production.

13. Cultural Resources

Cultural resources are nonrenewable, so any adverse impacts can be considered to render the resource disturbance irreversible and the integrity of the resource irretrievable. Since all cultural resources exist in a surface or near-surface context, burial by the construction of a gravel pad or road, while possibly not damaging in itself, would severely impact the resource upon removal. If cultural resources are encountered in the development of a gravel mine site, such resources could be damaged or destroyed. The loss of such cultural resource information would be irreversible and irretrievable. Any discovery of cultural resource data as a result of surveys required prior to development of a lease, would enhance long-term knowledge. Overall, such finds could help fill gaps in our knowledge of the history and early inhabitants of the area.

14. Subsistence-Harvest Patterns

Many important aspects of Inupiat society and culture are centered on subsistence activities (see Sec. III.C.3). Virtually every family in North Slope coastal communities participates in the hunting of the bowhead whale and the sharing of its meat. The activities associated with the taking of caribou, fish, birds, and seals are somewhat less important to the cultural integration of the region as a whole, but they are of equal importance to the social organization of each community, as well as the domestic economies of most households. The inability to harvest sufficient quantities of these resources would be an irreversible and irretrievable loss to the Inupiat diet, to Inupiat traditional practices of sharing and reciprocity, and to fundamental aspects of Inupiat identity.

15. Sociocultural Systems

Disruption of the traditional harvest of bowhead whale and caribou could constitute an irreversible and irretrievable loss to Inupiat social and cultural values. The contribution of oil and gas development in the Planning Area to the cumulative consequences of offshore and onshore energy development could--in conjunction with other processes of social change in the long term--lead to the irretrievable loss of Inupiat cultural behaviors and traditional practices.

16. Environmental Justice

Long-term population and productivity effects to the Teshekpuk Lake heard (TLH) of caribou from oil and gas development in critical insect-relief areas could produce irreversible and irretrievable effects to the herd and to the subsistence caribou hunt in Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut--communities that harvest caribou from the TLH.

17. Coastal Zone Management

There are no anticipated conflicts with the statewide standards of the Alaska Coastal Management Program or the enforceable policies of the NSB Coastal Management Program. Development activity would result in infrastructure, but the majority of the infrastructure would be inside the boundaries of the NPR-A. Some infrastructure, such as pipelines, could be located outside the Planning Area within the boundaries of the NSB but such infrastructure could be removed after development ends.

18. Recreation Resources and Wilderness

There would be no irreversible and irretrievable commitment of recreation resources and wilderness. Proper rehabilitation and removal of development pads, etc. would restore the perception of a natural environment. Wilderness values would be forgone in those areas affected by development for the duration of the development, rehabilitation and recovery.

19. Wild and Scenic Rivers

River values that would be protected by designating any of the 22 eligible streams as components of the Wild and Scenic River (WSR) System are: free-flow, unpolluted waters, subsistence, fisheries, wildlife, and cultural resources. Irreversible and irretrievable impacts on these river values are more specifically addressed in the sections dealing with water resources, subsistence, fisheries, wildlife, and cultural resources.

Under Alternative A, Alternative B, and the Preferred Alternative, no rivers would be found suitable for inclusion in the national WSR System. Irreversible and irretrievable impacts on river values are possible as a result of oil and gas development and production activities, but this would not affect the finding of nonsuitability.

Under Alternative C, all eligible rivers would be found suitable for inclusion in the national WSR System. Oil and gas development would be very limited under Alternative C and any development would be subject to mitigating measures that would protect, to the extent possible, the free-flowing unpolluted waters and the remarkable values of subsistence, fisheries, wildlife, and cultural resources. As a result, under Alternative C, irreversible and irretrievable impacts to these river values would be unlikely.

20. Visual Resources

There would be no irreversible or irretrievable commitment of visual resources. Proper removal, rehabilitation and revegetation of development pads and other facilities would restore the perception of a natural environment. To the casual observer, viewsheds would appear natural.

21. Wetlands and Floodplains

Wetlands and floodplains include those resources within the Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Biological resources that would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope include: Vegetation; Soils; Water Resources; Freshwater Quality; and Estuarine Water Quality.

Please refer to the discussions in this section for each of these resources regarding information on irreversible and irretrievable commitment of resources in relation to wetlands and floodplains.

22. Oil and Gas Resources

Oil and gas resources are economic oil and gas pools expected to be leased, discovered, developed, and produced as a result of leasing in the Northwest NPR-A Planning Area. The oil and gas resource estimates for a single lease sale under each alternative considered in this IAP/EIS are presented in Table IV-04. The oil and gas resource estimates for multiple lease sales under each alternative considered in this IAP/EIS are presented in Table IV-06. For the highest case scenario, approximately 1,470 million barrels of oil and 5.10 trillion cubic feet of gas are estimated to be produced under the high economic scenario ($30/bbl of oil) for multiple sales under Alternative A. Should these resources be produced, they would be irretrievably consumed. In the unlikely event of a large oil spill, the amount of oil spilled would be irretrievably lost.

J. Low-Probability, Very Large Oil Spill

1. Introduction

This section discusses the potential effects of a very large oil spill in the Northwest NPR-A Planning Area. A very large spill is defined as greater than or equal to 120,000 bbl of oil. A very large oil spill is a low-probability event with the potential for severe effects. A similar analysis of a very large tanker or pipeline spill was included in Appendix B of the *Northeast NPR-A Final IAP/EIS* (USDOI, BLM and MMS, 1998, vol. 2) and is incorporated here by reference. Various scenarios for large pipeline spills were analyzed in the recent Final EIS for the TAPS pipeline (USDOI, BLM, 2002)(see summary in Section IV.F.10). Because very large spills happen so infrequently, there is limited historical data for use in statistical analysis and prediction.

The record of Alaska North Slope blowouts is not validated, but is presented as the best available information. Although the State of Alaska does not maintain a database of North Slope well-control incidents, the Alaska Oil and Gas Conservation Commission (AOGCC) maintains an internal documentation of blowouts in Alaska. Neither of the authors cited below (Fairweather, 2000; Mallory, 1998) was allowed to review the documentation.

The AOGCC assured Fairweather that no blowouts had been overlooked.

There are two written reports regarding blowouts on the Alaska North Slope--Mallory (1998) and Fairweather (2000). Mallory (1998) presents the following data based on discussions with long-time Alaska drilling personnel in ARCO Alaska or BP Exploration Alaska (BPXA). In the period 1974-1997, an estimated 3,336 wells were drilled on Alaska's North Slope. Research conducted to date documented six cases of loss of secondary well control with a drilling rig on the well. The documentation does not differentiate between exploration and development wells. No oil spills, fires, or loss of life occurred in any of the events (Mallory, 1998).

Fairweather (2000) differentiated between a blowout and a well-control incident. A blowout was defined as an uncontrolled flow at the surface of liquids and/or gas from the wellbore resulting from human error and/or equipment failure. Fairweather (2000) found 10 blowouts, the 6 blowouts that Mallory had identified and 4 blowouts that occurred before 1974. Of the 10 blowouts, 9 were gas and 1 was oil. The blowout of oil in 1950 was unspectacular and could not have been avoided, as there were no casings or blowout preventers available (Fairweather, 2000). These drilling practices from 1950 would not be relevant today.

A third study confirmed that no crude-oil spills greater than or equal to 100 barrels occurred from blowouts between 1985 and 1999 (Hart Crowser, Inc., 2000). The record of oil spills from blowouts less than 100 bbl has not been searched by Hart Crowser, Inc.(2000).

The largest spill from a blowout in Federal waters was 80,000 bbl from the blowout in Santa Barbara Channel in 1969. One other Federal spill greater than 50,000 bbl has occurred since offshore drilling began in the United States--in the Gulf of Mexico in 1970. Because there have been no spills greater than or equal to 120,000 bbl in U.S. waters from blowouts, worldwide historical spill data must be incorporated to estimate the chance of a very large spill occurring. The information used here is based on spills from countries that do not have the regulatory standards that are enforced on the OCS or BLM lands. In addition, some drilling practices used elsewhere either are not practiced here or are against MMS and BLM regulations.

Internationally from 1979 through 2000, five oil-well blowouts greater than or equal to 10 million gallons (238,000 barrels) have occurred (*Oil Spill Intelligence Report, 1996*; Cutter Information Corp., 1997; DeCola, 2001). The blowouts mostly were the result either of war or of drilling practices that oil companies do not now use and are not allowed to use under MMS regulations in the United States. During this same time period, there were roughly 470,506 billion barrels of oil produced worldwide (British Petroleum, 2001; *Statistical Review of World Energy, 1997*, and earlier issues). These data produce a rate of about 0.01 blowout greater than or equal to 10 million gallons per billion barrels produced. If this rate is applied to Alternative A for Northwest NPR-A, the estimated probability of one or more oil spills of 10 million gallons (238,000 barrels) is 0.0074 or 0.7 percent over the lifetime of the project.

S.L. Ross Environmental Research Ltd. (1998) calculated the chance of an extremely large oil spill (greater than 150,000 bbl) from a blowout with an average number of wells from the Northstar and Liberty projects using worldwide spill frequencies similar to those presented in the preceding paragraph.

Scandpower (2001) recently completed a blowout-frequency assessment for the Northstar development project. This analysis modified statistical blowout frequencies to reflect specific conditions and operating systems for drilling at Northstar. The estimated blowout frequency for drilling into the oil-bearing zone and spilling greater than 130,000 bbl is 9.4×10^{-7}.

The State of Alaska prohibits the drilling of new wells or sidetracks from existing wells into major liquid-hydrocarbon zones at drill sites under their regulation during the defined period of broken ice and open water. This period begins on June 13 of each year and ends with the presence of 18 inches of continuous ice cover for ½ mi in all directions from the Northstar Island. This drilling moratorium eliminates the environmental effects associated with a well blowout during drilling operations in or near the lagoons during broken-ice or open-water conditions.

Although the drilling prohibition during broken ice and open water reduces the chance of a blowout, the chance of a blowout occurring is not completely eliminated during the time the field is producing oil. As noted in the following section, the State of Alaska requires as a planning standard the greatest possible oil spill discharge that could occur from a blowout. Thus, this IAP/EIS evaluates the potential effects of a very large oil spill.

2. Blowout Assumptions

The 120,000-bbl spill size was derived from previous oil discharge prevention and contingency plans (ODPCP) for the Alaska North Slope region that estimate the realistic maximum discharge. These ODPCP's typically use a 15-day time period and have been accepted and approved by the State of Alaska, Department of Environmental Conservation. For the Alpine development project, Phillips estimates a 7,500-bbl flow rate per day for 15 days, for a total of 112,500 bbl (Phillips Alaska Inc., 2001). Flow rates for exploration wells in Northeast NPR-A are estimated at 5,500 bbl/day for oil-spill planning purposes (Phillips Alaska Inc. 2001). In this analysis, the 7,500 bbl/day flow rate is used, rounded up to 8,000 bbl/day for a total of 120,000 bbl for the 15-day period.

The potential impacts and effects on specific resources are presented below. In each resource-specific analysis, the blowout hypothetically occurs in an area sensitive to that particular resource and releases crude oil into the environment for 15 days. For the scenario, the analyst places the blowout spill in the location most adverse to the resource. The general environments into which the oil could discharge are tundra, ponds and lakes, creeks and rivers, and lagoons. The blowout could occur at any time of the year. The receiving environment could be solid ice, broken ice, or open water, as well as snow and open ground.

The following blowout assumptions are taken from oil discharge prevention and contingency plans from facilities on the Alaskan North Slope (Phillips, 1999 and 2001, BP Exploration (Alaska), Inc., 2000, 2001).

1. The crude oil is assumed to be similar in composition to "Alpine" crude oil.
2. The theoretical facility is a 5-acre gravel pad.
3. The gas/oil ratio ranges from 400 to 2,200 standard ft^3/bbl.

The blowout spill rises into the air at an average rate of 300 bbl/hour (8,000 bbl/day divided by 24 hours). Oil droplets fall to the gravel pad and surrounding area in the direction of the prevailing wind. Assuming an Alpine-like crude oil, approximately 30 percent of the 120,000 bbl evaporates into the air, leaving 84,000 bbl on or adjacent to the gravel pad and surrounding area.

After 15 days from the start of the spill:

- 3,400 bbl remain on the gravel pad,
- 38,600 bbl have drained from the gravel pad into the environment, and
- 42,000 bbl have fallen to the surrounding environment (2,800 bbl/day).

The following figures are based on Alaska Clean Seas (1999a) Tactic T-6, assuming a 6.3-inch pipe and the lowest and highest gas/oil ratios. The highest gas/oil ratio results in the higher values below. Of the oil falling to the surrounding environment:

- 80 percent of the oil falls out from 300 ft (lowest gas/oil ratio) to 3,600 ft (highest gas/oil ratio) from the source in a plume 100 ft (lowest gas/oil ratio) to 400 ft (highest gas/oil ratio) wide, and
- 20 percent of the oil falls out from 3,600 ft (lowest gas/oil ratio) to 33,000 ft (highest gas/oil ratio) from the source in a plume 400 ft (lowest gas/oil ratio) to 2,000 ft (highest gas/oil ratio) wide.

3. Behavior of a Blowout Oil Spill During Winter

Oil would drain from the gravel pad to the ground and would fall to the ground in a scattered pattern. No oil would enter open water as long as the ice was solid. In the winter, oil spreads mainly on the surface of snow cover, ice and/or frozen soil. There would be little or no change in the oil's physical properties at very low temperatures and when buried under a snow cover. Blowing snow would tend to combine with pooled oil, until the oil is effectively saturated with snow crystals.

The oil would not penetrate any ice surface. It would spread mainly on the surface of the frozen soil. It is unlikely to penetrate the lower layers of soil because the seasonal thawed layer is absent (Chuvilin et al., 2001).

Broken ice occurs in the Northwest NPR-A during fall freezeup and spring breakup. The scenario for this analysis assumes that oil could drain from the gravel pad into broken ice in tundra ponds, lakes, streams, rivers, or lagoons and would fall to the broken ice in a scattered pattern. The ice would contain the oil somewhat and reduce spreading. Unless the oil is frozen into the ice, the evaporation rate would not change. Dispersion and emulsification rates are lower in broken ice than in open water.

a. Fall Freezeup

During fall freezeup, the oil would freeze into the grease ice and slush before ice sheeting occurs. Winds and storms could break up and disperse the ice and oil until the next freezing cycle. These freezing cycles can be hours or days. Later--in late spring and summer--the unweathered oil would melt out of the ice at different rates, depending on when the oil was frozen into the ice. In first-year ice, most of the oil spilled at any one time would percolate up to the ice surface over about a 10-day period. About mid-July, the oil pools would drain into the water. Thus oil could be pooled on the ice surface for up to 30 days before being discharged from the ice surface to the water surface. The pools on the ice surface would concentrate the oil, but only to about 2 mm thick, allowing evaporation of 5 percent of the oil, the part of the oil composed of the lighter, more toxic components of the crude. By the time the oil is released from the melt pools on the ice surface, evaporation has almost stopped, with only an additional 4 percent of the spilled oil evaporating during an additional 30 days on the surface of the pond, lake, creek, stream, or river.

b. Spring Breakup

For analysis, a spill during spring breakup would be assumed to have the same behavior and effects as a summer or open-water spill. At spring breakup, the ice concentrations are variable. With high concentrations of ice, oil would spread between ice floes. As the ice concentrations eventually decrease to less than three-tenths of the water surface area, the oil on the water behaves as an open-water spill, with local oil patches temporarily trapped by the wind against ice floes. Oil that is on the ice floes would move with the ice as it responds to currents generated by the wind (S.L. Ross Environmental Research Ltd., 1998).

4. Behavior of Spills During Summer

This scenario assumes oil would drain from the gravel pad onto the tundra and/or open water, including lakes, ponds, creeks, streams, rivers, or lagoons. If oil were to fall on a water surface, the oil would move with the direction of flow and/or the winds. On the tundra, during the summer, the oil spreads less because of the cover of vegetation. Oil may penetrate the lower layers of soil because of their thawed condition. Rain may also increase the penetration of oil into the soil. The oil may spread laterally if it reaches a permafrost lens or layer (Chuvilin et al., 2001).

5. Effects of a Low-Probability, Very Large Oil Spill

a. Soils

Oil spills of any size may impact soils as the vegetation is altered. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled and minimize surface disturbance.

b. Paleontological Resources

Surface and near-surface paleontological deposits could be much more adversely impacted by a summertime spill than by one that occurred during the winter. While contamination of the deposit would render much of the data recovery valueless, the cleanup procedures would create even greater impacts. Since paleontological resources are nonrenewable, the adverse effects could be quite significant.

c. Water Resources

As noted in Sec. IV.C.3.b.2, a very large crude-oil spill could have serious adverse impacts to streams and lakes. While the petroleum residue from a spill could be flushed from most streams within a few years, the impacts to lakes and ponds could persist for decades. Additionally, a very large spill could saturate the tundra mat, limiting the amount of crude oil that is recovered, and considerably lengthening the time over which impacts could occur. A spill that occurred in the winter could have similar impacts, though the snow and cold temperatures might retard the crude-oil runoff into the watershed and somewhat limit the contamination. A spill that occurred during spring breakup or fall freezeup could have the greatest adverse impacts, since it would be extremely difficult, if not impossible, to contain the spill when ice is either breaking apart or forming into semi-solid slush pans or jumble ice. Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects.

d. Freshwater Quality

For spills during frozen conditions, it is anticipated that oil would not reach open water. Following contaminated snow and ice removal, water-quality impacts from the residual oil would be very limited in extent. However, even small quantities of oil remaining after cleanup could result in lethal and sublethal toxicity levels in waters within the spill area for approximately 7 years.

During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches (Miller, Prentki, and Barsdate, 1980) that would retain 300 to 1,500 bbl of oil per acre. Even at high water levels, the tundra vegetation tends to act as a boom and vegetation and peat as a sorbent, allowing water to filter through, trapping the more viscous oil (e.g., Barsdate et al., 1980) and also making recovery of the oil more difficult. On the other hand, even small spills can spread over large areas, if the spill event includes aerial, pressured discharge. For example, in December 1993, ARCO Drill Site line failed and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott, 1997). For a large spill during breakup conditions or the summer season, oil-spill response likely would recover the bulk of spilled oil. However, sufficient oil could remain to result in lethal and sublethal toxicity levels in waters within the spill area for approximately 7 years. In addition, equipment used to contain and recover spilled oil could damage the tundra surface, potentially leading to thermokarst erosion and causing local water quality degradation.

e. Estuarine Water Quality

This assessment assumes a blowout in an estuary--unlikely as that would be. As estimated in the first part of this section, about a third of a 120,000-bbl blowout would evaporate, about 38,600 bbl would drain from the drilling island onto the sea surface, and about 42,000 bbl would rain down on the sea surface over a 15-day period. If such a blowout were to occur during winter, the oil would probably not penetrate the ice cover but, if it occurred during the open-water period, it could contaminate an extensive area. The scale of the effects would probably be similar to the effects of the 180,000-bbl blowout that was assessed in the *Liberty EIS* (USDOI, MMS, Alaska OCS Region, 2002b:Sec. IX.6). The analysis in the *Liberty EIS* concluded that the effects of such a spill would exceed the 1.5-ppm acute toxicity criterion during the first several days in an area less than 110 mi² (300 km²). The area of acute toxicity would be about the size of Admiralty Bay and Dease Inlet together. The risk of such a blowout effect would be lower with Alternative B, which would allow offshore exploratory drilling only during the winter solid-ice season.

f. Air Quality

A very large (120,000 bbl) oil spill would affect nearby air quality locally and temporarily. Air-quality effects would be caused by emissions from evaporation and from any burning associated with the oil spill or with oil-spill cleanup activities. The scenario for this very low probability, very large oil spill assumes that the release of crude oil continues for 15 days. Therefore, volatile organic compounds would continue to be released from the spilled oil for that time period. Those volatile organic compounds would likely evaporate almost completely after the spilling ceased. Please see Section IV.C.6.b.(2)(b) for greater detail on effects of an oil spill on air quality. Typical emissions from blowout or other large spills consist of hydrocarbons (volatile organic compounds). Only fires associated with blowouts produce other pollutants, such as nitrogen oxides, carbon monoxide, sulfur dioxide, and particulate matter. Air pollution would be limited because of atmospheric dispersion. Any significant adverse air-quality effects from a very large oil spill would remain quite localized and very temporary.

Conclusion

In the very unlikely event of a blowout or other very large oil spill, such a spill could cause a small, local increase in the concentrations of gaseous hydrocarbons (volatile organic compounds) as a result of evaporation from the spill. The VOC concentrations would be very low and normally be limited to only 1 or 2 km^2 (0.4 to 0.8 mi^2). Moderate or greater winds would further reduce the VOC concentrations in the air.

Effects on air quality from air emissions likely would be only a very small percent of the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, there likely would be only a minimal effect on air quality with respect to standards.

g. Vegetation

The only reported blowout of crude oil on Alaska's North Slope occurred in 1950 (Fairweather, 2000), and no crude oil was spilled off the pad during that blowout. There is no history of the effects of a very large (120,000 bbl in this scenario) spill of crude oil on North Slope tundra vegetation. Overall, past spills (of much smaller volumes) on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery, with wetter areas recovering more quickly (Jorgenson, 1997; McKendrick, 2000). It is estimated that a spill of 120,000 bbl would cover up to 1,500 acres, with 80 percent of the oil falling out on less than 30 acres. From this it is assumed that most of the vegetation affected would suffer adverse consequences similar to those of smaller spills (i.e., minor damage and a good potential for recovery). A small percentage of the vegetation affected would likely suffer longer-term, adverse consequences, suggesting that recovery would take longer and may not be as complete.

h. Fish Resources

(1) Freshwater and Anadromous/Amphidromous Fish

As discussed in the analyses for the alternatives, oil spills have been observed to have a range of effects on fish; the specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive) (for more detailed discussions see Starr, Kuwada, and Trasky, 1981; Hamilton, Starr, and Trasky, 1979; and Malins, 1977). If lethal concentrations were to be encountered, or if sublethal concentrations were to be encountered over a long enough period, fish mortality would be likely. Such a situation could occur during a large blowout spill (120,000 bbl) if the spill were to enter a body of water with restricted water exchange. The worst-case scenario would be a spill that occurred at fall freezeup or at the beginning of spring breakup in the lower reach of one of the large rivers that flows into Admiralty Bay. Cleanup of a spill when ice is either forming into slush pans or breaking apart would be difficult. Petroleum residue would persist through the winter (and beyond) if the spill occurred at freezeup. Compounding this problem is the likelihood that freshwater fish of all life stages would be congregating in this habitat to overwinter. Craig (1989a) calculated that the lower portion of coastal plains rivers on the North Slope provide most of the overwintering habitat for freshwater fish.

Though lethal effects of oil on fish have been established in laboratory studies (Rice et al., 1979; Moles, Rice, and Korn, 1979), large kills following oil spills are not well documented, probably because toxic concentrations are seldom reached (Rice, 1985). In this scenario--where it is assumed that a large quantity of oil reaches numerous fish and the oil is not rapidly diluted--a substantial portion of the waterbody's resident populations of fish species could be harmed or killed. Adults and juveniles might be able to avoid contact with oiled waters during a spill in the open-water season, but survival would be expected to decrease if oil were to reach a pool or series of pools isolated by ice and the fish were unable to avoid contamination. In the latter case, sublethal effects would be more likely to occur that would include changes in growth, feeding, fecundity, survival rates, and temporary displacement. Other possible effects would include localized reduction in food resources, and consumption of contaminated prey. Total fish loss would be dependent on the extent and duration of the contamination and the effectiveness of the spill cleanup. If the entire population of any given species in a drainage were spread out between overwintering sites in a river or adjacent lakes, the loss at any given site would not be expected to eliminate a population.

(2) Marine Fish

A very large spill of 120,000 bbl from a blowout is assumed to occur under Alternative A, Alternative B, and the Preferred Alternative. Under Alternative A , this spill is assumed to occur in the Dease Inlet/Admiralty Bay area. If it were to occur within the Inlet or along the shore during the summer open-water season, the spill would contaminate marine waters. For Alternative B and the Preferred Alternative, a nearshore spill of this size during the summer feeding period is likely to result in measurable adverse effects on some marine fish populations. Depending on the amount of oil deposited in the nearshore area during summer, and the amount of actual shoreline oiled, a 120,000-bbl oil spill is estimated to adversely affect 5 to 20 percent of the marine fish population in the area. Both lethal and sublethal effects would be expected. Fishes farther offshore of the nearshore feeding area would likely not be affected. The occurrence of this spill during winter could have similar effects when released from the ice during the following spring. In either case, recovery would be likely in 5 to 10 years. If such a spill were to occur well offshore in summer, much of its effect would be reduced by weathering and the resulting reduction in the amount of oil reaching nearshore feeding areas. While still expected to result in a measurable effect on some marine fish populations, the spill's effect would likely be greatly reduced (estimated recovery of 3 to 5 years).

i. Birds

(1) Effects of a Blowout Oil Spill on Birds

Throughout the summer and fall periods, many tens of thousands of long-tailed ducks and king eiders, substantial numbers of common eiders, and other waterfowl, loons, and seabirds are present for varying intervals in coastal lagoons and nearshore and offshore waters. In addition, three loon species, greater white-fronted geese, brant, tundra swans, small numbers of lesser snow geese, and thousands of shorebirds are present in Beaufort Sea terrestrial wetland and coastal habitats (Fischer, 2002; Fischer, Tiplady, and Larned, 2002; Johnson, 1994a,b; Johnson and Gazey, 1992; Johnson and Noel, 1996; Larned et al., 2001; Noel, Johnson, and Wainwright, 2000; Noel and Johnson, 1996; Stickney and Ritchie, 1996; Stickney et al., 1994; Troy, 1995). Long-tailed duck densities in lagoons during this period have been found to average 40 to 275 birds per km² (Noel, Johnson, and Wainwright, 2000; Stehn and Platte, 2000) and large numbers of king eiders could also be present. If a 120,000-bbl spill were to happen when large concentrations of molting, staging, or migrating individuals were present, tens of thousands could be contacted by oil, representing a significant loss from regional populations. Significant losses also could be experienced in such a scenario by postbreeding common eiders concentrated near barrier islands and in lagoons. In addition, a spill would be expected to contact several other species present in substantial numbers, including scoters, northern pintail, Pacific loon, phalaropes, and glaucous gull. Red-throated and yellow-billed loons, whose ACP populations are relatively small, also could be contacted. The probability of a large spill occurring is extremely small.

A large spill occurring in August or September and contacting a substantial proportion of the thousands of Ross' gulls that gather east of Point Barrow to feed each fall (Divoky et al., 1988), could result in a significant loss for this species, whose world population probably does not exceed 50,000. A spill remaining as stranded oil along a substantial proportion of the northern or western shoreline of the Northwest NPR-A Planning Area could result in mortality exceeding several thousand individuals of brood-rearing waterfowl or shorebirds.

An onshore spill in summer escaping from the pad where it occurs may contact eggs in nests or enter lakes and streams used by waterfowl and shorebirds for foraging. Because most species do not typically nest in groups, mortality associated with such a situation is not likely to be large, even with a large spill--probably fewer than 100 individuals per species. However, adults that contact oil may transfer it to the eggs, killing the embryos. Species such as brant, semi-palmated sandpiper, and western sandpiper that do nest in groups of a relatively high density in the Planning Area are at risk of greater losses. Losses resulting from any aspect of oil and gas development may be difficult to separate from natural variation in population numbers (see discussion in Section IV.C.9).

A spill occurring in winter and released in spring could produce a similar result if loons and other migrant waterfowl concentrated in open water near river deltas or other nearshore areas were contacted. For species such as yellow-billed and red-throated loons, with relatively small populations and low productivity, this could represent a significant loss.

Oil entrained in bottom sediments and mudflat areas--or that affects species-rich foraging areas such as boulder patches--is expected to kill substantial numbers of food organisms used by waterfowl and shorebirds. The actual impact on bird populations of such indirect effects on food organisms is difficult to determine. Presumably, decreased food availability would adversely affect the ability of young to develop as rapidly as they would normally, and could decrease fitness or survival, or the ability of individuals to accumulate fat reserves for migration. Any mortality from such indirect effects would be additive to the losses of oiled individuals.

(2) Effects of Oil-Spill Prevention and Response

(a) Blowout During Open-Water Conditions

Despite the potential for effective spill containment, recovery, and cleanup under ideal weather conditions, these may not exist during a spill incident and some loon, waterfowl, shorebird, and seabird habitats are likely to be contacted by oil. Recent aerial surveys (Fischer, 2002; Larned et al., 2001, 2003) recorded substantial numbers of loons, waterfowl, and seabirds along the northern coast of the Planning Area. Although some species exhibited concentrations in Harrison Bay and Dease Inlet/Elson Lagoon, as a group this suite of species was surprisingly widespread in its offshore distribution, ranging from the shoreline to 50 km offshore. If a large spill is not contained before reaching these areas, the most effective response may involve hazing.

Containment, recovery, and cleanup activities for a large spill are expected to involve hundreds of workers and numerous boats, aircraft, and onshore vehicles operating over an extensive area for more than 1 year. Persistence of oil in toxic or wildlife debilitating form in the environment will vary depending on weather conditions and speed of containment/recovery and cleanup. The presence of such a workforce is likely to act as a general hazing factor, displacing birds from the immediate area of activity, perhaps within a few kilometers, which potentially may be viewed as a positive result given the extreme vulnerability of birds to oil in the environment. If a reliable system of locating bird concentrations in a specific area can be devised, specific birds or groups in danger of oil contact could be targeted with specific hazing tactics. As noted following the *Exxon Valdez* spill, oil remains in undisturbed pockets or as weathered patches for some years after the event. However, most oil weathers to a relatively nontoxic state within 30 to 60 days of the spill's exposure to air. Cleanup of oil spill remnants may take several years; however, return of a large workforce to an affected area comparable to that employed during the initial response is not expected.

Displacement of female waterfowl with broods from coastal habitats by cleanup activity may have a negative effect if it prematurely forces them into the offshore marine environment where foraging may be more difficult for the ducklings, and other stresses may increase. Disturbance of nesting sea ducks by onshore cleanup activities is not expected to significantly affect their productivity. There appears to be little tendency for most of these species to nest near the coast, where there is the highest probability of disturbance by cleanup activity. Because of low nesting density, few nesting birds are likely to be displaced and potentially lose their clutches or broods to predators or exposure to weather as a result of disturbance by cleanup operations. Helicopter support traffic and human presence probably would be the most disturbing factors associated with oil-spill-cleanup activity. If their presence forces ducks from a marine area where oil contact is imminent, it may be considered a positive factor. Lesser snow geese nesting on Howe Island, brant nesting colonies along the coast, and both species brood-rearing in coastal habitats are likely to be disturbed by summer cleanup activity in nearby areas.

Prompt containment and removal of oil from offshore areas, accompanied by hazing tactics targeting high-use areas, is likely to result in a substantial reduction of sea duck and shorebird mortality from a large oil spill. Cleanup also would decrease the amount of oil available for uptake by bottom-dwelling organisms that are the principal food of sea ducks and shorebirds. This could reduce the potential for oil uptake by these species, and associated adverse physiological side effects, although the benefit of this indirect effect on these populations cannot be quantified at present.

Conclusion

The 120,000-bbl oil spill in open water assumed for this analysis would be expected to result in the loss of thousands of brood-rearing and young waterfowl and shorebirds if those birds were to contact stranded oil along a substantial proportion of the affected shoreline. In lagoon habitats, observed high densities of long-tailed ducks suggest that on some occasions, tens of thousands of molting individuals could be contacted by a spill sweeping over thousands of square kilometers, representing a significant loss from the regional population. Likewise, contact of substantial numbers of postbreeding king eiders and common eiders near barrier islands--or Ross' gulls near Point Barrow--during August through September could result in significant losses. Recovery would not be expected to occur while specific populations are in declining status.

(b) Blowout During Broken-Ice Conditions

Containment and oil recovery following a blowout spill that enters the marine environment under broken-ice conditions at meltout or freezeup is expected to be less effective than for an open-water spill. Although under these conditions the area covered by the spill would be smaller than a spill in open water, some bird species are not expected to occupy broken ice in either period unless areas of open water are available. However, Pacific loons, long-tailed ducks, king eiders, common eiders, and glaucous gulls have been observed in small areas of open water available under these conditions (Dau and Taylor, 2000). Even after spring melting provides areas of open water, most arriving spring migrants likely would occupy overflow areas off river mouths, because those are available earlier and are in the vicinity of nesting areas. The greatest benefits may result from containment and cleanup in such areas. In this season, the hazing effect of cleanup activity or actively hazing birds out of areas that oil is expected to enter may be counterproductive, because there are few alternative habitats that flushed birds can occupy. For sea ducks arriving via overland routes, the benefit of spill containment and cleanup would be minimal until they begin reentering the marine environment following breeding. By this time, the oil would have weathered and is expected to have become a decreasing plumage-fouling hazard. Indirect adverse effects resulting from intake of contaminated prey organisms may be higher under broken-ice than open-water conditions, because reduced cleanup capability would provide a longer interval for exposure and uptake by such organisms. Entrapment of large quantities of oil in coastal marsh and adjacent habitats could present a hazard to departing males following breeding and females with young following nesting as they move to offshore waters. In fall, beyond late September, most sea ducks and other waterfowl and shorebirds are not likely to be present in great numbers, and oil present in broken ice at this time may have weathered and become less of a plumage-fouling hazard. Long-tailed ducks and eiders are at risk until later in the fall than most other species.

Conclusion

A winter spill entering the environment after the ice melts in the spring could contact loons and other migrant waterfowl concentrated in open water near river deltas or other nearshore areas. Losses from a spill contacting terrestrial habitats would not be expected to result in significant effects. Any mortality or decreased fitness or productivity from indirect effects, such as decreased availability of food organisms or physiological effects from oil ingestion, would be additive to the losses of oiled individuals.

j. Mammals

(1) Terrestrial Mammals

For this analysis, a very large spill from a blowout is assumed to occur during the peak of the mosquito season within the TLH insect-relief area east of Dease Inlet. Impacts would be similar to those discussed under Alternative A, Effects of Spills. Any terrestrial mammals in the immediate vicinity of the blowout could be contacted by oil falling onto the surrounding tundra and open water. Loss of thermoregulation would not be a factor, except possibly in young caribou calves. Larger, more mobile animals such as caribou, bears and moose would likely move out of the area affected by the blowout, reducing their exposure. Smaller, less mobile animals might not be able to move out of the affected area, resulting in greater mortality of these species. Some animals could be killed from exposure to toxins, either absorbed through the skin or ingested during feeding. Ingestion typically results in pulmonary aspiration that can be lethal or predispose the animal to infections. Terrestrial mammals would be temporarily disturbed or displaced by clean up and rehabilitation activities. At this time of year, TLH caribou would be aggregated into large groups for insect avoidance. If a blowout occurred in the close vicinity of an aggregation, a relatively large number (100+) of caribou could be exposed to oil fallout. Movement of insect-harassed caribou in the vicinity of the blowout could be disrupted during the 15-day duration of the blowout and the following period of clean-up, reducing foraging efficiency. If foraging efficiency is reduced sufficiently to result in reduced weight gain, there could be greater over-winter mortality or a corresponding reduction in parturition the following year. This effect would only last for one season and would not result in long-term reduction in the population size unless followed or preceeded by a few years of higher mortality or lower parturition from other factors. The amount of habitat affected by such a spill would be minimal when compared to the amount of habitat available on the North Slope.

(2) Marine Mammals

(a) Effects from a Possible Very Large Blowout Spill in Marine Waters in the Dease Inlet/Admiralty Bay Area

For this analysis, a very large spill of 120,000 bbl from a blowout is assumed to occur in the Dease Inlet/Admiralty Bay area. If it were to occur within the Inlet or along the shore during the summer open-water season, the spill would contaminate marine waters. Large numbers of spotted seals (perhaps 100 to several hundred animals) could be exposed to the spill. Smaller numbers of other marine mammals such as ringed and bearded seals, polar bears, walruses, beluga whales, and gray whales that generally occur offshore of the inlet during the summer could be exposed to oil if some of the spill spreads offshore of the Dease Inlet/Admiralty Bay area. If several hundred spotted seals were to be oiled and suffer lethal effects from the spill, the population (about 1,000 animals), could take a few years or more to replace these losses. Losses of other marine mammals to the spill are likely to be small (a few individual polar bear to perhaps 100 or less individuals of the other species) with replacement expected within one year.

(b) Effects from a Possible Very Large Blowout Spill Onshore in the Dease Inlet/Admiralty Bay Area

For this analysis, a very large spill of 120,000 bbl from a blowout is assumed to occur onshore in the Dease Inlet/Admiralty Bay area. If it were to occur near the Inlet or along the shore during the summer open-water season, some of the oil would contaminate marine waters. Small numbers of spotted seals (perhaps 10 to 30 animals) could be exposed to some oil from the spill. Other marine mammals such as ringed and bearded seals, polar bears, walruses, beluga whales, and gray whales that generally occur offshore of the inlet during the summer are unlikely to be exposed to the spill. If 10 to 30 spotted seals were to be exposed to part of the spill and suffer sublethal or lethal effects from the spill, the population (about 1,000 animals) would be likely to replace these losses within one year.

k. Endangered and Threatened Species

(1) Bowhead Whale

If a 120,000-barrel blowout were to occur at a well located along the northern coast of the Planning Area or along a river tributary to the Beaufort Sea, oil could enter the nearshore marine environment and potentially be transported to offshore areas. Under most circumstances, contact of whales migrating through offshore waters during the open-water season likely would be brief. However, in some years, bowheads have been observed very near shore between Point Barrow and Cape Halkett during the westward fall migration. For example, 77 individuals were observed feeding near the shoreline between Smith Bay and Dease Inlet in September 2000 (Treacy, 2002). If bowheads were feeding in an area when spilled oil was present, contact could be prolonged and some of the oil could be ingested. It is not clearly known that a brief exposure, especially of volatile components, would not have adverse effects on lung or eye function.

During their spring migration, bowheads often are concentrated in the spring lead system as they move through the Chukchi Sea, past Point Barrow, and eastward through the Beaufort Sea. This behavior makes them vulnerable to any oil that enters the spring lead system. For example, a large spill occurring in late fall or winter could become entrained in the pack ice and the oil could be released into leads when the ice melts. However, a winter spill likely would melt out in July, so it is not likely that oil would be melted out of the ice in time to contact spring leads during the whale migration that spring. Oil released in broken ice conditions would be more difficult to clean up and more likely to enter the spring lead system. During the fall migration, oil from a meltout spill would be somewhat weathered and the toxic hydrocarbons at least partially evaporated before the oil would have entered the water. As a result of the weathering, the spill would be less likely to cause respiratory distress or other effects to bowheads surfacing to breathe.

Effects of an oil spill on bowheads would be as described in Section IV.C.11: oiling of the skin, inhaling hydrocarbon vapors or oil, ingesting oil or contaminated prey, fouling of their baleen, reduced food supply, displacement from feeding areas, and possibly death. The effect of fouling baleen has not been investigated adequately; the long filamentous bowhead baleen may be prone to more serious fouling than the coarser baleen of some other species, thereby depriving bowheads of a greater degree of normal function. The number of whales contacting spilled oil would depend on the timing and duration of the spill, ice conditions, effectiveness of containment and cleanup operations, and the whales' ability or inclination to avoid contact. Based on conclusions from studies that have examined the effects of oil spills on cetaceans, external exposure to spilled oil is unlikely to have serious effects on the bowhead whale. Most whales exposed to spilled oil are expected to experience temporary, nonlethal effects, although there is a potential for lethal effects to some individuals.

Conclusion

Based on conclusions from studies that have examined the effects of oil spills on cetaceans, exposure to spilled oil is unlikely to have serious direct effects on baleen whales. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects from oiling of the skin, inhaling hydrocarbon vapors, ingesting contaminated prey, fouling of their baleen, reduced food source, and displacement from feeding areas. Exposure of bowhead whales to spilled oil potentially could result in lethal effects to some individuals.

(2) Spectacled and Steller's Eiders

(a) Effects of a Blowout Oil Spill on Spectacled and Steller's Eiders

From early June to late July (males) and late June to early September (failed females or females with young), flocks of spectacled eiders may be staging or stopping during migration in coastal lagoons and offshore waters (Fischer, Tiplady, and Larned, 2002; Fischer, 2002; TERA, 1995b, 1999). This is suggested by detections of satellite-tagged spectacled eiders in several nearshore/offshore marine areas adjacent to or within the boundaries of the Northwest NPR-A Planning Area (Map 63), and occasionally substantial flocks observed during aerial surveys (e.g., one group of 144; Stehn and Platte, 2000). In late summer, females with fledged young move from coastal habitats to nearshore or offshore areas. Some of these flocks (or females with young) would be likely to be contacted by an oil spill that occurs in or enters areas along the northern or western coasts of the Planning Area; most contacts would be lethal. A spill occurring in winter and at least partially released from the ice in spring could contact eiders staging in open water near river deltas, or if released in summer (e.g., July), could jeopardize staging and fall migrant birds. For the spectacled eider, with its relatively small regional population and low productivity, the mortality that could result from such a spill--perhaps tens of locally nesting individuals, plus an unknown but potentially substantial number of migrants--could represent a significant regional loss, though it would not likely represent a significant loss from the world population. Because there is no clear trend in the coastal plain population, and there is a lack of certain data required to model population fluctuations, an estimate of recovery time from such a loss currently would be speculative. Also, losses may be difficult to separate from natural variation in population numbers (see the discussion in Section IV.C.9).

If a spill of this size were to occur in August or September, there would be a potential for small numbers of Steller's eiders that nest on the western Arctic Coastal Plain (ACP) to be contacted while staging in the western Beaufort Sea. This could represent a substantial proportion of the coastal plain population. Little information is available concerning presence, timing, or numbers in marine waters (but see Fischer, 2002; Fischer, Tiplady, and Larned, 2002; Larned et al., 2001; Martin, 2001, pers. comm.; Quakenbush et al., 1995).

Oil contacting or mixed into bottom sediments and mudflat areas, or affecting species-rich foraging areas such as boulder patches, is expected to kill substantial numbers of eider food organisms. It is difficult to determine the actual impact that a decline in food organisms would have on bird populations. Decreased food availability might adversely affect the ability of juvenile birds to develop as rapidly as they would normally, could decrease adult fitness, and might delay the accumulation of fat reserves for migration. Any mortality from such indirect effects would be additive to the loss of oiled individuals.

An onshore spill in summer that escaped from the pad where it occurred could enter lakes and streams used by eiders for foraging and nesting habitat. Because they do not typically nest in groups, mortality associated with such a situation is not likely to be large, even with a large spill--there probably would be fewer than 20 individuals.

(b) Effects of Oil-Spill Prevention and Response

1) Blowout During Open-Water Conditions

Ideal weather conditions that would facilitate effective spill containment, recovery and cleanup might not exist during a spill incident, and some marine nearshore/offshore and terrestrial aquatic eider habitats would be likely to be contacted by oil. These areas would need to be surveyed for eider presence to plan an adequate response strategy. If the spill were not contained before reaching these areas, the most effective response might involve hazing the birds from the area.

Although spectacled eiders apparently spend little time in nearshore coastal habitats, females with broods may occupy them briefly before moving to offshore staging areas. Containment, recovery, and cleanup activities for a large spill would be expected to involve hundreds of workers and numerous boats, aircraft, and onshore vehicles operating over an extensive area for more than 1 year. That the presence of such a workforce would be likely to act as a general hazing factor--displacing any eiders from the immediate area of activity, perhaps within a few kilometers--might be viewed as a positive result, given the birds' extreme vulnerability to oil in the environment. If a reliable system of locating eiders in a specific area can be devised, specific birds or groups in danger of oil contact could be targeted with specific hazing tactics.

Currently, no important specific foraging areas for eiders are identified adjacent to the Planning Area, although numerous satellite transmitter locations and visual observations during aerial surveys suggest that in and offshore of Smith and Harrison Bays may be an important area. Because spectacled eiders nest at low density, and there appears to be little tendency for them to nest near the coast (TERA, 1999), disturbance of nesting eiders by onshore cleanup activities would not be expected to result in significant increases in nest abandonment (or loss of eggs or young to predators or exposure to weather); or overall decreases in productivity. If cleanup activity were to displace females with broods from coastal habitats prematurely into the more saline offshore marine environment, it could result in increased stress on the ducklings, which have a relatively low tolerance to salt (USDOI, FWS, 1996). Helicopter support traffic and human presence probably would be the most disturbing factors associated with oil-spill cleanup activity. To summarize, if cleanup activities were to force eiders from a marine area where oil contact was imminent, it might be considered a positive factor; however, activity during the nesting season could also displace females from their nests or broods and result in egg or duckling losses from predation or exposure.

Spectacled eider mortality from a large oil spill could be minimized by prompt containment and removal of oil from offshore areas, accompanied by hazing tactics targeting high-use areas. Cleanup also would decrease the amount of oil available for uptake by bottom-dwelling organisms that are the principal food of eiders. This could reduce the potential for oil uptake by eiders and associated adverse physiological side effects, although the benefit of this indirect effect on the eider population cannot be quantified at present.

2) Blowout During Broken-Ice Conditions

Containment and oil recovery following a blowout spill that entered the marine environment under broken-ice conditions at meltout or freezeup would be expected to be less effective than for a spill that entered open water. Although, under these conditions, the area covered by the spill would be smaller than a spill in open water, spectacled eiders would not be expected to occupy broken ice in either period, unless substantial areas of open water were available. Many arriving spring migrants likely would occupy open overflow areas off river mouths that are available early and are near nesting areas; the most effective response could be to focus containment and cleanup efforts in such areas. During broken-ice season, the hazing effect of cleanup activity (or the active hazing of birds out of areas that oil is expected to enter) could be counterproductive, because there are few alternative habitats that flushed birds could occupy. Since most spectacled eiders arrive in the area via overland routes (TERA, 1999), the benefit of spill containment and cleanup would be greatest in nesting habitat. By the time the birds would reenter the marine environment following the breeding period, the oil would have weathered into less of a hazard for plumage fouling. Indirect adverse effects resulting from the intake of contaminated prey organisms could be higher under broken-ice than open-water conditions, because reduced cleanup capability would provide a longer interval for exposure and uptake by such organisms. Entrapped oil in coastal marsh and adjacent habitats could present a hazard to departing males after breeding and to females with young after nesting as they move to offshore waters. In fall, spectacled eiders are not likely to be present in numbers beyond late September, and oil present in broken ice at this time likely would not contact eiders.

3) Conclusion

The spill assumed for this analysis (i.e., 120,000-bbl blowout at a coastal prospect or from a river entering open water) would be expected to cause substantial spectacled eider mortality if oil were to contact flocks of staging or migrant eiders or females with young in lagoons and offshore. Also, in terrestrial or coastal habitats, males or unsuccessful females (early in the breeding season) or females with recently fledged young (later on) could have sufficient contact with stranded oil to result in some mortality. A terrestrial winter spill released even partially from the ice in spring could contact eiders concentrated in open water of river deltas or other nearshore areas. An onshore spill in summer could enter lakes and streams used by eiders, but because they do not typically nest in groups, mortality associated with such a situation probably would be fewer than 20 individuals.

Mortality that could result from such a large spill could represent a significant loss for the relatively small regional ACP spectacled eider population, but probably would not represent a significant loss to the world population. Recovery of the regional population would not be likely to occur while it is in declining status. Secondary mortality from decreased availability of food organisms or physiological effects from oil ingestion would be additive to the loss of oiled individuals. Although FWS survey data do not show a significant decline in the spectacled eider population of the coastal plain, the potential exists for a significant adverse effect from an oil spill on this regional population. Mortality of a few Steller's eiders would represent a significant loss to its small regional population.

I. Economy

The estimate of employment that would be related to spill cleanup is based on the most relevant historical experience of a spill in Alaskan waters, the *Exxon Valdez* oil spill of 1989. The estimate is based on a ratio of workers to barrels spilled. The *Exxon Valdez* spill was 240,000 bbl. This spill generated enormous employment that rose to the level of 10,000 workers doing direct cleanup work in relatively remote locations. Smaller numbers of cleanup workers returned in the warmer months of each year following 1989 until 1992. The Northwest NPR-A spill scenario assumes the spill is on land, not near the Beaufort or Chukchi Seas, or on possible drainage systems near and leading to those seas. If the spill is on land not near a sea, the number of workers could be less than the proportionate effort to clean up the *Exxon Valdez* spill. If the spill is on a drainage system near a sea, then the cleanup effort is likely to be close to that required to clean up the *Exxon V*aldez spill. For this analysis, it is assumed that up to 5,000 workers would clean up a 120,000-bbl spill.

Numerous local residents quit their jobs to work on the cleanup--often at significantly higher wages. This generated a sudden and significant inflation in the local economy (Cohen, 1993). Anecdotal information indicates that housing rents in Valdez in 1989 increased from 25 percent in some cases to sixfold in others, and inflated rents continued into 1990. Prices of food and other goods increased only slightly (Hennig, 1993, pers. comm.). The NSB would not experience similar inflation effects because cleanup activities would be managed and staged out of existing enclave-support facilities. The number of workers actually used to clean up a possible 120,000-bbl oil spill would depend on a number of factors, including: which procedures were called for in the oil-spill contingency plan; the level of preparedness (equipment and training) of the entities responsible for cleanup; how efficiently the cleanup activities were executed; and the degree of coordination between the numerous responsible entities.

Conclusion

An oil spill of 120,000 bbl would generate 5,000 jobs for 6 months in the first year, declining to zero by the third year following the spill.

m. Cultural Resources

Because of the contextual surface and near-surface domain of cultural resources in the NPR-A, these resources could be much more adversely impacted by a summertime spill than by one that occurred during the winter. While the contamination of the cultural resources would render much of the data recovery valueless, the cleanup procedures would create even greater impacts. Since cultural resources are nonrenewable, the adverse effects could be quite significant.

n. Subsistence-Harvest Patterns

Effects on subsistence-harvest patterns from a 120,000-bbl oil spill could potentially displace and/or cause a functional loss of habitat to CAH, TLH, and WAH caribou. This important subsistence resource could become unavailable, undesirable for use, or experience long-term population and productivity effects for a period longer than 5 years--a significant adverse effect. Exposure of bowhead whales to spilled oil could result in lethal effects to some individuals. Large numbers of spotted seals could be exposed to the spill and suffer losses, with the population recovery taking several years. Losses of other marine mammals are expected to be smaller with recovery occurring within 1 year. If a large spill were to occur when large concentrations of molting, staging or migrating birds were present, tens of thousands could be contacted by oil, representing a significant loss to regional populations. A substantial portion of resident fish populations could be harmed or killed by a very large oil spill. Access to subsistence hunting areas and subsistence resources and the use of subsistence resources could change if an oil spill reduced the availability of resources or altered their distribution patterns.

The communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut would be most affected. Even if few individual subsistence species were directly lost or displaced, a very large oil spill could potentially contaminate essential nearshore whaling areas and onshore terrestrial hunting and fishing areas, causing significant effects when the additive impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together.

o. Sociocultural Systems

Sociocultural systems in the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut could undergo severe individual, social, and institutional stress and disruption from a 120,000-bbl spill that could last up to 5 years. Considerable stress and anxiety would be expected over the loss of subsistence resources, contamination of habitat, fear of the health effects of eating contaminated wild foods, and the need to depend on the knowledge of others about environmental contamination (Fall, 1992; McMullen, 1993). Individuals and communities would be increasingly stressed during the time needed to modify subsistence-harvest patterns by selectively changing harvest areas (if such areas were even available). Associated culturally significant activities

--such as the organization of subsistence activities among kinship groups and the relationships among those who customarily process and share subsistence harvests--also would be modified or would decline.

A 120,000-bbl spill would be expected to affect individuals and social systems in ways similar to the experience of the *Exxon Valdez* oil spill. As shown by that spill, some individuals found a new arena for pre-existing personal and political conflict, especially over the dispensation of money and contracts. In the smaller communities, cleanup work produced a redistribution of resources, creating new schisms in the community. Many members of small communities were on the road to sobriety before the spill; after the spill, some people began drinking again, producing the re-emergence of numerous alcohol-related problems (such as child abuse, domestic violence, and accidents), that were there before the spill. Institutional effects included additional burdens being placed on local governments, disruption of existing community plans and programs, strain on local officials, difficulties dealing with the spiller, community conflict, disruptions of customary habits and patterns of behavior, emotional effects, and stress-related disorders, confronting environmental degradation and death, and the violation of community values (Endter-Wada, 1992). Post-spill stress resulted from the seeming loss of control over individual and institutional environments as well as from secondary episodes such as litigation, which produced secrecy over information, uncertainty over outcomes, and community segmentation (Smythe, 1990; Picou and Gill, 1993). Attempts to mitigate social effects were often ineffective because a higher priority was placed on concerns over litigation and this produced a reluctance to intervene with people for fear it might benefit adversaries in legal battles (Human Relations Area Files, Inc., 1994; State of Alaska, Dept. of Fish and Game, 1995b; Impact Assessment, Inc., 1990c, 1998, 2001).

p. Environmental Justice

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by Northwest NPR-A exploration and development. Effects on Inupiat Natives could occur because of their reliance on subsistence foods; and cumulative effects could impact subsistence resources and harvest practices. Potential effects would be focused on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough.

In the unlikely event that a 120,000-bbl spill occurred and contaminated essential nearshore whaling areas and onshore terrestrial hunting and fishing areas, major effects could emerge when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Oil-spill contamination and cleanup could potentially displace and cause a functional loss of habitat to CAH, TLH, and WAH caribou as well. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. Any potential effects to subsistence resources and subsistence harvests are expected to be mitigated to some extent, though not eliminated. For a detailed discussion of Environmental Justice effects, see Section IV.C.16 and the Cumulative Effects analyses for subsistence-harvest patterns and sociocultural systems in Section IV.F.

q. Coastal Zone Management

A spill of this magnitude is very unlikely. If a spill of this size were to occur, the spill itself and the resulting cleanup activities could have significant effects on one or more subsistence resources and access to those resources in the vicinity of the spill.

The North Slope Borough (NSB) Coastal Management Program (CMP) policies relate to impacts that are "likely and cannot be avoided or mitigated" and "development that will likely result in significantly decreased productivity of subsistence resources of their ecosystems." An oil spill of this size would be accidental and the probability of such an event is very low. Therefore, it is not considered to be a "likely" event that would introduce conflict.

The NSB CMP Best Effort Policy 2.4.5.1(b) states that access to subsistence resources can be restricted when there is no feasible and prudent alternative. This policy could come into play as a result of oil-spill-cleanup activity. If it is determined that there are no feasible and prudent alternatives, there would be no conflict with this policy.

Conclusion

Based on the low probability of an oil spill event of this magnitude--and on compliance with existing regulations for spill prevention and response, existing management practices, and proposed stipulations and required operating procedures--no conflicts are anticipated. For NEPA purposes, such an event and its potential must be analyzed, even though it is recognized to be very unlikely. This conclusion recognizes the very unlikely and accidental nature of such an event.

r. Recreation Resources and Wilderness

The impacts to recreation and wilderness resources would be primarily related to negative impacts to aesthetic values and naturalness associated with visible oil sheen and residues on vegetation and water.

s. Wild and Scenic Rivers

River values that would be protected by designating any of the 22 eligible streams as components of the national Wild and Scenic River (WSR) system are: free-flow, unpolluted waters, subsistence, fisheries, wildlife and cultural resources. The impacts of a low-probability, very large oil spill on these river values is more specifically addressed in the sections dealing with water resources, subsistence fisheries, wildlife and cultural resources.

The likelihood of a large spill affecting one or more of the 22 eligible streams is greatest in the northeast portion of the Planning Area because this is where the majority of oil and gas development is expected.

Under Alternative A, Alternative B, and the Preferred Alternative, no rivers would be found suitable for inclusion in the national WSR System. A large oil spill could possibly impact outstandingly remarkable values and water quality. Such impacts would not change the determination that none of the eligible streams are suitable for designation.

Under Alternative C, the probability of a large spill impacting river values is reduced to a practical minimum. Oil and gas development would be subject to mitigating measures that would protect, to the extent possible, the free-flowing unpolluted waters and the outstandingly remarkable values of subsistence, fisheries, wildlife, and cultural resources.

t. Visual Resources

For this analysis, a very large spill is assumed to occur in the Dease Inlet/Admiralty Bay area. If the spill occurs within the Inlet or along the shore during the summer open-water season, it would have little effect on visual resources overall, as the spill would be confined to rocky beach areas or the immediate shoreline vegetation. The occurrence of a very large spill during the winter could have a similar effect if it were released from the ice during the following spring breakup. If a very large spill were to occur onshore in summer, visual resources would be impacted by the visible oil and the resulting damage to the underlying vegetation. However, spills are most likely to occur on already disturbed areas such as drill pads and production areas and would not greatly increase the area already visually impacted.

u. Wetlands and Floodplains

Wetlands and floodplains include those resources within the Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Biological resources that would be classified as having the function and value of wetlands and floodplains on the Artic North Slope included: Vegetation; Soils; Water Resources; Freshwater Quality; and Estuarine Water Quality. Please refer to the discussions in this section for each of these resources regarding information on the potential impacts of a very large spill.

6. Comparison of Alternatives

Under the various alternatives presented in this IAP/EIS, the risk of the occurrence of a very large spill and the likelihood that such a spill would contact specific resources would vary. The risk of a very large spill occurring changes under each alternative because the projected level of oil and gas activities and production changes. The likelihood of a very large spill contacting specific resources changes under each alternative because the area that may be made available for oil and gas leasing changes. The potential impacts of a very large spill would not change under the different alternatives.

The risk occurrence of a very large blowout spill would be highest under the Alternative A multiple sale scenario because the greatest number of wells and the greatest volume of production are projected under that scenario. The likelihood of contact with surface resources would vary by resource. In general, the likelihood of contact would be highest under Alternative A because the greatest area would be made available for oil and gas leasing, exploration, and development.

Under the Alternative B multiple sales scenario, about 16 percent fewer wells are projected to be drilled and about 14 percent less oil is projected to be produced than under Alternative A. Given these scenarios, it is assumed, therefore, that the risk of a very large blowout spill would be about 14 to 16 percent less under Alternative B than under Alternative A. Under Alternative B, the proposed Kasegaluk Lagoon Special Area, which is about 4 percent of BLM-administered lands in the Planning Area, would not be made available to oil and gas leasing, exploration, and development. There would be no risk of a very large spill occurring in the area unavailable for leasing. The likelihood of contact to surface resources under Alternative B would be generally lower, but not eliminated, for those resources that occur in the areas unavailable for leasing.

Under the Preferred Alternative multiple sales scenario, the number of wells projected to be drilled and the volume of oil projected to be produced are the same as under Alternative B. It is assumed, therefore, that the risk of a very large blowout spill would be the same for the Preferred Alternative as under Alternative B, about 14 to 16 percent less than under Alternative A. Under the Preferred Alternative, there would be no risk of a very large blowout occuring in the western 17 percent of the Planning Area during the 10-year leasing deferral period. Under the Preferred Alternative, the proposed Kasegaluk Lagoon Special Area, which is about 4 percent of BLM-administered lands in the Planning Area, would not be made available to oil and gas leasing, exploration, and development; there would be no risk of a very large spill occurring in the area unavailable for leasing. The likelihood of contact to surface resources under the Preferred Alternative would be generally lower, but not eliminated, for those resources that occur in the areas unavailable for leasing.

Under the Alternative C, no development or oil production is projected. There would be no risk of a very large blowout spill occurring.

Under the No Action Alternative, none of the BLM-administered lands would be made available to oil and gas leasing, exploration, or development; no wells would be drilled; and no oil would be produced. There would be no risk of a very large blowout spill occurring.

K. Possible But Unlikely Permanent Roads

1. Scenario for a Possible Permanent Road within the Northwest NPR-A Planning Area

The scenarios for the alternatives evaluated in this IAP/EIS assume that permanent roads supporting oil and gas operations within the Northwest NPR-A Planning Area are unlikely and that ice roads will be built to support oil and gas activities within the Planning Area. While the BLM believes this is a realistic scenario, this IAP/EIS does not forbid construction of such roads under Alternative A, Alternative B, or the Preferred Alternative. Stipulation E-2 for Alternative C states "Permanent roads (i.e., gravel, sand) connecting to a road system or docks outside the Planning Area are prohibited."

A permanent road within the Planning Area would not be economically feasible under current economic and technological conditions. New oil and gas discoveries, changing economics, developing technologies, material availability, and the time constraints on ice roads are all factors that might influence the feasibility of "roadless" development versus the use of permanent roads.

The use of ice roads has logistical limitations. Heavy equipment cannot begin construction of ice roads until snow and permafrost reach sufficient depth to protect the tundra surface. Construction of ice roads is a time-consuming process as the road alignment must be surveyed, permits for water use obtained, and the ice built up layer-by-layer. The time needed to construct an ice road of many miles to a drill site and the time needed to move heavy equipment back along the ice road before spring breakup decrease the time available for winter drilling activities. Because of these time constraints, the feasible limit for use of ice roads is 50 mi over land and 100 mi over the bottomfast ice zone offshore. For production activities, an ice road would need to be constructed each year and alternate access (e.g., aircraft landing strip) would be needed to support operations during the summer.

Under Alternative A, Alternative B, and the Preferred Alternative, staging facilities could be established within the Planning Area (Map 107). It would also be possible for lessees to store equipment year round at Barrow. It is extremely costly to build ice roads over long distances, and the timing of when it becomes possible each year to begin construction is weather-dependent and unpredictable. While building a permanent road from staging facilities to possible drill sites would also be very expensive and difficult, such a road could be built.

For this analysis, the following assumptions are made for a possible permanent road within the Planning Area:

- the hypothetical road would be a 75-mi road from the northeastern part of the Planning Area (the high oil and gas potential area) to the Cape Simpson area or to Barrow; thus the road would have a northwest-southeast to northeast-southwest orientation;

- the potential Barrow-Atqasuk-Wainwright community road would not be routed through the area of highest oil and gas potential and is not assumed to support the activities considered in this analysis;
- 48,000 cubic yards (yd^3) of minerals materials would be required for each mile of road (a total 3.6 million yd_3 for a 75-mi road);
- deposits with suitable quantities of mineral materials (sand and gravel) have not been identified within the Planning Area (USDOI, BLM, 1981a:Appendix 8 to the *Draft Environmental Assessment Engineering Considerations for Gravel Alternates in NPR-A*); thus materials would have to be brought to the road-construction site by barge and/or truck via ice roads;
- interlocking mat systems might be used for construction of the road; these materials would have to be brought to the road-construction site by barge and/or truck;
- 4.25 acres would be covered by each mile of road;
- bridges would be required for crossing of major rivers;
- the road would be funded and built by lessees and closed to general public use (i.e., the road would be for use by the oil and gas industry and local access only); and
- permanent roads to the Cape Simpson area and/or Barrow would be used for support activities (moving heavy equipment and supplies, all-weather/all-season transport of personnel to central field locations, etc.).

2. Scenario for a Possible Permanent Road Connecting Northwest NPR-A to Outside of the Planning Area

The scenarios for the alternatives evaluated in this IAP/EIS assume that a permanent road connecting Northwest NPR-A Planning Area oil and gas fields to existing oil-field infrastructure to the east (e.g., Nuiqsut, Kuparuk field, or Alpine field) is unlikely. The BLM believes this is a realistic scenario. The current Integrated Activity Plan for the Northeast NPR-A prohibits permanent roads connecting Northeast NPR-A facilities to outside infrastructure. Stipulation 48 for Northeast NPR-A states, "Permanent roads (i.e. gravel, sand) connecting to a road system or docks outside the Planning Area are prohibited, and no exceptions may be granted" (USDOI, BLM, 1998b).

A permanent road across the Northeast NPR-A Planning Area would not be economically feasible under current economic and technological conditions. However, the Alaska Department of Transportation and Public Facilities is working with the North Slope Borough to develop possible routes for an all-season gravel road from the Haul Road/Dalton Highway corridor to the NPR-A (*Petroleum News Alaska*, 2002). The route currently under consideration would cross the Colville River via a permanent bridge and end in the village of Nuiqsut. The Nuiqsut/Dalton Highway road is described under the major factors considered in the cumualtive effects analysis (Sec.IV.F.7.i.(4)) .

If the regulatory framework of the Northeast NPR-A Plan were to change and if a permanent road within the Northeast NPR-A Planning Area were to be built and connect to the Nuiqsut/Dalton Highway road, such a road system could theoretically support oil and gas activities in the Northwest NPR-A.

3. Effects

a. Soils

The greatest potential impact to soil resources in the Northwest NPR-A Planning Area would be from the construction of permanent roads. The extraction of mineral materials for road construction and subsequent burial of soils by permanent roads are likely to result in permanent loss of soils in those areas directly affected. Permanent roads may also have detrimental effects on soils because of changes in stream banks, blockage of natural drainage patterns, and thermokarst erosion. Blockages and damming can increase soil loss through the cutting action of cold water during periods of high water flow. Blockages and damming can result in the thermal erosion of ice rich soils. These losses would amount to a permanent and irretrievable loss of soil resources.

The construction of a 75-mi-long road would result in the direct loss of about 320 acres of soils buried by the road. The area of direct impact (as a proportion of the Planning Area) is very small, less than 0.1 percent. A 175-mi road east of the Planning Area would result in soil losses of about 750 acres.

Although the use of an interlocking mat system would reduce the need for mineral material, it would not reduce the overall area of soil resources loss.

Over the long term, it is possible that the construction of roads could reduce overall cumulative soil impacts. Traditionally, there has been unregulated and dispersed low-technology overland summer travel by local residents in the NPR-A. A problem for soil occurs when traditional travel is affected by new technology. An example would be the replacement of walking by the use of off-highway vehicles as economic conditions change and human population increases. A well-planned, permanent road system could have the net effect of increasing the opportunities for exploration, development, and individual access to the land (some of which is private) and--while not a reduction in acreage of lost soils--could limit the overall impact to soils outside the acres directly affected by road construction.

As with vegetation, when added to the effects of oil-field developments described in Alternative A Multiple Sales, these roads almost triple the total acreage of surface (and therefore soils) affected. The proportion affected would remain less than 1 percent of the total Planning Area.

b. Paleontological Resources

The greatest potential impact to paleontological resources in the Northwest NPR-A Planning Area would be the construction of a permanent road(s). There are several reasons for this. It is most likely that the road(s) would be built from mineral material that is locally or regionally available. Because usable deposits of mineral material are rare in the Planning Area, and at the same time the most common preservation medium of fossil remains, it is very likely that the deposits from which the material would be mined would contain Pleistocene vertebrate fossils and possibly Cretaceous-age vertebrate fossils. These types of paleontological remains are of significantly greater value and they are much less frequently occurring than marine invertebrate or plant fossils. Paleontological resources are nonrenewable and any impact to them as a result of mining mineral material would either cause them to be destroyed or would remove them from their natural context, thereby compromising or negating their scientific value. Even if the mineral material were not mined within the Planning Area, it would have to come from somewhere nearby, significantly adding to the possible cumulative impacts within the region.

The construction of a 75-mi-long road would bury the surface of the route with approximately 48,000 cubic yards of mineral material per mile and cover a total area of roughly 320 acres. The 320 acres is approximately 0.0000341 percent of the Northwest NPR-A Planning Area and is miniscule by any standard. However, the road is not a block area but rather a 75-mi transect across a portion of the Planning Area. While the total area affected is the same, the impact of a 75-mi-long road is potentially much greater than that of a block area simply because the road traverses an extensive segment of the landscape rather than impacting a single, constrained locale. Construction of the road with an interlocking mat system rather than mineral material would decrease potential impacts to paleontological resources to some degree because no mineral material deposits would be mined.

However the impacts of laying down the mat system across the landscape would be equal to or possibly greater than that of laying down a roadbed comprised of mineral material. While deeply buried paleontological deposits are safely protected by nature from the impacts of the construction of a permanent road, near-surface and surface remains are not.

Surveys of probable road routes and mineral material sources conducted before the start of construction can be expected to identify many of the surface (and some of the near-surface) paleontological remains. This should allow most of the known locales of such remains to be avoided. It should be remembered that, unlike vegetation or soils, paleontological resources are not ubiquitous in the Planning Area and (because it is impossible to predict their location on the landscape to any meaningful degree) it is extremely difficult to assess the probability of impacts to the resource that could result from the construction of a permanent road. Obviously, the route and location of the road(s) as well as the value or significance of the resource (information not available at this time) would be a prime factor regarding the level and degree of potential impact. Given these limitations, the probability of physical impacts to significantly valuable paleontological resources resulting from road construction can be considered a reasonable possibility, though not a likelihood. Additionally, since the road would not be open to the public (there would be no way the public could access the road), impacts to the resource resulting from unauthorized collection of vertebrate fossils would be negligible.

If the 75-mi-long road within the Northwest NPR-A Planning Area were to be linked to a road traversing the Northeast NPR-A Planning Area (constructed from mineral material obtained from Colville River deposits), which in turn were to be connected to a road tying into the Dalton Highway (creating in total a 175-mi-long road), the potential impacts to the regional paleontological resources would be exponentially increased. In other words, the possible impacts previously discussed would have a greater probability of occurring because more area, a longer transect across the landscape and the mining of more mineral material deposits, would occur as the result of this additional permanent road construction. There is one other difference, however. That portion of the 175-mi-long road from the Dalton Highway west to the village of Nuiqsut, a distance of approximately 70 mi, would be open to the public. This circumstance creates the possibility of impact to paleontological resources through unauthorized collection--not a concern with the road segments within the NPR-A. However, even with the addition of 100 mi of road connecting with the 75 mi of road within the Northwest NPR-A Planning Area, impacts to paleontological resources remain a possibility rather than a likelihood.

c. Water Resources

The effects of permanent gravel roads on the water resources in the Planning Area are discussed in Section IV.C.3.b. In general, these may include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst); blockages of natural channels and floodways that disrupt drainage patterns; increased erosion and sedimentation; and removal of gravel from riverine pools, lakes, and floodplains (Walker et al., 1987).

Construction of permanent gravel roads would cover about a 4.25 acre/mi footprint of road, or a total of 319 acres for the assumed 75-mi road within the Planning Area. In the coastal plain of the North Slope, where low surface gradients limit flow and permafrost is ubiquitous, a gravel road could create significant water impoundments and thermokarst erosion--equivalent to approximately twice the area directly covered by the gravel--up to 638 acres.

Unlike the ice roads, gravel roads and pits would create long-term impacts over the life of the field(s). Since gravel roads have a severe potential impact on natural drainage patterns (creating flow diversions, impoundments, and thermokarst erosion), limiting the length and requiring that all of the permanent roads have approved drainage plans would do the most to reduce impacts to water resources (Walker et al., 1987). Limiting development on floodplains and wetlands would ensure compliance with Executive Orders 11988 and 11990 that direct Federal Agencies to minimize the destruction, loss, or degradation of floodplains and wetlands.

If the regulatory framework of the Northeast NPR-A Planning Area were to change and permanent roads within that Planning Area were to be built and connect to the proposed road to Nuiqsut, then an additional 744 acres of footprint would be created. This could impact up to 1,488 acres outside the Northwest NPR-A Planning Area, for a total of 2,126 acres of potential cumulative impacts from water impoundments, increased erosion and sedimentation, gravel removal, and thermokarst erosion (Walker et al., 1987).

d. Water Quality

This assessment assumes that a permanent road about 75 mi long might be constructed from the northeastern part of the Planning Area to Cape Simpson or Barrow. An additional 100 mi of road might be constructed outside the Northwest Planning Area (total 175 mi), part of which might be used by the public. Such roads would affect water quality in several ways, depending primarily on the type of construction (i.e., with gravel or an interlocking mat system). As explained below, roads on mats would probably alter some ponds and streams within 1,000 acres for several years, causing a measurable (though minor) effect on water quality. Gravel roads would block some down-slope movement of water, creating small impoundments for several decades, and the dust from gravel roads would increase local water turbidity for as long as the road was heavily used.

An interlocking mat system has been used for temporary drill pads on the tundra. Two advantages of the system are that water turbidity from gravel construction would not be a problem, and the impact on the tundra would probably persist for a relatively short period of time (compared to gravel fill). The duration of the impact is hard to determine because mat systems have apparently not been used for several years in one place. A mat system without a very effective insulation layer would probably increase the summer soil temperature under the mats over a period of years. Increased summer temperature would cause some melting of the tundra permafrost (or thermokarsting), leading to the formation of some new ponds and streams, which could influence the permafrost temperature further. The duration of impact of ice pads that have been insulated and used for more than one winter is only a few years (McKendrick, 2000). A mat road of about 75 mi in length would create some new ponds and streams within about 4.25 acres per road mi (or about 320 acres) for a few years while a road of about 175 mi would alter ponds and streams within about 740 acres. The total area that might be affected by an interlocking mat road system would be about ten times the area that is covered by the 97-acre Alpine development project. The alteration of some ponds and streams for several years over an area of 1,000 acres would constitute a measurable (minor) effect on water quality.

If the roads were constructed with gravel (usually about 2 m thick), there would be almost no effect on the permafrost temperature, but there would be other effects. The assessment for the Northeast NPR-A concluded that the primary water-quality effect from construction and placement of gravel structures would be related to up-slope impoundment of water (USDOI, BLM and MMS, 1998:Sec. IV.C.4.b (2)). If standard North Slope construction practices were followed, culverts would be used to reduce impoundment, but roads might block some down-slope movement of water, creating small impoundments and, as noted by McKendrick (2000), drying the down-slope substrate. The impoundment effect would be very local but would persist as long as the gravel fill (for several decades).

Gravel roads also would probably increase water turbidity for two reasons. Culverts tend to concentrate flows that would otherwise be dispersed over a wider area--the concentrated flows being more likely to cause erosion of ice-rich soils--and, consequently, might increase turbidity (as explained in the *Alpine Environmental Evaluation*, U.S. Army Corps of Engineers, 1997:Sec 4.3.1.2). Secondly, dust fallout could also increase water turbidity. The fallout from heavily used gravel roads can be substantial; for example, up to 25 cm (10 in) of dust has been measured next to a major North Slope road (McKendrick, 2000). The possible Northwest NPR-A road would not be open to the public, and only part of the other road would be open, so only a few streams might become more turbid from dust fallout. In conclusion, gravel roads would block some down-slope movement of water, creating small impoundments for several decades, and the dust from gravel roads would increase local water turbidity for as long as the road was heavily used.

e. Air Quality

A possible (but unlikely) permanent road--either within the Northwest NPR-A Planning Area or connecting to outside the Planning Area--would have some effects on air quality. The construction of a permanent road would have a very minor favorable effect on air quality by eliminating the repetitive yearly construction and time-concentrated heavy use of ice roads. Some adverse air-quality effects would occur during the construction of the road from emissions from heavy equipment and vehicles used in the road-building work. Some adverse effects would occur from subsequent vehicle use of the road. All of the emissions are expected to be very localized and temporary, except possibly dust (particulate matter less than 10 microns in diameter). Road-builders can reduce dust during construction by moistening the exposed surface. Similarly, moistening the road surface during periods of heavy use would reduce blowing dust. Adverse effects on ambient air quality should be insignificant. Air quality should remain well within ambient air-quality standards and Prevention of Significant Deterioration limits.

f. Vegetation

The impacts of permanent roads on vegetation would be of the same types as those from gravel pads and roads within oil field developments, as described in the analyses for Alternative A and the Preferred Alternative. These include the destruction of vegetation as a consequence of direct burial under gravel and the alteration of plant species composition in areas immediately adjacent to the road. The latter would be a consequence of dust or gravel spray and changes in moisture regimes from drifted snow or the blockage of natural drainage patterns.

A 75-mi road within the Planning Area would bury about 320 acres of land and alter the adjacent vegetation on about another 3,000 acres. A 175-mi road between the Planning Area and Nuiqsut would result in the destruction of vegetation on about 750 acres and the alteration of vegetation on about 7,000 acres. The two roads combined, when added to the effects of oil field developments, would almost triple the total acreage of vegetation affected, as presented in Alternative A, Multiple Sales. Most of the impact would be east of the Planning Area, associated with the longer road there. Within the Planning Area, the proportion of land affected would represent an increase from 0.05 percent to 0.09 percent of the total, but would remain a relatively small proportion overall. As long as roads and other developments are sited to avoid populations of rare plants, they would not be likely to adversely affect the continued existence of any plant species or community types.

g. Fish Resources

(1) Freshwater and Anadromous/Amphidromous Fish

(a) Within the Northwest NPR-A Planning Area

A road connecting the northeastern portion of the Planning Area to Cape Simpson or Barrow could result in additional impacts to freshwater fish. Potential impacts are related to gravel extraction, disruption of fish movements due to altered flow patterns, and sedimentation and contamination of habitat.

Material sites (for gravel extraction) needed for construction of roads have not been identified in the Northwest NPR-A Planning Area. A probable source includes river floodplains and channels. Given the road is likely to cross rivers close to overwintering and spawning habitat (lower reaches of major rivers), gravel removal from river beds could result in localized loss of spawning and overwintering habitat (loss of suitable substrate and overwintering pools). Road construction has the potential to alter flow patterns to, and within, waterbodies. Bridges, culverts, low-flow crossings and the road itself can interfere with fish migrations to spawning, feeding, and overwintering sites if improperly designed. Concerns related to road placement include diverting or eliminating flow from small tributaries that connect lakes or connect lakes and rivers. Potential loss of migratory capacity could stress or kill fish if they are unable to migrate to food-rich habitat in the summer, reach spawning areas, or move into overwintering habitat. Another impact of concern during road construction is erosion and subsequent instream sedimentation. Direct threats to fish from sediment include loss of physical habitat, and decreased reproductive success. Embedded sediments fill interstitial spaces and essential winter habitat used by juvenile fish. Filling of pool habitat further limits overwintering sites for adult and juvenile fish. Developing eggs can be smothered and newly hatched fry can be killed by suspended sediment that prevents emergence from spawning gravel and interferes with respiration. In instances where stream reaches are aggrading due to heavy sediment loading, physical habitat is further degraded when flows are redirected and erode channel banks. Once built, a road increases the chance of contaminant spills and subsequent impacts to aquatic habitat and resources. While impacts from gravel extraction, sedimentation, and altered flow patterns should be minor if adequate controls are in place, potential impacts from contamination will exist for the life of the road.

(b) Outside the Northwest NPR-A Planning Area

Potential impacts related to gravel extraction, disruption of fish movements from altered flow patterns, and sedimentation and contamination of habitat are similar to those discussed for within the Planning Area (see above). An additional 175-mile road connecting the northeastern portion of the Planning Area to Nuiqsut results in a small additional effect on freshwater fish relative to these impacts.

(2) Marine Fish

The effect of a permanent road on marine fish would depend on the road's location, size, and design characteristics. Construction of a road in nearshore waters could adversely affect the movement of some coastal marine and migratory marine fish, since they commonly feed and migrate in nearshore waters during the summer months. However, road construction is expected to occur on land and would have little to no effect on marine fish. While it may adversely affect some individual marine fishes, either directly (e.g. burial of nearshore marine habitat), or indirectly (e.g. increased turbidity), an onshore road is not likely to have a measurable effect on marine fish populations. If some portion of the road were to extend into marine waters, it should be engineered to provide for the unrestricted movement of nearshore marine fish. In that case, marine fish in the immediate area of the road would be likely to experience only short-term avoidance effects during the construction phase, and no measurable effects would be expected on fish populations. Otherwise, marine fish in the vicinity of the road are likely to be adversely affected due to their access to feeding and migrating areas being restricted by the road.

h. Birds

The route of a permanent road connecting potential development sites in the northeastern portion of the Northwest NPR-A Planning Area to Barrow, Cape Simpson, or Nuiqsut is likely to pass through or adjacent to important waterbird breeding habitats. For the Barrow route, this could include high-density areas for Pacific loon, red-throated loon, tundra swan, brant, white-fronted goose, northern pintail, long-tailed duck, shorebirds, arctic tern, and Sabine's gull. A route to Cape Simpson could impact high-density areas for yellow-billed loon in addition to most of these species, but probably not Pacific loon or Sabine's gull. A route to Nuiqsut could impact high-density areas for yellow-billed loon and king eider in addition to many of these species, but probably not red-throated loon, tundra swan, brant, or Sabine's gull. In winter, ptarmigan and potentially snowy owl and gyrfalcon could be disturbed in any of the areas. A projected road about 75 mi long would bury only about 320 acres of potential bird nesting habitat, but substantial areas of habitat adjacent to the road would be heavily disturbed (in some cases permanently disturbed) during construction. A 175-mi-long road would bury about 744 acres. While it is likely a road would be constructed in winter, a mat system could be constructed during the summer season. Adverse post-construction impacts on birds during the breeding season may result from: 1) vehicle and personnel traffic causing noise, visual, and/or dust disturbance along the road; 2) stream drainages or other aquatic habitats altered by the road presence; 3) greatly increased access to areas surrounding the road corridor for those engaged in waterfowl hunting or disturbance-causing activities; and 4) physical and physiological contamination from fuel/lubricant spills that enter aquatic habitats. In winter, only disturbance effects are likely to occur.

Overall, it is likely that bird use of habitats near a road would be altered, and the effects of road presence would vary considerably among species and by time of year (Troy, 1986; TERA, 1993b; Troy and Carpenter, 1990). Effects may be especially widespread among shorebirds. Disturbance from increased activity associated with a road would be the most important source of effects. The most likely result of disturbance from road traffic during the breeding season is for species that are intolerant of noise and/or human presence to seek out more distant nesting and/or brood-rearing habitat. Those species with highly specific breeding habitat requirements presumably would experience more difficulty locating appropriate alternate habitat--causing greater disruption of breeding season schedule--with possible effects on productivity, at least in the short term. More activity-tolerant species are likely to experience less disruption of their breeding activities. In Prudhoe Bay area studies, all shorebirds except red-necked phalarope were present at lower densities near roads than away from them during the breeding season (TERA, 1993b). This avoidance did not persist into the post-breeding season, when densities were highest near roads. Red-necked phalaropes were more numerous along roads, an effect probably related to dusting. Dust fallout is highest along the side of a road that is more persistently downwind, causing earlier snowmelt in spring and thus earlier availability of nesting habitats. At Prudhoe Bay, red-necked phalaropes and semi-palmated sandpipers occurred at higher densities along the most heavily dusted side of roads-- although the latter species was present at 40 percent lower density than expected in the absence of a road (TERA, 1993b). In general, road presence may result in considerable rearrangement of birds on a local scale (with densities near the road much lower than away from it), but probably would have relatively little effect on bird abundance in a region. Potential impacts from aquatic habitats altered by road presence or accidental fuel or lubricant spills are likely to be local in extent. As such they would, respectively, cause a small proportion of locally nesting birds to seek alternate nesting habitat or result in a few locally breeding birds becoming contaminated and potentially dying. Neither impact is expected to result in a substantial population effect. In the absence of restrictive regulations, some local non-oil- and gas-related activity (e.g., waterfowl hunting) would be expected to have adverse effects on bird populations, but there is not enough information for a realistic estimate of effects. Disturbance effects in winter would be negligible.

i. Mammals

(1) Terrestrial Mammals

(a) Within the Northwest NPR-A Planning Area

If a permanent road were constructed from oil fields to coastal areas, there would be additional impacts to terrestrial mammals. Potential impacts would include disturbance during construction, disruption of movements or migration, accidental mortality, and loss of habitat. Grizzly bear, wolf, wolverine, foxes, and other small mammals may be disturbed during construction of the road or accidentally killed by vehicles after construction is complete. A minor amount of habitat for these species would be lost due to road construction. Impacts to moose and muskoxen would be minimal due to their low densities within the northern part of the Planning Area. The greatest potential for impact would be on caribou. Impacts to caribou would be similar in type to those discussed under Alternative A. The level of impact would vary depending upon location of the road. Construction of a road from the northeastern part of the Planning Area to Point Simpson would cross the TLH insect-relief area (Map 50) and would disrupt movements of insect-harassed caribou between insect-relief areas and foraging areas. In addition, such a road would interfere with movements of TLH caribou between the calving grounds and other parts of their range (Maps 48, 49, 50, and 54). Construction of a road northwest to Barrow would be somewhat less disruptive during insect season but would also interfere with movements of TLH caribou from wintering areas southwest of Barrow to calving grounds east of Teshekpuk Lake. Wintering TLH animals may be temporarily disturbed by traffic. Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings may be affected in larger numbers; however, there would be no population level impacts on these species. These impacts would continue for the life of the road and would be dependant upon traffic levels. Since the road would not be open to public use, no increase in access would occur.

(b) Outside the Northwest NPR-A Planning Area

An east-west road connecting the Planning Area to Nuiqsut would result in additional impacts to terrestrial mammals. Potential impacts would include disturbance during construction, disruption of movements or migration, accidental mortality, loss of habitat, and increased public access into wildlife habitat. Moose, muskoxen, grizzly bear, wolf, wolverine, foxes, and other small mammals may be disturbed during construction of the road or accidentally killed by vehicles after construction is complete. Some loss or disturbance of habitat would occur, particularly within the Colville River, the source of mineral materials for road construction. The general impacts of roads on caribou are discussed under Alternative A. Wintering TLH animals may be temporarily disturbed by construction or traffic on the completed road (Map 54). Depending upon the location of the road across Northeast NPR-A, the road could interfere with movements of TLH caribou to and from their calving grounds or result in the loss of some calving habitat (Map 48). The road would likely cross TLH insect-relief habitat, resulting in disruption of movements of insect-harassed TLH caribou (Maps 49 and 50).

(2) Marine Mammals

A permanent road connecting potential development sites in the northeastern portion of the Northwest NPR-A Planning Area to shore base and staging areas at Barrow or Cape Simpson is not likely to result in disturbance of gray whales, beluga whales, walrus, ringed seals, or bearded seals because these animals infrequently approach nearshore habitats where noise associated with construction or traffic on such a road could be expected. Noise and/or visual presence of personnel during construction, or use of a road, or use of an associated shore base for equipment offloading and staging potentially could affect spotted seal and polar bear behavior. Seals are found in Dease Inlet/Admiralty Bay and at the mouth of the Piasuk River in Smith Bay during summer, and polar bears may occur in coastal areas in any season. Barge traffic to a shore base served by a road to Barrow or Cape Simpson potentially could disturb a few individuals of these species, although it would be considered a rare event. A permanent road from the Planning Area to Nuiqsut would not impact any marine mammals. Disturbance effects associated with the presence of a permanent road are likely to be negligible for marine mammal species.

j. Threatened and Endangered Species

The route of a permanent road connecting potential development sites in the northeastern portion of the Northwest NPR-A Planning Area to Barrow, Cape Simpson, or Nuiqsut is likely to pass through or adjacent to important spectacled and/or Steller's eider breeding habitats. For the Barrow route, this could include high-density areas for both species. A route to Cape Simpson or Nuiqsut could impact a few areas where either species is present, though densities generally are lower east of the Planning Area. In winter, these species are absent from the Planning Area. A projected road about 75 mi long would bury only about 320 acres of potential eider nesting habitat, but it is assumed that substantial areas of habitat adjacent to the road would be heavily disturbed (in some cases permanently disturbed) during construction. Likewise, a 175-mi-long road would bury about 744 acres. While it is likely that a road would be constructed in winter, a mat system could be constructed during the summer season. Adverse post-construction impacts on eiders during the breeding season could result from: 1) vehicle and personnel traffic causing noise, visual, and/or dust disturbance along the road; 2) stream drainages or other aquatic habitats altered by the road presence; 3) greatly increased access to areas surrounding the road corridor for those engaged in waterfowl hunting or disturbance-causing activities; and 4) physical and physiological contamination from fuel/lubricant spills that enter aquatic habitats.

Overall, it is likely that use of habitats by eiders near a road could be altered. The effects of road presence may vary considerably among individuals (TERA, 1995b). Disturbance from increased activity associated with a road would be the most important source of effects. The most likely result of disturbance from road traffic during the breeding season would be for eiders to seek out more distant nesting and/or brood-rearing habitat. However, studies in the Prudhoe Bay oilfield complex do not suggest a significant avoidance effect (TERA, 1995b). Although studies in that area confirm higher dust fallout along the side of a road that is more persistently downwind, causing earlier snowmelt in spring (and thus earlier availability of nesting habitats), influence of this situation on spectacled eider nesting habits has not been indicated, as shown for some shorebirds (TERA, 1993b). Nesting and brood-rearing spectacled eiders in the Prudhoe Bay area have not been found to avoid pursuing these activities near roads. Some eiders in this area were found to nest in habitat completely bounded by roads, and five tracked broods spent considerable time near roads and were recorded crossing roads five times (TERA, 1995b). However, eiders breeding in the Prudhoe Bay area could be relatively more habituated to roads and road traffic than those in NPR-A; thus, the latter may respond to the presence of a road with a greater (although unknown) degree of avoidance. In general, road presence may result in an unknown degree of rearrangement of birds on a local scale, but probably would have relatively little effect on regional eider abundance. Potential impacts from aquatic habitats altered by road presence or accidental fuel or lubricant spills are likely to be local in extent. Those impacts could, respectively, cause a small proportion of locally nesting eiders to seek alternate nesting habitat or result in a few locally breeding eiders becoming contaminated and potentially dying. Neither impact is expected to result in a substantial population effect. In the absence of restrictive regulations, local non-oil and gas-related activity (e.g., waterfowl hunting) could have an adverse effect on eider populations, but there it is difficult to estimate the magnitude of this effect without information on potential routes.

It is unlikely that the bowhead whale would be affected by a permanent road in NPR-A. During the fall migration period, however, whales in the nearshore zone potentially could be exposed to increased barge traffic if a road were to serve a new shore base in the Cape Simpson or Barrow area for equipment offloading and staging.

k. Economy

Construction of a 75-mi permanent road within the Planning Area to Cape Simpson or Barrow would reduce the need for ice roads constructed each winter and (to some degree) use of aircraft to access exploration, development, and production sites.

Lessees would presumably choose to build the road because the cost would be less than other options (i.e., using ice roads and aircraft as access for exploration, development, and production sites). Because of these cost savings, the employment and personal income would be less than those forecast in the Economy section for Alternative A (Section IV.C.12). Exact information on costs, employment, and personal income for a permanent road versus options using ice roads and aircraft is not available. Estimated employment and personal income using permanent roads could be 2 percent less than shown in Table IV-31, "Effects of Preferred Alternative on Employment and Person Income by Place of Residence with Oil at $30/bbl of Oil."

Construction of a 175-mi, permanent, east-west road from the northeast portion of the Northwest Planning Area and across all of Northeast NPR-A Planning Area to Nuiqsut would substitute for other transportation options. Using assumptions and analysis similar to that for the 75-mile road above, estimated employment and personal income effect from using permanent roads could be 4 percent below that shown in Table IV-31, "Effects of Preferred Alternatiave on Employment and Person Income by Place of Residence with Oil at $30/bbl of Oil."

The North Slope Borough cannot collect property tax on infrastructure or improvements on Federal lands, so no property taxes would accrue to the Borough from road improvements in NPR-A.

I. Cultural Resources

As with paleontological resources, the single greatest potential impact to cultural resources in the Northwest NPR-A Planning Area is the construction of a permanent road(s). The many reasons for this all stem from the assumption that the road(s) would most likely be built from mineral material that is locally or regionally available. Most prehistoric and historic cultural resource sites that are the result of past human activity on the North Slope lie on relatively well-drained ground. This is not surprising in a region that often appears to be more water than land. As a result, gravel deposits--mineral material--that have surface exposure almost always support one or more cultural resource sites. There are other relatively dry locales (such as stabilized sand dunes and pingos) that occur on the landscape with much greater frequency than gravel deposits. Many of these also support cultural resource sites. However, mineral material deposits appear to have been the most sought after and regularly used camping locales. Mineral material deposits in the region are rare, and deposits with surface exposures are rarer still, and that rarity makes almost any deposit worth mining for roadbed material. As a result, the potential for impacting cultural resource sites is high if the road(s) is to be constructed of local/regional mineral material.

Like paleontological resources, cultural resources are nonrenewable, and any impact to them as a result of mining mineral material would either cause them to be destroyed or would remove them from their natural context, thereby compromising or negating their scientific value. Even if the mineral material were not mined within the Northwest NPR-A Planning Area, it would have to come from somewhere nearby, significantly adding to the possible cumulative impacts within the region. In addition to the potential impacts to cultural resources from the mining of the more than 3.6 million cubic yards (yd^3) of mineral material necessary to construct a 75-mi-long road within the Northwest NPR-A Planning Area, the building of the road itself presents further impacts to the resource.

The construction of a 75-mi-long road would cover the surface of the route with approximately 48,000 yd^3 of mineral material per mile, thus burying any cultural sites within the right-of-way. Cultural sites which lie on the surface would probably be destroyed or otherwise adversely disturbed by this process. Near-surface cultural sites would probably survive the burial episode with little negative impact to their physical integrity but would be lost as the result of being buried. The construction of a 75-mile-long road would cover/bury a total area of roughly 320 acres. The 320 acres is approximately 0.0000341 percent of the Northwest NPR-A Planning Area and is miniscule by any standard. However, the road is not a block area but rather a 75-mi transect running across the landscape of the Planning Area. While the total area affected is the same, block or transect, the impact of a 75-mi-long road is potentially much greater than that of a block area simply because the road would traverse an extensive segment of the landscape, and therefore have the potential to impact many more cultural resource sites than would the burial of the surface of a single block of 320 acres of tundra.

Construction of the road utilizing an interlocking mat system rather than mineral material would decrease potential impacts to cultural resources to some degree, because no mineral material deposits would be mined. However the impacts of laying down the mat system across the landscape would be equal to or possibly greater than that of laying down a roadbed comprised of mineral material. Surveys of probable road routes and mineral material sources conducted before the start of construction would be expected to identify many of the surface (and some of the near-surface) cultural remains. This should allow most of the known locales of such remains to be avoided or impacts to them be otherwise mitigated. It should be remembered that unlike vegetation or soils, cultural resources are not ubiquitous in the Planning Area. Because of their nature, the location of cultural resource sites is somewhat more predictable than paleontological deposits, however it remains difficult to predict their location within the Planning Area to a reliable degree. Therefore, it is extremely difficult to assess the probability of impacts to the resource that might result from the construction of a permanent road. Obviously, the route and location of the road(s), as well as the value or significance of the resource--information not available at this time--would be prime factors in estimating the level and degree of potential impact. Given these limitations, it is possible that road construction could significantly physically impact valuable cultural resources. Additionally, since the road would not be open to the public, impacts to the resource resulting from unauthorized collection would be negligible.

If the 75-mi-long road within the Northwest NPR-A Planning Area were to be linked to a road traversing the Northeast NPR-A Planning Area, which in turn were to be connected to a road tying into the Dalton Highway--creating in total a 175-mi-long road--the potential impacts to the regional cultural resources would increase exponentially. The impacts previously discussed would have a greater probability of occurring because more area (a longer transect across the landscape) and the mining of more mineral material deposits would occur as the result of this additional permanent road construction. There is one other important aspect of such a road. That portion of the 175-mi-long road from the Dalton Highway west to the village of Nuiqsut, a distance of approximately 70 mi, would be open to the public. This circumstance creates the possibility of impact to cultural resources through unauthorized collection, which would not be a concern with the road segments within the NPR-A.

m. Subsistence-Harvest Patterns

There is great concern among Inupiat that subsistence and cultural sites could be damaged because of such a sweeping undertaking as a road. In the BLM's 1979 Section 105 (c) study of NPR-A, the Inupiat Community of the Arctic Slope stated in *The Inupiat View*: "Areas identified in the TLUI (Traditional Land Use Inventory) as critical to subsistence or cultural sites should be off limits to any oil and gas exploration and development activities, including transportation systems. Activities proposed outside these sites should be evaluated on a case-by-case basis in close cooperation with local residents and representatives of the Borough and ICAS; for in order to mitigate the effects of such disruption and alien uses, in a special environment of great significance to many people, requires special knowledge that only we can provide" (USDOI, BLM, 1979a).

In Hall's 1983 subsistence study for the proposed Brontosaurus exploratory well, many Inupiat were interviewed about their concerns regarding potential impacts from the project. Overwhelmingly, the most threatening factor was the potential contamination of the local watershed and subsequent impacts on local fisheries in the Inaru River drainage. According to Hall, one subsistence hunter felt that the Inaru basin was "akin to the ocean, being an extreme example of a wetlands and providing a feeding ground for the Inupiat." Those interviewed believed that "White scientists" were ignorant about the entire Inaru drainage, "particularly in terms of the nature and intensity of water movement and sediment transport." According to local residents, the watershed is a complicated web of lakes north and south of Niklavik Creek and the Inaru River connected by small streams that could be navigated by fish at high water. They believed that contamination of any single water body "whether directly or indirectly by run-off from the land" would ultimately affect any part of the downstream drainage. In addition, ice jams on the Meade River delta could cause water to flood back up the Inaru as far as Niklavik Creek, effectively bringing any contaminants upstream from their origin. To local Inupiat, the Inaru drainage was a unique yet susceptible aquatic resource. Flossie Itta stressed this point in an interview by Hall when she spoke of her grandparents warning her as a child to not even dispose of soapy wash water in local waterbodies because it could harm or frighten fish (Hall, 1983). These observations suggest that local subsistence-based communities would have major concerns with a potential permanent road between development sites in the northeastern portion of the Northwest NPR-A Planning Area. This road could compound run-off impacts over a much more widespread area, potentially affecting lakes, streams, and major rivers and threatening local subsistence fisheries.

As part of the fieldwork protocol for a 1984 MMS technical report entitled *Barrow Arch Socioeconomic and Sociocultural Description*, researchers asked people in various Chukchi Sea villages their opinions on building land links between local communities and other regions of the North Slope. The majority of the people interviewed opposed land links to villages because 1) they appreciated the quality of life afforded them by semi-isolation, 2) they believed that roads would have a negative impact on wildlife resources, and 3) they worried that road access would increase liquor imports into "dry" villages (ACI, Courtnage, and Braund, 1984).

Walker et al. in their 1987 paper *Cumulative Impacts of Oil Fields on Northern Alaska Landscapes* found: 1) major landscape impacts from Prudhoe Bay development; 2) that indirect impacts such as thermokarst may not develop until many years after initial development; and 3) that the total area covered by direct and indirect impacts can greatly exceed the area of planned development. According to Walker et al. (1987): "There is a need to develop methods to assess cumulative impact and to foster comprehensive regional planning to anticipate the large impacts that are likely to occur on the coastal plain in the next few years." A permanent road would certainly represent one of these "large" impacts and would call for a massive planning effort, accompanied by the gathering of all necessary baseline data along any potential route (Walker et al., 1987; see Sec. IV.F.8.n, Cumulative Effects on Subsistence-Harvest Patterns).

In a 1987 FWS study that compared the actual and predicted impacts of TAPS, researchers concluded that: "Fish and wildlife habitat losses resulting from construction and operation of the Pipeline System and Prudhoe Bay oilfields were greatly underestimated in the [USDOI's 1972 Final] EIS [on the Trans-Alaska Pipeline]. They included the direct losses of 22,000 acres from gravel fill and excavation, the even greater indirect losses of habitat quality due to the secondary impacts of construction (dust, siltation, erosion, impoundments, contaminants, etc.), and the blockage of fish and wildlife access to habitat by roads, pipelines, and causeways. Some of these indirect impacts were not predicted in the EIS, and the observed magnitude of frequency of others were greater than expected. Although some effort has been made to reduce habitat loss (through siting, consolidation of facilities, culverting, etc.) rehabilitation efforts along the Pipeline System have resulted in little restoration of habitat values...a lack of predictive capability may be expected whenever development moves into new geographical areas" (USDOI, FWS, 1987).

Potential permafrost loss and hydrological changes related to global climate change could compound impacts from road construction and maintenance. The thawing of permafrost and associated increased maintenance costs have already become problems in arctic and sub-arctic areas (www.grida.no/climate/ipcc/regional, 2002).

The route of a permanent road connecting potential development sites in the northeastern portion of the Northwest NPR-A Planning Area to Barrow, Cape Simpson, or Nuiqsut would pass through important subsistence resource habitat and important subsistence-harvest areas for caribou, fish, and birds. A road, combined with any development pipelines, would disrupt and displace caribou along its length and potentially disrupt hunting patterns by producing major alterations in hunter (including non-subsistence hunter) access patterns in both summer and winter. Any road access would represent a major arterial where only trails had existed before. A road would promote the development and expansion of the oil patch, bringing with it similar issues about hunter access restrictions, hunting area reductions, trespass issues, disturbance and displacement of game, and the effectiveness of mitigation--all persistent and unresolved concerns from ongoing expansion at Prudhoe Bay, Kuparuk, and Alpine. The Dalton Highway, paralleling much of the Arctic portion of the Trans-Alaska Pipeline, has provided human access into remote regions and increased hunting and off-road vehicle impacts and accompanying impacts on caribou (NRC, 2003; Bergerud et al., 1984; Spellerberg, 1998; Ricketts et al., 1999).

A 1997 study on the proposed Eureka to Rampart road assessed impacts to subsistence resources and activities by non-local residents as a result of increased access from existing road projects. Effects identified in the study communities of Rampart, Stephens Village, Tanana, Eureka, Minto, and Manley Hot Springs included: 1) increased non-local hunter use as a result of local access using the Dalton Highway; 2) increased non-local pressure on the hunting of moose, bear, and waterfowl, fishing for salmon, pike, whitefish, and blackfish, and trapping; 3) increased noise activity from non-local hunter boat use; 4) increased minerals development; 5) State land disposals increasing home site developments and increased populations of potential subsistence users; 6) loss of habitat for subsistence resources and loss of lands used for subsistence harvests; 7) declines in moose populations; and 8) illegal use of Native lands by non-local users. As a result of this increased non-local access and hunting pressure, many local hunters curtailed their fall moose hunt and often waited until the winter season to hunt (Betts, 1997). Similar hunting, access, and habitat pressures on subsistence resources and harvest activities could be expected from potential State or NPR-A road development on the North Slope.

In general, caribou, fish, birds, and other terrestrial mammals would be expected to experience greater and more continuous disturbance and contamination effects from a road, with those nearest the road experiencing the greatest local disturbance and displacement. In the absence of restrictive regulations, local non-oil- and gas-related activities--including inevitable non-subsistence hunting (and the eventual pressure for increased sport hunting)--would be expected to have adverse effects on subsistence resource populations and subsistence-harvest patterns.

A 175-mi-long road would produce more regional (thus, more profound) effects on the habitat and movement of subsistence resources, and on hunter access. Bridging the many productive rivers from Nuiqsut west would make these watercourses more vulnerable to siltation and fuel-spill contamination. Of primary concern would be 1) the lack of any reliable process for assessing and monitoring changes to subsistence-harvest patterns, 2) changes to hunter access, and 3) enforcement of the regulations that would already have been enacted to mitigate the profound and widespread effects such an artery would bring with it (Haynes and Pedersen, 1989).

n. Sociocultural Systems

The presence of a road connecting portions of the NPR-A with Barrow or Nuiqsut would irrevocably alter traditional Inupiat subsistence culture. Profound disruptions would ripple through the sociocultural fabric, and existing institutions would be altered and displaced.

Subsistence resources could experience long-term disturbance and displacement effects leading potentially to reductions in resource populations. Even without reductions, movement patterns might change, causing hunters to alter traditional harvest practices by traveling to unfamiliar areas. Over the long term, such alterations could cause displacement of ongoing social systems and community activities by disrupting traditional practices for harvesting, sharing, and processing subsistence resources.

o. Environmental Justice

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough--the area potentially most affected by the presence of a road within the Northwest NPR-A Planning Area and a road connecting the Northwest NPR-A to the east. Inupiat Natives could be affected because of their reliance on subsistence foods; a permanent road could impact subsistence resources and harvest practices. Potential effects would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough.

Subsistence resources could experience long-term disturbance and displacement effects, as well as potential population reductions, causing subsistence hunters to alter traditional harvest practices by having to travel to unfamiliar areas. If this were to happen, long-term displacement of ongoing social systems would be expected. Community activities and traditional practices for harvesting, sharing, and processing subsistence resources would be altered, and disproportionate, high adverse effects would be expected for the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut (see Section IV.K.3.m, Subsistence-Harvest Patterns and Section IV.K.3.n, Sociocultural Systems).

p. Coastal Zone Management

The habitat, subsistence, and water-quality standards of the ACMP and the related enforceable policies of the North Slope Borough address the main areas of concern to North Slope residents. Subsistence uses of the coastal resources have been and will continue to be of the highest priority for North Slope residents. The route of a permanent road connecting potential development sites in the northeastern portion of the Northwest National Petroleum Reserve-Alaska Planning Area to Barrow, Cape Simpson, or Nuiqsut could pass through important habitat and important subsistence-harvest areas for caribou, fish, and birds. Activities related to road construction and the presence of a permanent road in or adjacent to coastal areas (including river crossings) could be subject to review under the ACMP. The inland coastal boundary of the North Slope Borough includes the zones of direct interaction and direct influence and extends inland approximately 25 mi. For the mid-Beaufort region, the inland coastal boundary includes certain river corridors (notably the Colville River corridor) to protect anadromous fish spawning and overwintering habitats.

If construction activities or the location of the road were to have reasonably foreseeable effects on any land or water use or natural resource of the coastal zone, a review under the ACMP would be necessary. If a specific proposal were presented for review and approval, a site-specific analysis would determine whether an ACMP review were necessary and if so, which standards and enforceable policies would be applicable.

The most obvious ACMP standards that may need to be addressed are:

- Coastal Development;
- Transportation and Utilities;
- Mining and Mineral Processing;
- Subsistence;
- Habitats;
- Air, Land, and Water Quality; and
- Statewide Historic, Prehistoric, and Archaeological Resources.

The National Petroleum Reserve-Alaska Federal lands are excluded from the coastal zone. However, the Federal Coastal Zone Management Act requires that Federal applicants proposing activities that have reasonably foreseeable effects on any coastal use or resource include as part of their Federal application a certification that activities will be conducted consistent with the state's coastal management program, including the enforceable policies of the NSB CMP. If a project is located in the coastal zone and requires a Federal authorization that is on the ACMP list of Federal authorizations requiring review, a review will be required (15 CFR 930.53(a)(1)). The State may concur with or object to an applicant's certification. At the time that future site-specific plans are submitted for any activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone, the applicant will be required to submit a consistency certification to the State.

q. Recreation Resources and Wilderness

Impacts from a permanent road within the Planning Area would have little effect on the recreation resources. Primitive recreation opportunities would be impacted in the immediate vicinity of the road but--as explained in the Visual Resource section--beyond a 1/2-mi distance from the road, those impacts would be minimal. Sight-seeing and other road-related recreation pursuits would benefit from the road. However, under this scenario (with the road being closed to the public), these benefits would not be available to the public. The area from the road to approximately 1/2 mi away from the road would be classified as Roaded Natural (RN) under the BLM's ROS system. The rest of the Planning Area would remain classified as Semi-Primitive Motorized (SPM).

The wilderness values would be most impacted within 1/2 mi of the road, and with the road being a permanent feature, these impacts would be long term. Approximately 48,300 acres (644 acres/mi x 75 mi) would be impacted, and the wilderness values of naturalness, solitude, and opportunity for a primitive and unconfined recreation experience over that area would be impacted.

An east-west road connecting the Northwest NPR-A Planning area to Nuiqsut and the Dalton Highway would result in additional impacts to both the recreational and wilderness values of the area. Raised bridges, mineral material extraction areas, etc. would all add to the adverse impacts of primitive recreation experiences and certainly to the naturalness of the area. Because the portion of the new permanent road through the NPR-A would be closed to the public--offering no new opportunities for recreational endeavors--the impacts of the road would be directly to the natural resources of the area (described in previous sections) and not to the public. There would be long-term loss of the wilderness values of naturalness, solitude, and primitive and unconfined recreation near the road.

r. Wild and Scenic Rivers

River values that would be protected by designating any of the 22 eligible streams as components of the national Wild and Scenic River System are: free-flow, unpolluted waters, subsistence, fisheries, wildlife and cultural resources. The impacts of permanent roads on these river values are more specifically addressed in the sections dealing with water resources, subsistence, fisheries, wildlife and cultural resources.

The likelihood of a road impacting one or more of the 22 eligible streams is greatest in the northeast portion of the Planning Area because this is where the majority of the oil and gas development is expected.

Under Alternative A, Alternative B, and the Preferred Alternative, no rivers would be found to be suitable for inclusion in the national Wild and Scenic River System. A road could possibly impact outstandingly remarkable values, free-flow, and water quality. Such impacts would not change the determination under these alternatives that none of the eligible streams are suitable for designation.

Under Alternative C, impacts from a permanent road on river values are reduced to a practical minimum. Under this alternative, all 22 eligible rivers would be found suitable for inclusion in the national Wild and Scenic River System, and Federally-assisted projects, including road construction, that might affect free-flow, would not be approved without protection for river values. Road development would be extremely unlikely under Alternative C, and any development would be subject to mitigating measures that would protect, to the greatest extent possible, the free-flowing unpolluted waters and the outstandingly remarkable values of subsistence, fisheries, wildlife and cultural resources.

s. Visual Resources

Impacts to visual resources from a permanent road within the Planning Area would be greatest within a half-mile radius. The gravel road would be raised above the surrounding terrain and bridges would be needed to cross major rivers, both of which would contribute to the visibility of the road and the reduction of naturalness of the area. The road would impact approximately 644 acres/mi or 48,300 acres total (644 acres/ mi x 75 mi) over the length of the road and would result in the long-term loss of visual resources.

An east-west road connecting the Planning Area to the Dalton Highway would result in additional impacts to visual resources. Potential impacts would include the raised road, any bridges needed to cross water bodies, and material sites used for gravel extraction. These features would reduce the naturalness of the area and would result in the long-term loss of visual resources.

t. Wetlands and Floodplains

Wetlands and floodplains include those resources within the Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Biological resources that would be classified as having the function and value of wetlands and floodplains on the Artic North Slope included: Vegetation; Soils; Water Resources; Freshwater Quality; and Estuarine Water Quality.

Please refer to the discussions in this section for each of these resources regarding information on the potential impacts of permanent roads.