CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

Sections 4.1 to 4.6

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CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 Preview of this Section

This section examines how authorized activities, including oil and gas exploration and development, may impact natural, cultural, and socioeconomic resources in the Planning Area under each alternative. The analyses for each alternative focuses on the potential impacts that may result from opening up areas currently closed to oil and gas exploration and development and from implementing prescriptive or performance-based ROPs and lease stipulations. The impacts associated with the No Action Alternative incorporates by reference the discussion of the Environmental Consequences of the Preferred Alternative in the 1998 Northeast IAP/EIS (see 1998 Northeast IAP/EIS; pages IV.6.1 through IV.6.88) and will focus further on those potential impacts that may have changed since the analysis was done. In that IAP/EIS, our current No Action Alternative was the Preferred Alternative as modified by the ROD for the 1998 Northeast IAP/EIS.

Within each resource area, applicable direct and indirect impacts are evaluated. In addition, cumulative impacts, unavoidable adverse impacts, and those resource commitments that cannot be reversed or are lost also are identified in separate sections that follow the analyses of direct and indirect impacts. These impacts are defined as follows:

- Direct impacts – Those effects that occur at the same time and in the same general location as the activity causing the effects (see Sections 4.3, 4.4, 4.5, and 4.6).
- Indirect impacts – Those effects that occur at a different time or in a different location than the activity to which the effects are related (Sections 4.3, 4.4, 4.5, and 4.6).
- Cumulative impacts – Those effects that result from the incremental impact of the action when it is added to other past, present, and reasonably foreseeable future actions (Section 4.7).
- Unavoidable adverse commitments – Those effects that could occur as a result of implementing any of the action alternatives. Some of these effects would be short term, while others could be long term (Section 4.8).
- Irreversible commitments – Those commitments that cannot be reversed, except perhaps in the extreme long term (see Section 4.10).
- Irretrievable commitments – Those commitments that are lost for a period of time (see Section 4.10).

4.1.1 Relative Severity Criteria, Best Management Practices, and Mitigation

Criteria were developed to indicate the relative severity of impacts for each resource. These criteria have been designed to reflect the context and the intensity of the effect, as defined in CEQ Regulations (40 CFR 1508.27). Although some criteria are based on legal or regulatory limits or requirements, others reflect discretionary judgment and use of lease stipulations and ROPs on the part of the BLM. Quantitative and qualitative analyses have been used to determine whether there would be an effect, and whether a particular effect would be minor, moderate, or high. These three terms are used throughout this Amended IAP/EIS to indicate the relative severity of the predicted effects.

- Minor – The term used to indicate the relative degree of severity of an environmental effect that could occur but might not be detectable, or that would be detectable, but would not be considered a moderate or high effect, as defined below; where the predicted consequences of implementing an action do not suggest the need for additional care in following standard procedures, employing lease stipulations or ROPs, or applying precautionary measures to minimize adverse effects; or where there is little uncertainty inherent in whether the effects forecasted by a predictive model would occur.

- Moderate – The term used to indicate the relative degree of severity of an environmental effect where the predicted consequences of implementing an action suggest the need for additional care in following standard procedures, or using lease stipulations or ROPs to minimize adverse effects; or where there is some uncertainty inherent in whether the effects forecast by a predictive model would occur. For example, impacts to vegetation would be moderate if overland travel by heavy vehicles occurred when there was insufficient snow or frost cover on the ground to protect the vegetation. However, if ground operations only occur when frost and snow cover is at sufficient depths to protect the tundra, per ROP C-2(a), the impact would be minor.

- High – The term used to indicate the relative degree of severity of an environmental effect that would exist if the impact was still evident even after employing lease stipulations or ROPs, or applying precautionary measures to minimize adverse effects. For example, impacts from an action to air quality would be considered high if it resulted in a violation of a state or federal standard, even after use of best available control technology and lease stipulations and ROPs. Additional mitigation measures may be required to reduce the effects of the action.

A summary of the relative degree of predicted effects for each resource was provided in Chapter 2, Table 2-3. All effects disclosed in this chapter assume that there would be compliance with the direction provided by existing management plans and that lease stipulations and ROPs identified in this chapter and in Section 2.6, Lease Stipulations and Required Operating Procedures, would be implemented.

This chapter should be read together with Chapter 2 (Alternatives), which explains the alternatives, and Chapter 3 (Affected Environment), which describes the important resources and their occurrence and status within the Planning Area. The analyses of environmental consequences in this chapter build upon and relate to information presented in these earlier chapters 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.

As noted above, each of the alternatives includes mitigation in the form of lease stipulations and ROPs. The effectiveness of mitigating measures is evaluated for each resource and summarized in Chapter 2, Table 2-2. There are also NSB, state, and federal agency (e.g. USFWS, USEPA) regulations that govern activities in the Planning Area. For example, there are state and federal requirements that operators must have approved oil spill contingency plans. There are also state regulations that prohibit the harassment of wildlife by use of aircraft, snowmachines, or boats (5 AAC).

4.2 Introduction and Basic Assumptions for the Environmental Consequences Assessment

4.2.1 Ground-impacting Management Actions

Ground-impacting management actions refer to activities managed through the BLM's regulatory and permitting processes. These activities could have some level of impact "on the ground" in the Planning Area. For this amendment, ground-impacting activities have been divided into those associated with, and those not associated with, oil and gas exploration and development.

4.2.1.1 Activities Not Associated With Oil and Gas Exploration and Development

This section describes activities not associated with oil and gas exploration and development that could occur within the Planning Area, including their probable location, their anticipated frequency of occurrence, and the time of year in which they would likely take place. The anticipated extent of some of these activities under each of the alternatives is summarized in Table 4-1. Standardized lease stipulations that commonly would be applied in conjunction with non-oil and gas activities are presented in Appendix F. These lease stipulations are not proposed to be changed by this amendment.

Table 4-1. Summary of Selected Non-Oil and Gas Related Management Activities.[1]

Activity	No Action Alternative	Final Preferred Alternative (Alternative D) and Alternatives B and C
Aircraft Use [2]		
Point-to-point	Regular but not daily	Same as Alternative A
Wildlife aerial surveys	21 days during June and July	Same as Alternative A
Other Aerial surveys	Several 1- to 2-week periods	Same as Alternative A
Excavation and Collection		
Research/archeological	4 acres disturbed	Same as Alternative A
Ground Activities [3]		
Large camps[4]	12 weeks	Same as Alternative A
Small camps	6 to 12 weeks	Same as Alternative A
Overland moves	20 to 60 trips	Same as Alternative A
Recreation (Colville River float trip parties) [5]		
Above Umiat	6 with SRPs[6]; 3 casual parties	Same as Alternative A
Below Umiat	8 with SRPs; 5 casual parties	Same as Alternative A

[1] All estimates are for levels of annual activity.
[2] This does not include use that is associated directly with oil and gas development or recreation. It also assumes that fixed-wing aircraft and helicopters are used and that use occurs almost exclusively in summer.
[3] Camps in this category are not associated directly with oil and gas development or recreation and assumes that all camps occur in summer.
[4] Large camps are at least 15 persons and may have 5,000 gallons of fuel. Camps are likely to be located at Umiat, Lonely, Ivotuk, Inigok, and sites near the headwaters of the Kiligwa and Meade rivers.
[5] Average of four persons per party.
[6] SRPs = Special Recreation Permits (i.e., guided and regulated by the BLM).

Aircraft Use

Almost all aircraft activity would take place during the summer. While it is likely that aircraft would fly over nearly all of the Planning Area, some areas would receive greater use than other areas. Aircraft activity associated with surveying resources and monitoring human use would be concentrated along the Colville and Ikpikpuk rivers. Use of aircraft to complete cultural and paleontological surveys would most likely occur in the central portion of the Planning Area. Aerial wildlife surveys would be most common during late June and early July, over caribou and waterfowl habitat areas.

Watercraft Use

Watercraft would be allowed for summer transportation and supply. Non-recreational airboat use would be allowed on all streams, lakes, and estuaries. Boats and other watercraft would likely be used by researchers during study efforts if facilities or areas of concern were located near large water bodies such as the Beaufort Sea, rivers, or large, deepwater lakes. These activities would occur during the summer months, but the type of activities and their frequency and locations remain speculative because data quantifying these activities have not been collected for the Planning Area.

Excavation and Collection

Excavating and collecting archaeological, paleontological, geologic, and soil resources occurs during the summer. All excavation is done using a trowel or hand shovel, is usually limited to an area of several square feet, and rarely extends more than 3 feet 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 Planning Area.

Ground Activities and Camps

Ground activities include small groups of scientists hiking across tundra or recreationists floating down a river. Ground camps range from those with their own aircraft to those with only a backpack's worth of supplies. 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 at the Inigok airstrip, the Lonely DEW-Line site, and the Ivotuk airstrip, with a temporary camp on the Kiligwa River (Map 3-45). 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 clean-up material, and a cache of more than 50 gallons must be contained within a portable dike. Some solid wastes can be burned on site, and all non-burnable wastes would be 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 at current levels or increase slightly over the next few years to support Native allotment fieldwork and monitoring of species of concern.

Solid and Hazardous Waste Removal and Remediation

Wastes, including those considered hazardous, are associated with human activity. A phased approach would be used to address hazardous and solid wastes in the Planning Area. This process would include verification and site evaluation of uncontrolled releases of hazardous substances on public land. The process for hazardous waste removal, described below, is consistent with guidance and regulations from CERCLA and the National Contingency Plan.

Initial Incident/Site Examination

In response to a discovery that a hazardous substance has been released, or the threat of a release into the environment, trained personnel perform an initial incident/site examination, confirming the release and verifying land ownership. This inspection and verification of discovery information potentially requires the use of helicopter or fixed-wing aircraft to move personnel to the site. Time spent on these activities would likely amount to 2 to 3 weeks per field season, but would depend on the number and types of reports or discoveries.

If the initial examination were to suspect or verify a release, a risk assessment would be completed to determine whether the situation posed an imminent threat to either public health or sensitive environments. If the situation warranted immediate action, an emergency response or removal action could be initiated.

Site Evaluation

If the initial examination verified that the release of a reportable quantity of a hazardous substance (as defined in 40 CFR § 302.4) occurred, a threat existed, or a release was suspected but the situation did not warrant an emergency response, a site evaluation would be conducted. The site evaluation process would be concurrent with identifying potential responsible parties. The responsible party, once identified, would complete, under federal and state oversight, all remaining evaluative and remedial actions.

The first step in the site evaluation is to document whether the released material is a hazardous substance and to identify the potential targets of impact. Collection of non-intrusive samples is often required. The site evaluation also determines the need for, and appropriateness of, removal actions and whether expanded sampling is required. Expanded sampling programs take approximately 2 weeks per site and often involve the use of shovels and hand augers.

It is estimated that 20 percent of release sites would need additional site characterization, based on analytical results of the site evaluation (for example, if sensitive potential targets or impact pathways are identified). Advanced studies to determine the extent of contamination typically require 3 to 4 weeks of field time, and may involve the use of drill rigs for deep sampling or hydropunches and backhoes for near-surface sampling. Approximately 80 percent of the drilled holes are backfilled immediately, and the remaining borings usually become monitoring wells. The final recommendation of the site evaluation may call for removal of contaminated material or other remediation measures.

If further investigation of the site was necessary, a remedial site evaluation could be required to determine the relative significance of the site in terms of risk to targets. This stage would also identify cost-effective and efficient permanent solutions for important sites. These studies generally address complex situations that require long-term treatments, and are subject to the regulatory time frames for submitting remedial reports once the process has been initiated and the sites are published in the Federal Register.

Site Clean-up

Areas that support relatively high levels of human contact and biologically sensitive areas would have the highest priority for contaminant removal actions. At lower priority sites, alternatives to removal could include in-situ treatments such as fencing the site to secure it and prevent contact by humans or wildlife, or capping the contaminated area with clean soil or gravel.

During removal, contaminated materials would be excavated (generally no deeper than 5 feet) and removed for treatment and disposal, if necessary. Disturbed areas would be backfilled and leveled, and erosion-control measures would be engineered. Removal activities could involve heavy equipment, such as large and small backhoes, front-end loaders, bulldozers, dump trucks, pickups, and all-terrain vehicles. This type of equipment would be transported overland in winter, or a barge could be used if the site was accessible by water. At sites where cleanup could only be accomplished in summer, a gravel pad or road might be constructed for use during the operation to protect the underlying soil and vegetation, and then removed after project completion.

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 lease stipulations, would have a negligible impact on the environment. Permafrost underlies the entire Planning Area, and floodplains/wetlands cover the majority of the Planning Area. 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. Vehicles allowed for use in overland moves would exert low ground pressure and be permitted to travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts. Typically, overland moves would originate in Prudhoe Bay or Nuiqsut, and would take place exclusively on offshore ice, if conditions allowed. If the ice were determined to be unsound, portions of the trip would be made overland, following the shoreline. For safety reasons, moves farther inland could also occur. Overland moves would typically begin in December, when there is adequate snow cover and the ground is frozen, and ends in early May. On a yearly basis, 20 to 60 trains of 10 to 15 vehicles and attached sleds could engage in overland travel. The width of overland trails is approximately 12 feet wide. Should oil and gas exploratory drilling and development increase the amount of general activity on the North Slope, the number of overland moves would likely be closer to the high end of this range.

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 could be authorized in the Planning Area.

Recreation

The BLM issues Special Recreation Permits (SRPs) to commercial recreation operators, such as hunting and float-trip guides, who focus their activity along the Colville River. A typical hunting or float trip would consist of four people, and would take place in August or the first week of September. A limited number of SRPs could also be associated with other types of use. Float-equipped aircraft could be used to take 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 River would carry enough fuel for a small stove and their boat engines. They would camp for no more than 1 night in any one place, and their camping practices and impacts would generally be consistent with those of fly camps or backpack camps described earlier in this section under Ground Activities and Camps.

4.2.1.2 Oil and Gas Exploration and Development Activities

Introduction

This section provides a general description of the activities typically associated with oil and natural gas operations on the North Slope of Alaska. Current state-of-the-art technologies and project designs are used to project scenarios for future petroleum development in the Planning Area. Petroleum-related activities include conducting seismic operations; constructing ice roads for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting production pads to main facilities, and landing strips; drilling production and service wells; and installing pipelines.

The activities described in the following section are reasonable scenarios based on oil and gas technology today, because the timing and location of future commercial-sized discoveries cannot be predicted until exploration of those reserves occur. It is reasonable to expect that new technologies and designs developed in the future will allow for better attainment of goals to maximize the safety and efficiency of operations while minimizing the effects of exploration and development on the environment.

The general descriptions of petroleum-related activities are followed by a discussion of possible reasonable development scenarios. A fundamental assumption of these scenarios is that the level of future activities is directly related to the petroleum-resource potential made available for leasing and development. However, industry's interest in exploring for new reserves is influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development activities and associated impacts are controlled by several factors, including the perceptions of economic potential of the area, the areas available for leasing, industry's ability to identify prospects to drill, and the competitive interest in exploring for new fields.

The scenarios include activities required to develop and produce the total economically recoverable oil potential. Future production of the natural gas potential is discussed under Effects of the Cumulative Case (Section 4.7) The

1998 Northeast IAP/EIS considered two sets of scenarios: the "first lease sale scenario" and the "multiple lease scenario." Since two lease sales have already occurred since 1998 in the Planning Area, the scenarios presented in this document assume multiple lease sales and full development of the estimated resources within the constraints of each alternative.

The potential extent of future petroleum development on the North Slope, including current as well as reasonably foreseeable activities, is discussed in Section 4.7 (Effects of the Cumulative Case).

Resource Estimates

Estimates of oil and gas resources provide the basis for identifying areas for possible future leasing and projecting reasonably foreseeable development scenarios analyzed in environmental impact studies. At this time, it is not certain that future leasing in the Planning Area or that commercial discoveries will be made. However, the NEPA process requires reasonable and foreseeable consequences of the proposed action be considered.

Estimates of undiscovered resources are uncertain for geologic, engineering, and economic reasons. An accurate accounting for all oil or gas reserves is possible only after the entire production cycle is completed, perhaps decades into the future. Geologic data are in a nearly constant state of revision, as new concepts are revealed by detailed studies, mapping, and new well information. Engineering evolves with new technology and experience. Economic conditions, such as oil price, are difficult to predict beyond the near future. To account for these uncertainties, resource estimates usually are reported as a range of volumes. A corresponding range of activities, tied to resource production levels, is generated to represent reasonable scenarios, should leasing and exploration take place.

Crude Oil

The following resource estimates represent a range of production at oil prices of $20 to $30 per barrel (in constant dollars). This estimate does not imply that oil prices will always remain within this price range, as prices will be outside of this expected range during periods of short-term volatility. However, this price range represents reasonable long-term average prices to bracket commercial development scenarios. If oil prices remain below this range over long periods, very low levels of petroleum activity would be expected. It also is conceivable that greater volumes of oil could be recovered through future technologies that are unknown at present. Because the effects of future technology cannot be adequately quantified, the higher resource level (at $30) could represent additional production from advanced technology rather than a prediction of higher average oil prices in the future.

The full economic potential (FEP) in the Planning Area ranges from 435 MMbbls with a $20 per barrel oil price to 3,600 MMbbls with a $30 per barrel oil price. This estimate is based on the BLM and MMS resource assessment of the National Petroleum Reserve – Alaska conducted in 2002, a discussion of which is presented in Appendix 7 of the Northwest IAP/EIS (USDOI BLM and MMS 2003). Petroleum recovery amounting to the FEP assumes that all BLM-administered lands (approximately 4.6 million acres) in the Planning Area would be made available for leasing and that no regulatory restrictions would adversely affect leasing interest or the economic viability of future operations. The 2002 petroleum resource assessment increased the estimated economic potential at the $30 benchmark price by 1.4 billion barrels (2.2 Bbbl to 3.6 Bbbl) from the comparable estimate in the 1998 Northeast IAP/EIS. Since the former assessment was completed, additional drilling and seismic data resulted in revisions to oil and gas play parameters. The announced discoveries in the Planning Area and expansion of the Alpine field to include new satellites have confirmed that economically recoverable resources indeed exist in the Planning Area.

Natural Gas

The BLM and MMS 2002 oil and gas resource assessment estimated that 8.5 trillion cubic feet (Tcf) of natural gas resources are economically recoverable in the Planning Area at a benchmark price of $4.27 per Mcf (equivalent to a $30 oil price). This analysis was based on assumptions that a transportation system (pipeline) will be constructed and will have a delivery tariff to the U.S. Midwest of $2.50 per Mcf. Economic gas resources were not assessed at a price of $2.85 per Mcf (equivalent to a $20 oil price) because the minimum required market price for new gas fields in the National Petroleum Reserve – Alaska is approximately $3.00 per Mcf. However, commercial gas production will not occur until there is a transportation system to move North Slope gas to outside markets.

In January 2004, a consortium of companies (MidAmerican Holdings Company) filed a formal proposal under the Stranded Gas Act to the Alaska Department of Revenue to build a natural gas pipeline from the North Slope into Canada that would ultimately be used to ship natural gas into the lower 48 states (Yahoo! 2004). The proposed 745-mile pipeline route would go from the North Slope southward to the Alaska-Yukon border at Beaver Creek. The application was approved but subsequently withdrawn, however a number of other groups have submitted applications or indicated that they will soon file applications. The North Slope producers (ExxonMobil, ConocoPhillips, BP) have also filed an application under the Stranded Gas Act for a gas pipeline to the Lower 48. Two pipeline companies Enbridge and Trans Canada Corporation (ANGTS project discussed above) have filed similar applications. The Alaska Natural Gas Authority was created by a statewide ballot measure, with the stated purpose of developing a gas pipeline from the North Slope to Valdez where the gas would be liquefied and transported as LNG. They have not filed an application for their project. An Alaska Gasline Port Authority consisting of the City of Valdez and the Fairbanks North Star Borough has also filed an application for a similar pipeline to transport ANS gas to Valdez for liquefication and sale. Several large pipelines have also entered into agreements with the State of Alaska indicating they would be submitting applications for various pipeline projects to get ANS gas to market. It should be noted that all these applications are under the Stranded Gas Act and relate only to fiscal negotiations with the State.

Because there are abundant gas reserves on the North Slope, it is likely that some exploration targeting new undiscovered gas resources in areas remote from existing infrastructure may occur during the life of this plan. However, the development scenarios do not include the production of natural gas for sale outside of the Planning Area. Until a major transportation system is constructed, future gas discoveries will be shut-in (startup delayed for an undetermined period). Associated gas recovered as a by-product of oil production would be used as fuel for facilities or reinjected into reservoirs to increase oil recovery. The reinjected gas would not be lost as a potential future resource, but gas sales to outside markets would be postponed for the foreseeable future. Future natural gas development scenarios are discussed in a general sense under Effects of the Cumulative Case (Section 4.7).

A new gas-processing technology, termed “gas-to-liquid” (GTL), can be used to convert natural gas to a refined liquid product that could be transported through the TAPS. This strategy could accelerate natural gas production on the North Slope, including stranded gas fields in National Petroleum Reserve – Alaska. However, this new technology is untested for large-scale operations and is, at the present time, a more expensive proposition than constructing a large-diameter gas pipeline. In the future, GTL technology could be used to produce gas from small, remote fields in the Planning Area, but this situation is beyond the scope of reasonably foreseeable scenarios for the intended life of this plan and the present analysis. Therefore, it will not be considered in this amendment.

Petroleum Operations in Arctic Conditions

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 oil discovery at Norman Wells in 1920, a field that has been produced intermittently since then. The Umiat oil field, located in the southeastern National Petroleum Reserve – Alaska, 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 the National Petroleum Reserve – Alaska, managed first by the Navy and later by the USDOI (USGS/Husky), ended in the early 1980s. Extensive exploration in the 1960s resulted in numerous oil and gas discoveries in northern Alaska and the Mackenzie Delta in Canada. The largest of the discoveries, Prudhoe Bay, which was found in 1967, has produced 13 Bbbl of oil. After the completion of TAPS in 1977, a number of oil discoveries on State of Alaska land 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 the National Petroleum Reserve – Alaska was initiated in the early 1980s and restarted by the BLM in 1999. A recent discovery, and undoubtedly the most important factor in the renewed interest in the Planning Area, is the Alpine field in the

Colville River Delta. Oil production from the Alpine field began in November 2000. Additional discoveries in the Northeast National Petroleum Reserve – Alaska have also influenced renewed interest in additional leasing of National Petroleum Reserve – Alaska lands.

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 the historical literature relevant to the National Petroleum Reserve – Alaska, but readers are directed to excellent documentation in the 105 Policy Analysis Reports generated for previous National Petroleum Reserve – Alaska leasing (USDOI BLM 1979a, b, c, d); an operational history of government-sponsored exploration in the National Petroleum Reserve – Alaska (Gryc 1988, 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 *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* report published by the NRC (2003).

Technology Advancement

The following discussion is an update of the text previously provided in the 1998 Northeast 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 amendment.

- 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.
- Three-dimensional (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 have replaced 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 drilling can tap reservoir targets miles away from the surface pad. Fewer drilling pads are needed to develop subsurface reservoirs, resulting in a smaller overall footprint for development facilities.
- Portions of a single well bore can be used to produce from multiple lateral legs, thus increasing well productivity and reducing the number of surface wellheads. Fewer wellheads at closer spacing reduces the pad footprint.
- A new modular-drilling platform designed and built by Anadarko, offers additional technology and the possibility of year-round drilling in remote or higher-relief areas not suitable for constructing ice roads and ice pads.

A generalized timetable for a typical project in a remote area of the North Slope is presented in Table 4-2. 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 the Planning Area are not expected for a minimum of 7 to 8 years following a lease sale. Considering the logistics of oil and gas exploration and development and distances between existing operations and

Table 4-2. Development Timeframe for a Typical Oil Field.

Project Phase	Duration of Activity (years)[1]	Activities
Exploration	1 to 10	• conduct seismic surveys to define prospects • conduct well-site surveys and permitting • drill exploration wells
Discovery	Can occur anytime during or after exploration	• determine producible well • drill delineation well(s) • conduct additional seismic survey (3-D) • appraise and engineer reservoirs • complete project design and environmental studies/factors • apply for permits
Development	Normally takes 3 to 6 years past the initial discovery	• establish construction base camp • set up environmental monitoring programs • install gravel pads for facilities • design and build production modules • begin drilling development wells • install pipelines and pump stations • install production facilities and hookup
Production	10 to 30 years post-development	• continue development-well drilling • ramp-up production (2 to 5 years) • reach peak production plateau (3 to 8 years) • expect production declines • well workovers (every 3 to 5 years) • conduct infill drilling (well spacing reduced) • employ tertiary recovery methods • progressively shut in wells • reach an economic limit
Abandonment	Individual wells can take 2 to 5 years	• plug and abandon wells • remove production equipment • dismantle facilities • decommission pipeline • restore and re-vegetate sites • phase out environmental monitoring

[1] See Section 4.2.1.2 (Oil and Gas Exploration and Development Activities) for more information.

potential future operations in the Planning Area, it is more likely that 10 years or more would pass between a lease sale and the startup of oil production from new fields. Gas production from Planning Area lease sales would not occur until many years after a transportation system was constructed from the North Slope. Considering the economic and political aspects of future project(s), gas production from the Planning Area could be delayed several decades.

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 the state. 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 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 airports 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 Planning Area operations must move at least 75 miles 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 2½ 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 typically moves slowly (2 miles per hour) on ice roads or permanent gravel roads.

Remote base camps, which can be established for year-round use, 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 major factor that adds time and cost to operations in the Planning Area, compared to similar activities in the Prudhoe Bay area.

Exploration

It is anticipated that a maximum of six exploration drill rigs would be available for use in the Planning Area at any one time, over a maximum exploration phase of 10 years. Drilling would be conducted entirely during the winter months (early December to mid-April) in most portions of the Planning Area. In the Teshekpuk Lake Caribou Habitat Area, however, exploratory drilling would only be allowed from existing production pads or platforms sited within a lake body from May 20 through August 20, and depending upon which alternative allows this activity. Upon completion of drilling operations, all equipment and materials would be removed (during winter operations) over ice roads to staging areas and then to other locations on the North Slope, or to recycling centers out of the country. If an exploratory drilling program were to lead to a new field discovery, delineation of the field could take place over 1 to 3 drilling seasons.

Seismic Surveys

Seismic survey work is an integral part of exploration for oil and gas fields, because the data from seismic surveys are used primarily to identify drilling targets. Although seismic data has been collected in the National Petroleum Reserve – Alaska for decades, collection of additional seismic data is warranted for several reasons: 1) to provide a closer grid spacing for more subsurface detail; 2) to acquire new data using advanced techniques for better resolution of subtle geologic features and stratigraphy; and 3) to delineate fields discovered by exploration wells.

In contrast to early seismic programs that used dynamite in shot holes as the energy source, seismic programs now use vibrator equipment (Vibroseis) to generate energy into the subsurface. This newer technique provides high-quality data with minimal disturbance to the area. In aquatic settings (summer surveys), different survey methods could be used.

Seismic Survey Methods. Vibroseis is the standard method for acquiring seismic data on the North Slope of Alaska, and only occurs in the winter months. The Vibroseis sound source is designed to produce a specific bandwidth of frequencies in a repeatable and consistent fashion. Electronics control a hydraulic system that transmits vibrations through a base plate on the ground. Reflected signals from the subsurface are recorded by arrays of receivers, called geophones, which are installed by hand on the frozen surface of the tundra or frozen water bodies. Vibroseis trucks are typically run in groups of four or five, with their output signals coordinated to generate the energy necessary to record the seismic records to depths of 20,000 feet or more. Returning signals are gathered from the geophone array and processed to tune the seismic data into a coherent representation of the subsurface geology. The Vibroseis technique works best on a hard surface, as a spongy surface does not transmit the output energy very well. Intervening layers (a water layer below a frozen lake surface) degrade both the outgoing and incoming signal for Vibroseis survey. For these reasons, Vibroseis is not an effective tool for summer conditions on the North Slope or for water bodies where the surface ice layer is not frozen to the seabed or lake bottom.

Seismic surveys also have occurred, and could continue to occur, in deeper bodies of water where Vibroseis surveys are not effective. Collection of seismic reflection data in aquatic areas (ocean, lakes, bays, and lagoons) is commonly accomplished using vessels of varying size during ice-free periods. Typically, one or more airguns are used as a sound source. Airguns, which are deployed behind the seismic vessel, generate a seismic signal by creating a sharp air bubble pulse in the water at intervals on the order of once every 10 seconds. Marine receivers are composed of piezoelectric hydrophones that are contained in long, sealed tubes. Receiver systems can be deployed either as “streamers” that are towed behind a vessel or “cables” that are laid directly on the seabed or lake bottom. Seismic streamers can be several miles in length and are generally used in deeper water where maneuverability is not an issue. Seismic cables (On-Bottom-Cables) are used in shallower water. Both receiver systems contain numerous hydrophones that measure faint pressure signals returning from reflections in the subsurface. To increase sensitivity and cancel out unwanted noise, responses from groups of hydrophones are summed to produce a single seismogram, thus acting as an antenna to focus faint pressure signals. These seismic data acquisition techniques are generally intended for imaging subsurface depths of several hundred feet to 6 miles. Surveys designed for shallower subsurface depths and higher resolution generally employ lower sound levels and shorter hydrophone systems, while surveys focusing on deep subsurface features employ higher sound sources (usually airgun arrays) and longer hydrophone streamers or On-Bottom-Cables.

Alternatively, seismic surveys have been conducted over frozen lakes using dynamite as the sound source. Shot holes approximately 3 inches in diameter are drilled through the ice and several feet into the lake bottom. Dynamite (or other explosive) charges are installed in boreholes, and geophone receivers are placed on the ice surface. The dynamite charges are then detonated, and reflected energies are recorded by the geophones. Over-ice seismic surveys were conducted in this fashion on Teshekpuk Lake in 1974 and 1975. The approximately 120 line-miles of seismic data that were collected during these surveys are the only seismic data available for large portions of Teshekpuk Lake.

Seismic Survey Types. Two types of seismic surveys could be used in the Planning Area. Two-dimensional surveys (2-D seismic), which involve rather widely spaced survey lines, are useful for broad reconnaissance survey work. Three-dimensional surveys (3-D seismic), which involve a dense grid of seismic lines, are a more modern technology that provides a complete image of the subsurface under the survey area. Similar energy sources and recording equipment are used for both survey types; however, the density of survey lines, the amount of data collected, and the overall cost of the survey are greater in 3-D surveys. The techniques of setting up geophone arrays and Vibroseis shot points are similar for 2-D and 3-D surveys; however, 3-D surveys are more efficient because the equipment does not have to be moved far between new survey lines. Because of the extra expense, 3-D surveys are generally not used for reconnaissance mapping unless they are essential to map subtle stratigraphic prospects. Therefore, 3-D surveys are most commonly conducted for the delineation of fields, while 2-D surveys are more commonly conducted for reconnaissance.

Typically, three to four seismic crews are active on the North Slope each winter; one to two crews could be expected to collect seismic data in the Planning Area in future winter seasons. Overland seismic surveys on the North Slope are always collected in the winter when sufficient snow cover and ground frost is present to minimize any damage to the tundra surface. These surveys employ low ground pressure vehicles (soft tracks) to further minimize potential impacts. While the winter operating period could be as long as 5½ months (early December to mid-May), typical seismic operations for an individual survey would last about 100 days.

Mobile camps (called “cat trains”) to support seismic operations would likely originate from the Kuparuk oil field. Each cat train would consist of survey vehicles and modular camp units. A train would consist of the approximately 10 (2-D) to 15 (3-D) vehicles that would run the seismic testing equipment, and 1 or more fuel trucks and strings of trailers comprising the camp modular units pulled by bulldozers. A train typically would include two or three strings of trailers. Each string would have four to eight trailers and would be pulled by a single bulldozer. These bulldozers and modular units generally exert greater ground pressure than do the vehicles that run the seismic lines. Seismic survey equipment is currently stored at the Inigok airstrip for use in next winter’s seismic program. This location is preferable to the Kuparuk oil field because it puts the seismic trains much closer to the area of exploration interest.

Once in the area of operation, camps typically are moved every few days to once a week. The fuel truck or trucks make runs back to a fuel-supply depot, such as the Inigok airfield, through 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.

Data collection operations are conducted by 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 fixed-wing aircraft. Seismic operations would be supported by fixed-wing aircraft. The only summer activities would be reconnaissance by aircraft to prepare for winter surveys. It is expected that seismic crews would be active in the Planning Area for the foreseeable future.

A 2-D seismic party typically consists of 40 to 60 persons, including all support personnel associated with the winter camp. The survey party can collect 5 to 10 line-miles of seismic data per day, and a typical 2-D operation would collect about 250 line-miles of data in one winter season. The individual survey lines would be several miles apart. In some cases, shorter 2-D surveys would be collected to supplement seismic data already collected over most of the Planning Area. These short surveys would be collected as ties between wells or as infill to existing grid lines. The 2-D surveys could also be used to extend well data or connect areas of 3-D coverage. Each survey line of 2-D seismic would be run by about 10 vehicles, including Vibroseis (sound source) vehicles and receiving vehicles (geophone support and recording equipment).

A typical 3-D seismic operation would collect about 600 mi^2 of data in a single winter season. An operation typically would involve about 15 vehicles. Each line-mile would consist of a pair of linear areas, each about 100 feet wide, through which the vehicles would drive. The grid patterns for 3-D seismic surveys would be considerably closer spaced than those of 2-D surveys. The exterior dimensions of 3-D survey blocks could range to tens of miles on a side. The number of line-miles crossed in a 3-D survey area would be much greater than for 2-D surveys because the survey lines would be closer together. Impacts to soil and vegetation from 3-D surveys are usually less than for 2-D surveys as rubber-tracked vehicles are used and camp moves generally move down the center of the survey line.

Following the end of each winter seismic season, each crew would store its equipment at approved staging areas on existing gravel pads. During summer, a repair crew would spend 2 to 4 weeks performing annual maintenance and installing upgrades to seismic equipment. These activities would require aircraft support, with one to two fixed-wing and two to three helicopter flights per week. Upon completion of maintenance work, the crew would leave the equipment at the staging area, and their activity would cease until the following winter. Maintenance operations would be self-contained and use accommodations that were part of the seismic camp. Upon completion of the work, all wastes would be removed and disposed of at approved disposal sites on the North Slope. Disposal of solid wastes would take place in accordance with applicable rules and regulations; none of these activities would require the establishment of new landfill locations. No solid waste would be of disposed on site.

Seismic Operations

Proposed Seismic Operations. Seismic survey operations are a fundamental part of an exploration program because they are used to identify targets for drilling. After discoveries are made, seismic surveys can be collected to define the limits of the oil pool and to help design efficient development drilling programs. The level of future seismic survey work would be dependent on drilling results and regulatory restrictions on activities.

A 2-D survey area varies in size, but for this analysis it is assumed that 250 line-miles would be collected in a 600-mi2 (384,000-acre) area during the next 15 years. Surveys would likely be used to tie between existing wells or as infill to existing surveys. The 2-D surveys would occasionally be used to connect areas of 3-D coverage. Each line of 2-D seismic would be run by about 10 vehicles. Approximately 40 to 60 personnel would be required for each survey group. The vehicles would run parallel to each other through an area about 200 feet wide. The maximum area covered by seismic vehicles would be approximately 6,060 acres (250 miles x 200 feet wide), although not all of the area within the 200-foot-wde path would be traversed by vehicles.

A typical 3-D seismic operation can survey an area of about 600 mi^2 in a single winter season. An operation like this typically would involve about 15 vehicles. Each line-mile would consist of a pair of linear areas, each about 100-feet wide, through which the vehicles would drive. The receiver lines would be spaced 1,100 feet apart, while the source line upon which the survey units and vibrator travel would be spaced 1,320 feet apart and cross diagonally to the receiver lines. Vehicle travel would be restricted within the grid area. In general, all vehicles would travel within 50 feet of receiver lines. For any given receiver line, a path of about 100 feet could be impacted by vehicle use (50 feet on either side of the line). The area impacted along the source line would be less than 50 feet wide. For each square mile surveyed, 24.2 acres would be impacted along the source lines, and 58.2 acres would be impacted along the receiver lines, or 82.4 acres total per square mile surveyed (13 percent of the survey area). This estimate is considered high, since some areas impacted would be common to both the source and receiver lines.

The techniques of setting up geophone arrays and shot points are similar for 2-D and 3-D surveys. However, 3-D surveys are more efficient because the equipment does not have to move far between lines, and 3-D surveys generally provide better coverage of subsurface features. They are more expensive than 2-D surveys, and are not used for initial reconnaissance mapping unless it is essential to map subtle stratigraphic prospects.

To date, almost the entire Planning Areas has been covered by 2-D surveys. An extensive exploration program was conducted by the U.S. Navy, and later by the USGS/Husky during the 1970s to early 1980s. Figure 4-1 shows areas surveyed by the USGS during the 1970s and 1980. Additional 2-D surveys have been conducted since the late 1970s in the Planning Area, but information from these surveys is proprietary and is not included in Figure 4-1. Almost the entire area of high oil and gas potential in the Planning Area has been covered by 3-D seismic surveys. These 3-D surveys have identified stratigraphic prospects in the Planning Area that are similar to the Alpine, Tarn, and Meltwater fields. Since 1998, about a dozen 3-D seismic surveys have covered approximately 2 million acres (3,200 mi^2), or 44 percent of the Planning Area. A basic assumption is that seismic surveys would not be repeated in areas for which survey data are already available. It would be much less expensive to purchase data from the original contractor (or client) rather than conduct a new survey. Therefore, it is assumed that future seismic surveys would be conducted only in unsurveyed areas.

South of the existing 3-D seismic coverage area, the foothills might require additional seismic surveys. Current 2-D seismic data on a reconnaissance grid has been used to identify numerous anticlinal structures. Although 2-D seismic data is less expensive to acquire than 3-D seismic data, and can adequately image subsurface structure

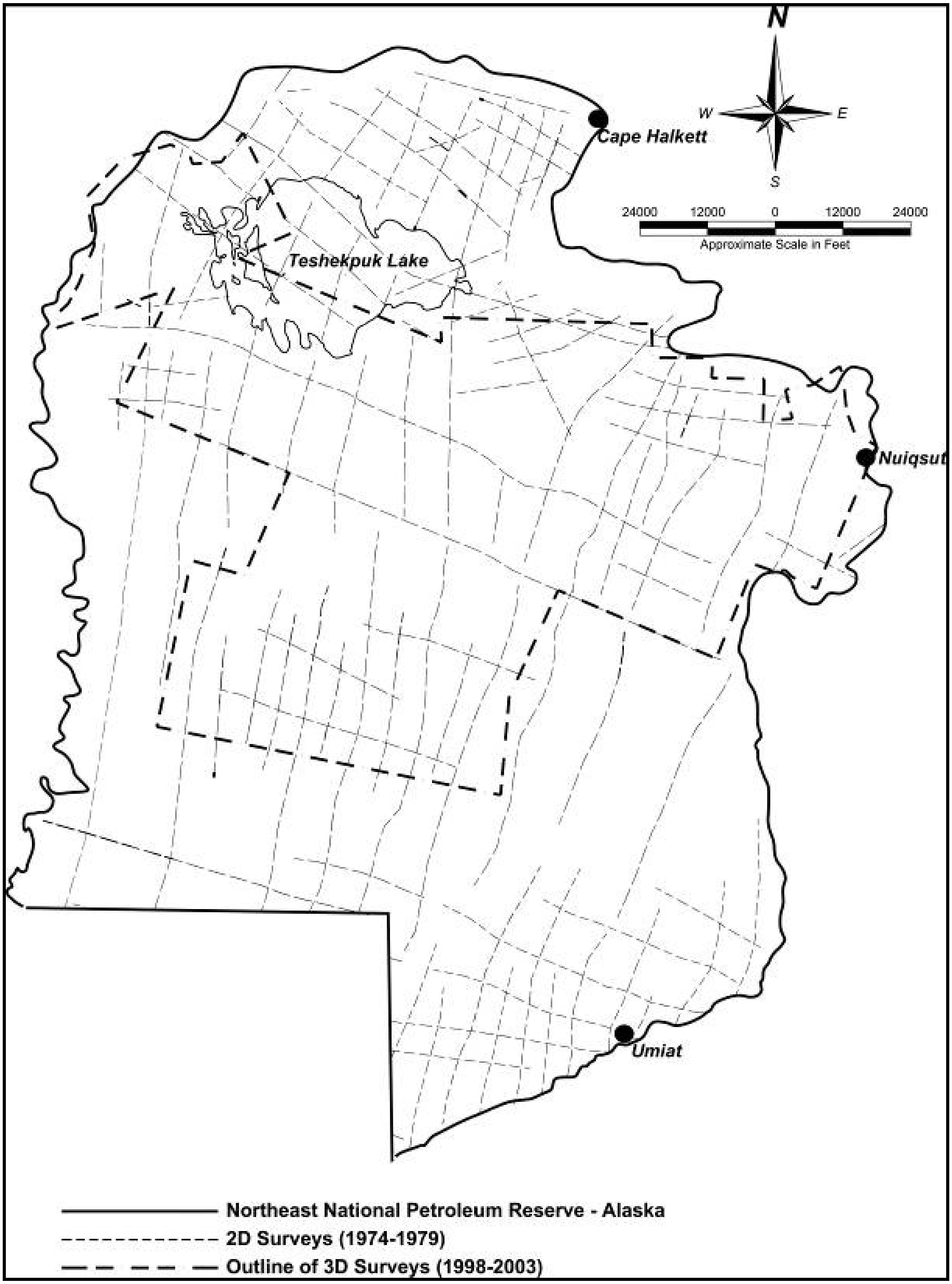

Figure 4-1. Seismic Surveys Conducted in the Northeast National Petroleum Reserve – Alaska.

enough to proceed with exploration drilling, it is likely that local 3-D seismic surveys will be collected for field delineation.

The following discussion recognizes the tradeoff of 3-D (better resolution at higher cost) versus 2-D seismic surveys. General assumptions on the type and location of probable activities are used for the purpose of impact analysis. As seismic survey techniques improve, more seismic data may be gathered in less time than is described here.

At this time, the Teshekpuk Lake area, which is currently excluded from leasing (approximately 600,000 acres), is recognized as an area of high oil and gas potential. Seismic survey lines over the lake area are relatively sparse, so it is assumed that additional seismic survey work would be necessary prior to exploration drilling. Winter over-ice surveys were conducted on Teshekpuk Lake in 1974 and 1975 using dynamite as a sound source. Shot holes were drilled into the ice and then into the bottom of the lake, and then charges were detonated. Geophone arrays were installed on the frozen lake surface to record the returning signal. Approximately 120 miles of 2-D seismic data were collected. Although Teshekpuk Lake is a high priority area for 3-D seismic data acquisition, there may be attendant logistical problems for more preferable Vibroseis surveys in this area. Furthermore, the use of explosives to collect seismic survey information may not be appropriate if there are substantial impacts to fish and wildlife. A lake survey could be done during the summer using boats and airguns, as is done offshore, but these surveys could also impact fish and wildlife.

Under all of the alternatives, 3-D seismic survey data are more likely to be acquired than 2-D data. However, 2-D seismic data might be collected for regional reconnaissance purposes or as ties into or infill for existing surveys. These 2-D surveys would likely be designed to identify and delineate large, comparatively complex, and faulted structural prospects in the southern part of the Planning Area. Extensive 3-D seismic have been used in the Planning Area to direct exploration and appraisal drilling because of the size of the area, the economy of scale, and the opportunity to identify multiple prospects. There is a high probability that two additional large 3-D surveys would be conducted in the Planning Area in the future. The likelihood of other surveys occurring is more speculative, and would depend on exploration successes. It is important to note that there would be minimal duplication of future seismic surveys. Overlap would occur along survey borders or corners, depending upon how the surveys were oriented. To date, most surveys have been conducted at oil companies' requests and specifications rather than for speculative purposes by the seismic industry. Based on these general concepts, the number of seismic surveys required for each alternative have been estimated as follows.

No Action Alternative (Alternative A). Extrapolation of current 3-D seismic data gathering techniques suggests that the entire area could be covered by two to four additional 3-D surveys under the No Action Alternative. These surveys could take as little as 2 years, depending on the number of seismic operators and the number of crews they employed. Two to three 2-D seismic surveys would be needed to infill along the foothills and tie into existing 3-D surveys. The length of surveys would be much shorter than normal, however, and the total length for all surveys would be unlikely to exceed 250 miles. These surveys could be accomplished in a season or two. With aggressive exploration, seismic operations could be completed 2 to 3 years after the next lease sale. Weakened interest or regulatory issues would likely delay the onset of seismic operations and possibly extend the number of years required to complete the data-gathering process.

Alternative B. Extrapolation of current 3-D seismic data gathering techniques suggests that the entire area could be covered by two to five additional 3-D surveys under Alternative B. These surveys could take as little as 3 seasons, depending on the number of seismic operators and the number of crews they employed. The Teshekpuk Lake area would be a separate survey, irrespective of its size. Two to three 2-D seismic surveys would be needed to infill along the foothills and tie into existing 3-D surveys. However, the length of surveys would be much shorter than normal, and the total length for all surveys would be unlikely to exceed 250 miles. These surveys could be accomplished in a season or two. With aggressive exploration, seismic operations could be completed 2 to 3 years after the next lease sale. Weakened interest or regulatory issues would delay the onset of seismic operations and possibly extend the number of years to complete the data gathering process. Two-D seismic surveys might not even be conducted if the 3-D coverage was gathered quickly.

Alternative C. Extrapolation of current 2-D and 3-D seismic data gathering techniques suggests the entire area could be covered by a similar level of effort as described for Alternative B—250 miles of additional 2-D surveys and two to five additional 3-D surveys.

Final Preferred Alternative (Alternative D). Extrapolation of current 2-D and 3-D seismic data gathering techniques suggests the entire area could be covered by a similar level of effort as described for alternatives B and C—250 miles of additional 2-D surveys and two to five additional 3-D surveys. Seismic surveys would probably not occur in Teshekpuk Lake unless it became likely that Teshekpuk Lake would become available for leasing after the 10-year deferral period.

Roads and Drilling Pads

Exploratory drilling would generally be limited to temporary facilities such as ice roads, pads, and airstrips, and temporary platforms, unless the lessee can demonstrate that construction of permanent facilities, such as gravel airstrips, storage pads, and connecting roads is environmentally preferable or necessary to carry out exploration more economically (Lease Stipulation D-2). In the Teshekpuk Lake Caribou Habitat Area, however, exploratory drilling would only be allowed from current production pads or platforms sited within a lake body from May 20 through August 20, depending upon which alternative is chosen, to minimize impacts to caribou in the area. Ice roads would provide seasonal routes for heavy equipment and supplies moved to remote staging areas or well locations. These temporary, seasonal roads are constructed by spreading water pumped from local lakes to build up a rigid surface. Typically, ice roads are designed to be a minimum of 6 inches thick and 30 to 35 feet wide, and can be tens of miles long. Water supplies must be located along the proposed route to supply approximately 1 to 1.5 million gallons of water per mile of road. New ice-road construction methods, such as using aggregate chips shaved from frozen lakes, substantially decrease both water demands and construction time. For example, under good (very cold) conditions, an ice-road-buildup rate using only liquid water is 1.5 inches per day, whereas using aggregate chips could increase the buildup rate to 4.5 inches per day, with equivalent reduction in the volume of water required. Ice bridges over rivers and lakes are constructed by similar flooding and composite (aggregate chip) methods, but the ice thickness is increased to rest on the bottom of shallow rivers or lakes. Floating ice bridges are used to cross deep rivers, such as the Colville River.

Ice drilling pads are commonly used as platforms for winter exploration wells. Ice pads are constructed much like ice roads, with the tundra surface flooded with water to build up progressive layers of ice. As with ice roads, the use of aggregate chips speeds the process while decreasing water demands. A typical ice pad is designed to be a minimum of 1-foot thick, covers 6 acres, and requires approximately 500,000 gallons of water to construct. Depending on the well site, ice pads could range in size from 3 to 10 acres. Water requirements vary, depending on the pad size and availability of aggregate chips shaved from nearby lakes.

Exploration and Delineation Wells

Exploration operations require movement of heavy equipment (a drilling rig) and large amounts of materials (steel casing, drilling mud, fuel) to remote locations, which typically occurs on ice roads during the winter months. Transportation logistics must also allow for regular crew changes and re-supply. An exploration well crew could consist of 30 to 60 people, working 1- to 2-week shifts, who would be transported to the site by aircraft landing on constructed ice runways. Large lakes (1 mile more across) could be prepared quickly as winter landing strips.

The oil and gas companies have used, and are testing, alternative methods to manage exploration and production operations in areas where traditional methods would be limited or challenging because of distance, water availability, or terrain. ConocoPhillips has obtained permits and staged a drilling rig on an insulated ice pad west of Teshekpuk Lake throughout the summer in order to have the rig available on-site for exploration work the following winter. By over-summering the rig at remote sites, more of the time that would have been required to build an ice pad, possibly build an ice road, and mobilize and demobilize the rig was available for drilling and/or well testing activities.

Anadarko field-tested a new drilling system, the Arctic Platform, which has potential for use in the National Petroleum Reserve – Alaska. The Arctic Platform is like an offshore platform, but is used on land. A self-contained drilling system and crew quarters sit atop a deck made of interlocking modules that rest on pilings set into the permafrost below the tundra. The platform is elevated approximately 12 feet off the tundra, eliminating the need for gravel or ice pads. Surface use of this technology could allow operators to perform exploration drilling outside the winter season, since ice pads would not be required. This technology could also allow access to remote areas, to areas where water to build ice roads is scarce, and to areas where steep grades make it difficult to set a rig. The Arctic Platform could be used for exploration drilling and as a production unit.

Exploration wells in the northern portion of the Planning Area (the area of highest oil potential) are likely to range from 6,000 to 12,000 feet in depth. For these depths, most exploration wells could be drilled, logged, and tested within a single winter season. If a discovery were made, a second (delineation) well could be drilled from the same ice pad in a single season, depending on well depth and the efficiency of drilling operations. In the Teshekpuk Lake Caribou Habitat Area, however, exploratory drilling would only be allowed from current production pads or platforms sited within a lake body from May 20 through August 20 to minimize impacts to caribou in the area.

To define the limits of reservoirs after a discovery was made, several delineation/confirmation wells would likely be drilled before making a commitment to project development. Additional delineation wells surrounding the discovery well would likely be planned for the following winter or two, and would require new ice pads. Because of high development project costs, two to four successful delineation wells would likely be drilled to establish reservoir continuity over an area. For example, a possible field-development project consisting of two production well pads might require a total of seven wells (one exploration and six delineation wells). Delineation-well drilling would be coordinated with any existing 3-D seismic surveys.

During drilling operations, wells would be tested for the presence of hydrocarbons. If testing indicated that hydrocarbons were not present in commercial quantities, the wells would be plugged and abandoned. Cement plugs would be placed throughout the well bore to prevent migration of fluids and gases and to protect subsurface resources. Successful wells (discoveries) could be re-entered for use as production wells at a later time by drilling out the cement plugs, but most exploration wells would be considered expendable and would not be used for later production. If commercially producible hydrocarbons were found, equipment and materials could be left at the site, supported on pilings, to reduce mobilization time the following winter drilling season. Rock cuttings from delineation wells could be either backhauled to existing disposal wells or processed (ground and treated) for subsurface disposal in the abandoned wells. Upon completion of drilling operations, all equipment and materials would be moved back to staging areas on ice roads. No materials or drilling wastes (mud and cuttings) would remain at the site.

Water Demand and Rock Cuttings

Drilling operations require large amounts of water to create drilling fluid. Drilling fluid is typically a preparation of water, clay, and chemicals that is circulated into a well during drilling. The drilling fluid is used to lubricate and cool the bit, transport rock cuttings to the surface, prevent sloughing from the sides of the drill hole, and provide a weighting medium to prevent the migration of oil and other fluids into the well. A 10,000-foot well could require approximately 850,000 gallons of water for drilling, in addition to approximately 100 gallons per day for each person in the drilling crew (for camp use). Approximately 50 to 60 people would be needed to operate a drilling rig. Over a 3 to 4 month drilling season, a one-well drilling operation could require a total of 1,650,000 gallons of water, which would be obtained (if possible) from a source close to the well site. The use of melted snow could supplement this water requirement. Estimated water requirements are much lower for development wells, because 50 percent or more of the drilling mud would be reconditioned and reused.

A typical 10,000-foot well could use 630 tons of drilling mud and produce 820 tons of rock cuttings. If an exploratory well were to be abandoned, drilling mud and cuttings could be re-injected into an appropriate formation through the borehole. If the well were to be converted to production, it would be temporarily shut in, and the operator would dispose of drilling mud and cuttings at an approved grind and inject facility. No liquid or solid waste would be disposed of on site.

Effects of Shortened Drilling Seasons

An important concern pertaining to oil and gas operations on the North Slope is that the winter drilling season has been reduced from 208 days in 1970 to 103 days in 2003 as a result of rising global temperature (Arctic Climate Impact Assessment [ACIA] 2004, Rhodes 2004). Because at least 120 days are needed to effectively conduct projects, the shortened seasons result in the need for more drilling seasons, causing projects to take longer to complete. As a result, projects have become more costly in an area already constrained by the high costs of finding and developing oil and gas resources. Because of the shortened season, a growing proportion of the available drilling season is used to build roads, and there is less time to drill wells. Seismic operations are also constrained because shorter seasons reduce the amount of data that can be obtained. In an effort to create a more flexible system for determining when operations can begin, in 2002 the ADNR divided the Alaska North Slope into four regions, allowing each region to independently determine when activities can commence (Anchorage Daily News 2004). One of these regions allowed operations to commence on December 23, 2003, the earliest opening in 8 years. The ADNR is also attempting to deal with the problem by testing ground transportation equipment. During 2003-2004, testing was conducted by tracking several types of equipment over test plots. The tests were conducted from October to January to determine the effects of equipment on the ground as it is freezing. The ADNR announced in March 2004 that based on the tests that were conducted, it will set tundra travel opening dates based on the type of equipment that will be used (Rhodes 2004).

Other methods of dealing with the shortened season involve innovations to drilling equipment technology. During 2003 and 2004, Anadarko Petroleum Corporation drilled a test well to evaluate methane hydrate, a solid material that is formed from methane gas and water and is found at depth in the permafrost of the Arctic and in the deep sediment in the world’s oceans (Petroleum News 2004). While the main purpose of the well was to conduct research on hydrates, the equipment used to drill the well has features that could change the way shallow exploration drilling is conducted in the Arctic. Rather than drilling from an ice pad, the derrick, associated equipment, and living quarters were placed on a platform composed of 16 aluminum modules supported on steel legs. The impacts on the ground are holes used for the leg supports, which can be easily filled at the completion of operations. The test well was initiated in the winter of 2003 and completed in the winter of 2004. Although no drilling was conducted in the intervening months between the winters, the rig and the equipment were left in place with no apparent effects to tundra or wildlife (Petroleum News 2004). Since an ice pad is not needed for this drilling rig, it is conceivable that this type equipment could extend the drilling season.

Another drilling innovation that would help mitigate the constraints of the shortened season is the newly constructed “Arctic Millenium [sic]” rig (Bradner 2004). The rig, built by NI Energy Development Inc., is highly automated and can drill beyond 20,000 feet, and the modular units into which the drilling rig breaks down for transportation are much lighter than conventional rigs. The lighter and more mobile modules have implications for the drilling season in that the rig can be more quickly mobilized to drilling sites and the individual modules are light enough to travel over packed snow as soon as the tundra freezes, rather than waiting for the construction of ice roads to transport the rig.

Discovery and Development

Delineation and development activities could take from 4 to 10 years prior to production startup. Production activities would last between 10 and 50 years, depending on the size of the field. Abandonment activities, including well sealing and site restoration, could last 2 to 5 years after the end of production. This representative time frame suggests that new oil production would not be expected for at least 5 years following the lease sale, and it is more likely that 8 to 12 years would elapse before production from leases sold in the next Planning Area sale would begin. The discovery and development of commercial fields is likely to be staggered over a 10-year period, and petroleum activities could continue for decades after a lease sale.

For this discussion, a field is an accumulation of oil and gas 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 unproven resources that has not been developed. Some discoveries require additional drilling to confirm that oil or gas is commercially recoverable.

After a field has been discovered and confirmed to be of commercial size by delineation wells and seismic surveys, a number of construction activities are required to establish a permanent production operation. A new field would contain production well pads that could potentially support tens to hundreds of wells, a pipeline gathering system to a Central Production Facility (CPF), infield roads, a crew support camp, and an airstrip. Figure 4-2 shows a possible layout for a CPF with five satellite fields. Table 4-3 shows the estimated area of surface disturbance and amount of gravel needed for oil and gas facilities for a typical field. A new sales-oil pipeline would be built to carry oil production to the existing pipeline network capable of supporting transportation needs. Winter ice roads would be used to move heavy equipment and materials to other North Slope oil fields, rather than a permanent gravel road. Light loads, such as camp supplies and crew changes, could be transported by fixed-wing aircraft or Rolligons. Roadless, or seasonal road development, would likely be the preferred strategy for future fields in the Planning Area, for resource protection, practicality, and cost reasons. There are circumstances, however, under which permanent roads could be appropriate, and permanent roads are currently being considered for the Alpine field as part of the Alpine Satellite Development Plan (USDOI BLM 2004c).

Staging Area

Staging areas are used to support exploration, development, and abandonment activities. All materials and equipment necessary to develop a new field must be stockpiled, moved, and assembled in remote portions of the Planning Area, subject to seasonal constraints for transportation. Consequently, staging areas are very important components to development. Ideally, a staging area contains buildings for warehouses and crew quarters, gravel pads for stockpiling materials, and a serviceable airstrip. If located on the coastline, a causeway or dock may be needed for loading materials and equipment transported by barges. For purposes of this Amended IAP/EIS, it is assumed that each staging area would be approximately 50 acres.

Considering the expense to establish a new staging area in a remote site, it may be more cost-effective to reoccupy existing sites, even if some refurbishing is necessary. Camp Lonely, BLM-administered lands (Cook Inlet Region Incorporated [CIRI] lease site and the DEW-Line site), Inigok, and Umiat have been used as major staging areas for past National Petroleum Reserve – Alaska operations. The DEW-Line site at Camp Lonely is technically considered by the U.S. Air Force to be an inactive site that could fulfill the mission if called upon. Thus, consultation would be required for any use of the airstrip.

Development of staging areas would occur in winter prior to the start of development activities. The number of barges required in each sealift to support development activities would be up to 30 barges per year. Modules and equipment would be offloaded from barges in 3 to 5 days and stored on the staging area pad until winter. They would be transported by ice road during the winter to the CPF sites. Individual modules could be 20 to 30 feet in height. Each CPF would likely require one or two large sealifts (1 year apart), depending on its size. Modules would eventually become the site's energy generation, operations, and housing facilities complex.

It is likely that the first development operations in the Planning Area initially would be staged out of existing facilities at the Greater Prudhoe Bay Unit or Kuparuk River Unit. Both of these base camps have all-season airports, are connected by road systems, and have marine loading sites on the coast (West Dock and Oliktok Point). Materials and equipment likely would be moved to staging areas within the Planning Area using marine transport in the summer months and/or by trucks over ice roads in the winter months. Aircraft would access remote sites at all times of the year; however, air traffic would be restricted by low clouds and fog in the summer, and by storms with whiteout conditions in the winter.

After the tundra was sufficiently frozen and tundra travel had been authorized, ice roads would be constructed to remote development sites. Equipment could also be transported by Rolligon trail. Earth-moving equipment would then move gravel to the site to establish a construction camp and perhaps a year-round airstrip. Later, drilling equipment and supplies would be moved to the site over ice roads. Production equipment (modules) and pipeline-construction materials would be moved during the final stages of development. The overall development phase, from construction of a staging area and remote base camp to production startup, could take 3 to 7 years, depending on the size and location of the new field.

Table 4-3. Estimated Area of Surface Disturbance and Amount of Gravel Needed for Oil and Gas Facilities for a Field Consisting of a Central Production Facility Field with Five Satellite Fields.

Facility/Disturbance	Number of Facilities/Miles/Acres	Total Amount of Impact
Development/Operational Facilities		
Central production facilities (2 pads, road, airstrip)	1	100 acres
Satellite pad (10 acres each)	5	50 acres
Satellite airstrip (1,30 feet x 5,000 feet; 11 acres each)	1	11 acres
Roads to satellite fields (7.5 acres per mile)[1]	50 miles	376 acres
Total acres – pads, roads, and airstrips		537 acres
Staging areas (50 acres each)	1	50 acres
Ice roads (10 miles per satellite pad)[2]	50 miles	250,000,000 gallons
Gravel Consumption		
Central production facilities (10,000 cubic yards per acre)	100 acres	1 million cubic yards
Satellite pad (10,000 cubic yards per acre)	50 acres	500,000 cubic yards
Satellite airstrip (10,000 cubic yards per acre)	11 acres	110,000 cubic yards
Staging area (10,000 cubic yards per acre)	50 acres	500,000 cubic yards
Roads (41,000 cubic yards per mile)	50 miles	2.1 million cubic yards
Total gravel consumption		4.2 million cubic yards
Field Pipeline Right-of-ways		
Vertical support members (VSMs; 96 per mile)	53 miles	5,088 VSMs

[1] Assumes that there are 10 miles between each satellite pad and 3 miles between each Central Production Facility pad.
[2] Assumes that 10 miles of road are constructed for each satellite pad and that roads are constructed annually for 5 years.
Sources: USDOI BLM and MMS (1998, 2003) and USDOI BLM (2004).

Gravel Requirements

Much of the initial work for a new project would involve the construction of gravel pads for wellheads, production and support facilities, infield roads, and an airstrip. The development area must be level, stable, and elevated above the wet tundra surface. Because the tundra surface is unstable, and subject to flooding in summer and ice-jacking forces in winter, pads are designed to be at least 5 feet above the tundra surface.

Gravel is the preferred material for pad construction. Gravel borrow pits are relatively common east of the Colville River, but gravel is a scarce commodity in the Planning Area. A variety of alternate strategies could be adopted, including the following:

- Extracting gravel from existing sites;
- Developing new sand and gravel mine sites within the Planning Area;
- Barging construction materials to coastal staging areas;
- Processing bedrock for construction materials;
- Designing alternatives (year-round ice pads; composite all-season pads); and
- Reusing gravel from previous drillsites.

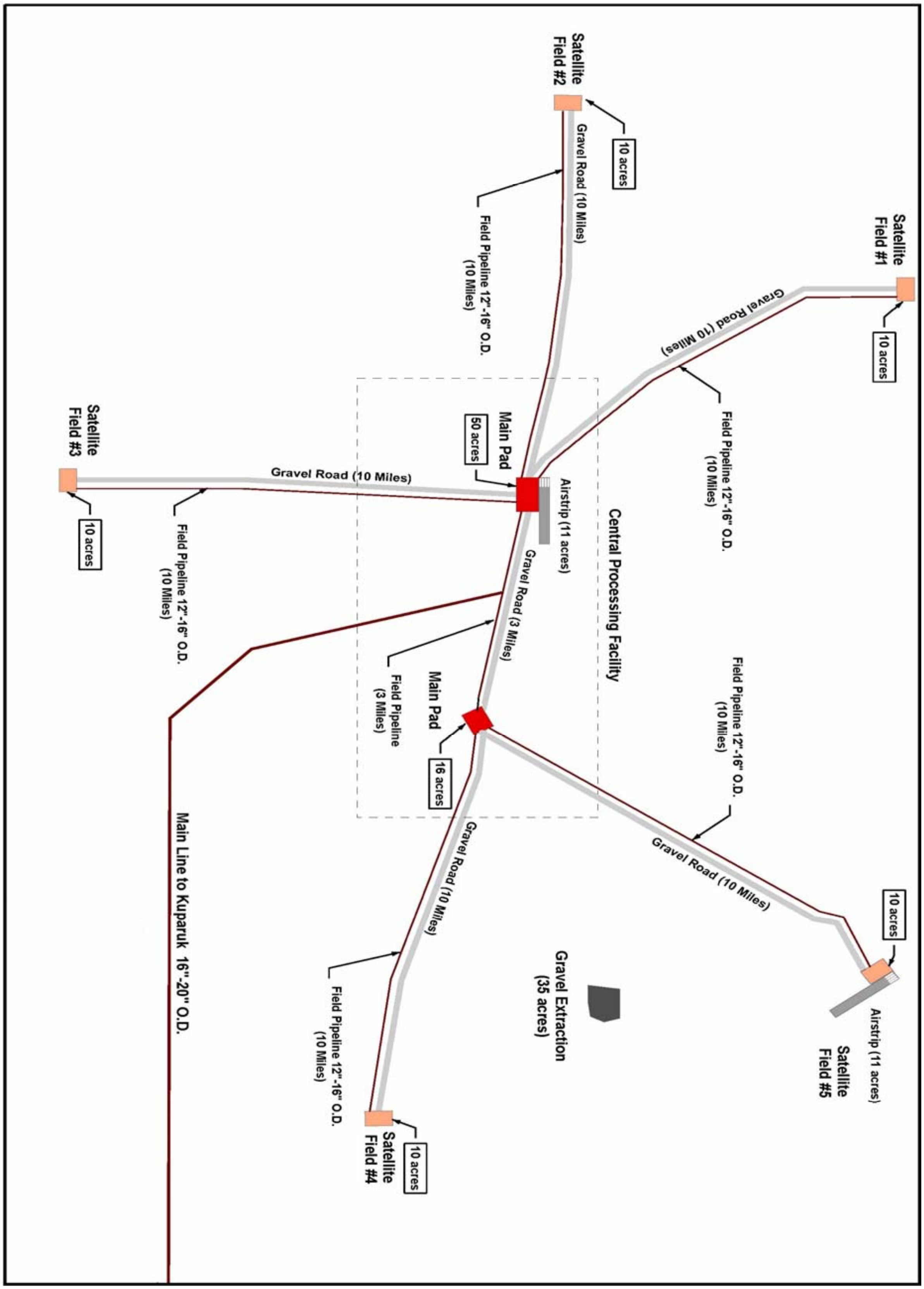

Figure 4-2. Hypothetical Layout of a Central Processing Facility and Satellite Fields.

Project plans for new field development in the Planning Area would depend largely on site-specific conditions and the site location relative to sources of construction materials.

For permanent production facilities, the preferred pad design is one made up entirely of gravel. However, composite pads are a proven alternative. An all-gravel pad rising 5 feet or more above a wet tundra surface requires 8,000 to 12,000 cubic yards (yd^3) per acre of surface footprint (Table 4-3). Gravel roads (typically 52 feet wide from toe to toe with 2:1 slopes) cover approximately 7.5 acres per mile and require approximately 41,000 yd^3 of gravel per mile. Airstrips (typically 100 feet wide and 5,000 feet long) cover approximately 11 acres and could require 110,000 yd^3 of gravel. The airstrip could also have an apron and taxiway that could cover another 5 to 8 acres.

Site-specific conditions would dictate the facility requirements and consequent footprint size of new fields in the Planning Area. 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 could have footprints of 200 acres or more. For purposes of analysis, it is assumed that new fields would have footprints of approximately 100 acres. The average gravel requirement for a footprint of 100 acres is approximately 1 million yd^3, or about 10,000 yd^3 per acre of footprint. Smaller satellite developments would require proportionally less gravel.

Several types of gravel pads have been used in the Planning Area. Gravel requirements are reduced substantially by composite pad designs, in which the lower portion of pads are built using blended (geotextured) mixtures of sand and silt. This lower lift is overlain by rigid foam (Styrofoam) insulation boards and then covered by a layer (2 feet thick) of clean gravel. Material for the lower portion of pads is common in surficial deposits throughout the Planning Area, and could be extracted and blended during winter months from borrow areas near the development site. Use of all-season pad designs could reduce the overall gravel requirement by 33 to 50 percent, as compared to use of all-gravel pad designs. In addition, the use of a blended sand-silt mixture for the lower portion of the composite pad would enhance reclamation after abandonment by providing a more natural substrate for re-vegetation.

Gravel used for developments in the eastern portion of the Planning Area could be extracted from existing or yet undiscovered borrow sites on lands east of the Colville River and then transported to the development sites by trucks over winter ice roads. For more distant sites in the central and western portion of the Planning Area, gravel could be mined from existing borrow pits, barged to coastal staging areas, and stockpiled for later transport by trucks over winter ice roads. Sand and gravel could also be extracted from new sites within the Planning Area. Investigations to identify gravel sources in the Planning Area are underway. It is possible that numerous gravel production sites would be needed. For each new site, overburden removal and sand/gravel mining could impact areas of 20 to 50 acres or more, depending on the thickness and extent of the deposit and amount of material extracted. Since 1973, North Slope oil development has resulted in approximately 1,200 acres of gravel mines, and a total gravel footprint of 9,640 acres. Thus, for this Amended IAP/EIS, an assumption was made that approximately 1 acre would be disturbed for gravel removal to meet the gravel needs for 5 acres for oil and gas development.

Few gravel sources exist for sites in the southern part of the Planning Area. Surficial gravel sources are rare outside river corridors, so it is likely that alternative materials would 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 restrictions on their extraction are likely. Gravel trucked on long ice roads would add substantially to the cost of developments in the southern portion of the Planning Area.

Development and Production Well Drilling

The number of production wells is determined by the unique characteristics of the oil reservoir, such as thickness, permeability, lateral continuity, and oil qualities. Well drainage areas vary, but generally do not exceed 640 acres per well. Thicker, high-quality reservoirs tend to have larger well-drainage areas. Thinner, or more laterally discontinuous reservoirs, normally require closer well spacing to achieve effective subsurface drainage. However, horizontal wells with long lateral sections drilled in the reservoir can replace several closely spaced vertical wells. Later in the life cycle of a field, well spacing typically is reduced by infill drilling in the attempt to capture more oil reserves as the reservoir energy is depleted.

In addition to production wells, other wells are drilled to inject water or gas into the field to maximize oil recovery. These wells generally are referred to as service (or injection) wells. Numerous injection wells are required for waterflood programs, which are used routinely throughout the production cycle to maintain reservoir pressure. The proportion of producer to service wells can vary for each field, but a typical ratio of producers to service wells is 2:1 (i.e., one-third of the total number of wells are non-producing service wells).

Production pads are generally most efficiently spaced at distances of approximately twice the reservoir depth. For example, a reservoir at 8,000 feet requiring two production pads would normally have pads located approximately 16,000 feet apart (3 miles). Assuming an 8,000-foot step-out radius, approximately 4,600 acres (7.2 square miles) could be drained from each pad. If each well had a subsurface drainage area of 160 acres, each production pad would hold 29 producer wells and 15 service wells, for a total of 44 wellheads. Extra pad space could be allocated for additional infill production wells.

The time required to drill and complete a production well largely depends on the drilled (or measured) depth of the well. On the North Slope, it normally takes approximately 20 to 30 days to drill and complete a 10,000-foot well, which equates to approximately 10 to 12 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, initial reservoir development drilling operations would take 3 to 4 years to complete. Seasonal restrictions on drilling operations and transportation capacity would increase the overall time to fully develop a field.

Another key consideration is the pressure regime and flow dynamics of oil reservoirs. Once production begins, reservoir dynamics must be carefully managed to optimize oil recovery. Discontinuous production is not an advisable engineering (or economic) practice for oil fields. Therefore, ensuring adequate production rates is a factor in well location selection and the timing of drilling activities.

Drilling Mud and Rock Cuttings

Drilling operations for each development well require large amounts of drilling mud and produce large quantities of rock cuttings. The estimates provided for exploration/delineation wells would apply to development wells of equivalent depths. The goal of current North Slope drilling operations is zero surface discharge of wastes. Generally, dedicated disposal wells are used for injection of drilling wastes, although it is possible to inject wastes into shallow zones of production wells while allowing oil production from deeper zones. Up to 80 percent of the drilling mud may be reconditioned and reused, reducing the costs of both materials and disposal.

Generally, all wastewater, spent fluids, and chemicals would be disposed of offsite in injection wells approved by the USEPA or ADEC, depending upon waste characterization. Solid wastes would be incinerated and hauled to approved offsite landfills. Normal practices do not allow onsite burial of solid wastes.

Water Demand

Water is needed for both drilling and camp use. Drilling water demand is estimated to be 21,000 to 63,000 gallons per day, or 850,000 or more gallons per well. Water demand is estimated to be 100 gallons per day per person. Potable water demand would drop after 2 to 4 seasons, when the major construction phase would be finished. Approximately 160 persons would be on site during the production and development phases for each CPF and four to six satellite fields (S. Rothwell, ConocoPhillips, pers. comm). Drilling-water demand over the 20-year production life of the field (largely for workover operations and infill drilling) would likely be less than the 21,000 gallons per day estimated above. Water requirements for ice roads needed for access to drilling areas are discussed under Section 4.3.4.1 (Water Resources, Effects of Disturbances, Ice Road and Pad Construction).

Production

Production Facilities

A CPF would serve as the operational center for long-term production activities in a North Slope oil field. 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 most North Slope projects, many components of the CPF are constructed as transportable modules in offsite locations, perhaps outside Alaska, barged to the North Slope, then moved over gravel roads or winter ice roads to the field and assembled. All buildings are supported above the ground on pilings to accommodate ground settling or frost heaving. An airstrip usually is located near the CPF to allow transport of supplies and personnel to the field site.

The CPF typically is located on the largest and most central, or initial, development pad. Equipment at the CPF is used to separate the materials that are produced from the wells (oil, natural gas, and water) on the pad. The CPF would likely process production from smaller, outlying satellite pads as well. Produced oil is filtered (to remove sand) and processed (to remove water and gas) before being piped through a sales meter and into the sales-oil pipeline system. Gas is processed (to remove liquids and impurities), pressurized (compressed), and re-injected into the reservoir through service wells. Likewise, water is processed (chemically treated) and then re-injected into the reservoir for pressure maintenance. Re-injection of produced gas and water helps maintain reservoir energy, increasing the ultimate oil recovery. This practice normally is initiated from the onset of production.

Production Rates

Because development well drilling occurs over several years, the production profile for a field is much broader than for any individual well within a field. Initial production usually occurs when sufficient volumes to effectively operate conditioning equipment are achieved. The production profile would typically increase to peak production volumes as additional development wells are drilled and completed. Production rates typically peak after several years, and may remain at this level for many years, depending on production handling design, future satellite field discoveries, reservoir and well performance, and other factors. Production rates would ultimately taper off from a single field as the reservoir energy is depleted and the recoverable oil is produced.

Waterflooding

During production, waterflooding would constitute the major water demand. Waterflooding is a key secondary production practice that can substantially increase oil recovery. Injecting water into selected areas of the reservoir maintains subsurface pressure and promotes fluid flow to the production wells. To maintain reservoir pressure, the volume of oil withdrawn from the reservoir must be replaced with an equivalent or greater volume of water. Therefore, pressure maintenance requires large quantities of water. For example, a field with a daily production rate of 50,000 bbl of oil would require approximately 2 million gallons per day of water (1 bbl = 42 gallons) for balanced waterflooding, given that some volumetric allowances must be made for each fluid under subsurface conditions. At this example production rate, a waterflood program would require approximately 760 million gallons (2,352 acre-feet) of water each year.

To meet waterflood demands, potential sources of water could include nearby deep lakes. Normally, there are restrictions to withdrawals from surface water sources that are vital to fish and waterfowl. Water wells could also be drilled below the permafrost layer (up to 1,500 feet thick) and water pumped from subsurface aquifers, but this practice is costly.

Often, local freshwater sources are inadequate to meet the demands of waterflood programs, so seawater is used. Seawater supplies are virtually unlimited, and unlike freshwater, which must be treated so that it is chemically compatible with the formation into which it is injected, seawater is reasonably compatible (similar chemically) to the brines present in most petroleum reservoirs. Waterflood systems may include a seawater-intake and treatment plant located on the coast and an insulated pipeline from the seawater plant to service wells in the field. Waterflood programs using seawater are initiated from the onset of production for most North Slope oil fields. As the oil field is produced, the volumes of formation water recovered with oil (water cut) increases. In time (5 to 7 years), injection water demands are met by produced formation water, and the seawater-waterflood system is shut down. Seawater from the treatment plant can then be used for the next field's waterflood program.

New oil fields in the northeastern portion of the Planning Area would likely receive seawater for waterflooding programs from existing facilities that currently serve fields in the Prudhoe Bay and Kuparuk River Unit areas. Seawater pipelines would be installed on vertical support member (VSM) pipeline supports that would also hold sales-oil and service pipelines. For areas farther to the west, seawater intake and treatment plants would likely be fabricated on barges and moved into temporary locations along the coast. Because the ability to incorporate waterflooding as a reservoir management strategy greatly improves recovery efficiency, the economics of fields discovered near the coastline could be improved. However, the value of increased oil recovery would be balanced against the increased costs of seawater-treatment facilities and temporary overland pipelines. With increasing distances inland, expensive heat generators and pump stations could be required to deliver treated seawater to remote fields in the severely cold winter temperatures of the North Slope. Small or very remote fields may not be able to justify the costs of startup waterflood programs and would rely entirely on later waterflooding using produced formation water.

Miscible Injection

In addition to waterflooding, miscible fluid injection is used to increase the recovery of oil and maintain pressure in the reservoir. Miscible injection involves the injection of various types of gases (generally under high-pressure conditions) into the reservoir. The injected gases can include liquefied petroleum gas (LPG), methane, hydrocarbon gas mixtures, nitrogen, and CO_2. Hydrocarbon gases are primarily used on the North Slope because they are readily available. Lack of markets makes re-injection the best use and conservation of the commodity, since a portion of the re-injected gas would be available for future production and sales.

Abandonment

At some time in the life cycle of a field, the revenue from production is insufficient to justify the expenses of operation. The end of economic life occurs before all of the recoverable oil is extracted from the reservoir. The factors leading to a decision to abandon a field could differ for each field, but declining production rates and oil price are usually the two key considerations.

Wells are plugged and abandoned as the field matures. Abandonment operations generally include removing all equipment, plugging all wells, restoring the site, cutting well casing at least 3 feet below the surface, and conducting final environmental studies. Gravel and gravel/sand pads may or may not be removed, depending on such factors as the impacts of removal, future use values, and the need to recycle and re-use gravel for ongoing projects. Reclaimed or abandoned pad sites may be revegetated with native species, or revegetated with species that would ultimately be replaced by native vegetation or allowed to bed naturally. Abandonment operations could take place over many years, as revegetation and environmental monitoring studies would continue to document the long-term effects of past operations at a particular site. A series of permitting and inspection activities would be associated with oil field abandonment, and would involve visiting the site as needed until satisfactory revegetation occurred.

Transportation

Regional Oil Transportation

A regional oil-transportation system for the North Slope oil fields was established in 1977 upon completion of the TAPS. Oil is transported some 800 miles through a 48-inch pipeline to the ice-free port of Valdez, Alaska. From the storage and marine loading terminal at Valdez, oil is loaded onto tankers and transported to U.S. and foreign markets.

The throughput capacity of the TAPS pipeline is a vital factor to North Slope development. The maximum daily throughput capacity of TAPS is slightly over 2.0 MMbbl/day (achieved in 1988). Currently, TAPS throughput is 993,000 bbl per day (Alyeska Pipeline 2004). The minimum throughput for a viable TAPS operation has been widely debated by government and industry. The common perception is that a minimum throughput of between 200,000 and 500,000 bbl/day represents a realistic mechanical and economic limit to operation. When this minimum throughput rate would be reached is also speculative, because it is difficult to accurately predict the size and timing of new oil field development on the North Slope. However, based on the declining production trends of existing North Slope fields, and assuming no changes to economic conditions or discovery of major new oil fields, the operational limits of TAPS could be reached within the next 20 years. Industry is well aware of this future problem, and aggressive efforts are underway by North Slope producers to reverse the production decline trend by exploring for new fields and using innovative methods to develop marginal fields. Renewed industry interest in the Planning Area is an important strategy to maintain the throughput of TAPS within acceptable limits. Without this vital transportation system, continued production from the North Slope is unlikely. All National Petroleum Reserve – Alaska development scenarios assume that TAPS would continue to operate and carry North Slope oil production.

North Slope Pipelines

The central portion of the North Slope contains numerous oil fields connected by pipeline gathering systems to TAPS Pump Station Number 1 (Map 3-3). Because of its location, most new oil development projects in the National Petroleum Reserve – Alaska would use the main line between the Kuparuk River Unit and TAPS Pump Station Number 1. The 24-inch Kuparuk River Unit pipeline has a capacity of approximately 350,000 bbl/day. As the large fields (Kuparuk, Milne Point) feeding this pipeline decline, excess pipeline capacity could be used by new fields. For the purposes of analysis in this amendment, it is assumed that a new pipeline would be constructed from the Planning Area to the Alpine oil field, and would then connect to the Kuparuk River Unit. This pipeline would likely follow existing pipeline or road right-of-ways and would result in little new surface disturbance.

Oil production from satellite fields, in addition to water handling and gas reinjection capabilities at the Alpine oil field production facility, have the potential to affect the timing of development of future discoveries in the National Petroleum Reserve – Alaska. Originally, peak oil production at the Alpine field was expected to last for 3 to 5 years after startup (2001), with production rates declining to about half of peak rate in 15 years. Recent developments and future development of current proposals at Alpine field satellite fields will delay the originally anticipated production decline. ConocoPhillips Alaska, Inc., has plans to increase the handling capacity of the production facilities at the Alpine field, but has not proposed to increase the pipeline carrying capacity from the Alpine field to the Kuparuk River Unit pipeline. Consequently, the initial production from National Petroleum Reserve – Alaska discoveries may be delayed. Unlike discoveries in the Colville River Delta, some National Petroleum Reserve – Alaska production may be delayed by 5 to 10 years after initial discovery unless additional pipeline capacity is added to the existing Alpine oil field.

Future National Petroleum Reserve – Alaska Pipelines

The actual locations of new pipelines in the Planning Area would depend on the location and sequence of commercial-sized discoveries. At present, there is no reliable way of predicting where or when new commercial fields would be discovered and developed. Fields developed early in the future development cycle could establish the first pipeline corridors connecting new Planning Area fields to existing infrastructure east of the Colville River. Fields developed later in the cycle would be likely to use the existing pipelines, should capacity be available. If large fields were discovered late in the exploration sequence, new sales-oil pipelines could be built. It is possible that commercial-sized fields discovered by different companies would be shut in (i.e., not produced) until an agreement was reached to share the costs of constructing a pipeline system through the Planning Area.

The diameters and lengths of new pipelines in the Planning Area would depend on the characteristics of new fields (undiscovered at present) and the resource-development scenarios for each leasing alternative (Figure 4-2). Generally, infield pipelines (flowlines) carry multi-phase slurries (oil, gas, water) from wellhead manifolds to CPFs. Return lines containing gas or water would carry these substances back to injection wells on production pads. Infield flowlines would be 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 centrally located main line (16 to 20 inches). This main pipeline would then connect several producing fields to the Kuparuk River Unit pipeline (24 inches) and then on to TAPS (48 inches).

Pipeline Construction

Pipeline construction techniques have evolved over decades of experience in the Arctic environment on the North Slope. The following assumptions about the general engineering for pipeline design and construction would apply to future National Petroleum Reserve – Alaska projects.

Pipeline crossings of large rivers, such as the Colville River, could use horizontal directional drilling techniques similar to those used at the Alpine oil field. Narrow streams would likely be crossed by elevated pipelines to minimize impacts to streambanks and riparian vegetation, and to avoid potential problems associated with corrosion, maintenance, and abandonment of buried pipelines. It has been determined that the construction of a bridge over the Colville River would be expensive. Nonetheless, construction of a bridge over the river was recently analyzed in the *Alpine Satellite Development EIS* (USDOI BLM 2004c).

- Relatively wide, shallow rivers could be crossed by trenching and burying insulated pipelines in the riverbed. These pipelines would be installed during winter at locations selected to minimize disturbance to overwintering fish habitat.
- Narrow streams could be crossed by elevated pipelines on suspension spans, as fewer impacts would occur to the stream, streambanks, riparian habitat, and aquatic resources if a properly designed elevated pipeline crossing were to be used.
- Pipeline alignments would be routed to avoid crossing lakes.
- Pump stations could be required along the new mainline route, depending on distances, pipeline diameters, and production rates.
- Future pipeline routes and installation designs would depend on site-specific conditions evaluated by preconstruction engineering studies.

Typically, pipeline routes are laid out in straight-line segments (or alignments) and are installed aboveground on VSMs. On the North Slope, this installation method is preferred over buried pipelines, because aboveground pipelines take less time to construct, cause less disruption to the land during installation, are easier to monitor and repair, and provide more flexibility for later modification (e.g., adding new pipelines) than buried pipelines. Typically, VSMs are spaced 55 to 70 feet apart. Currently, within the Planning Area, they are installed with minimum heights of 5 feet above the ground to minimize disturbance to caribou herd movements. Pipeline clearance is generally higher (up to 20 feet) over topographic lows (stream valleys), because engineering calls for a nearly level pipeline route. Small, shallow lakes could be crossed by elevated VSMs, whereas large or deep lakes would have pipeline VSMs routed around their shorelines with some setback. Powerlines could be placed in cable trays on VSMs or suspended from VSMs.

"Roadless" Development

The term "roadless" development does not mean an absence of roads. Rather, it indicates an attempt to minimize the construction of permanent roads. It should be recognized that most fields would be connected by winter ice roads to allow transport of heavy equipment and supplies to outlying field locations. These seasonal roads would be used for 4 to 5 months each winter (December to April). In addition to ice roads, remote fields would use alternate transportation systems, such as marine barging and/or airstrips for year-round access. Within individual fields, short gravel roads (i.e., permanent roads) would connect production pads and facilities. In addition, gravel roads could connect nearby fields to one another to allow sharing of infrastructure.

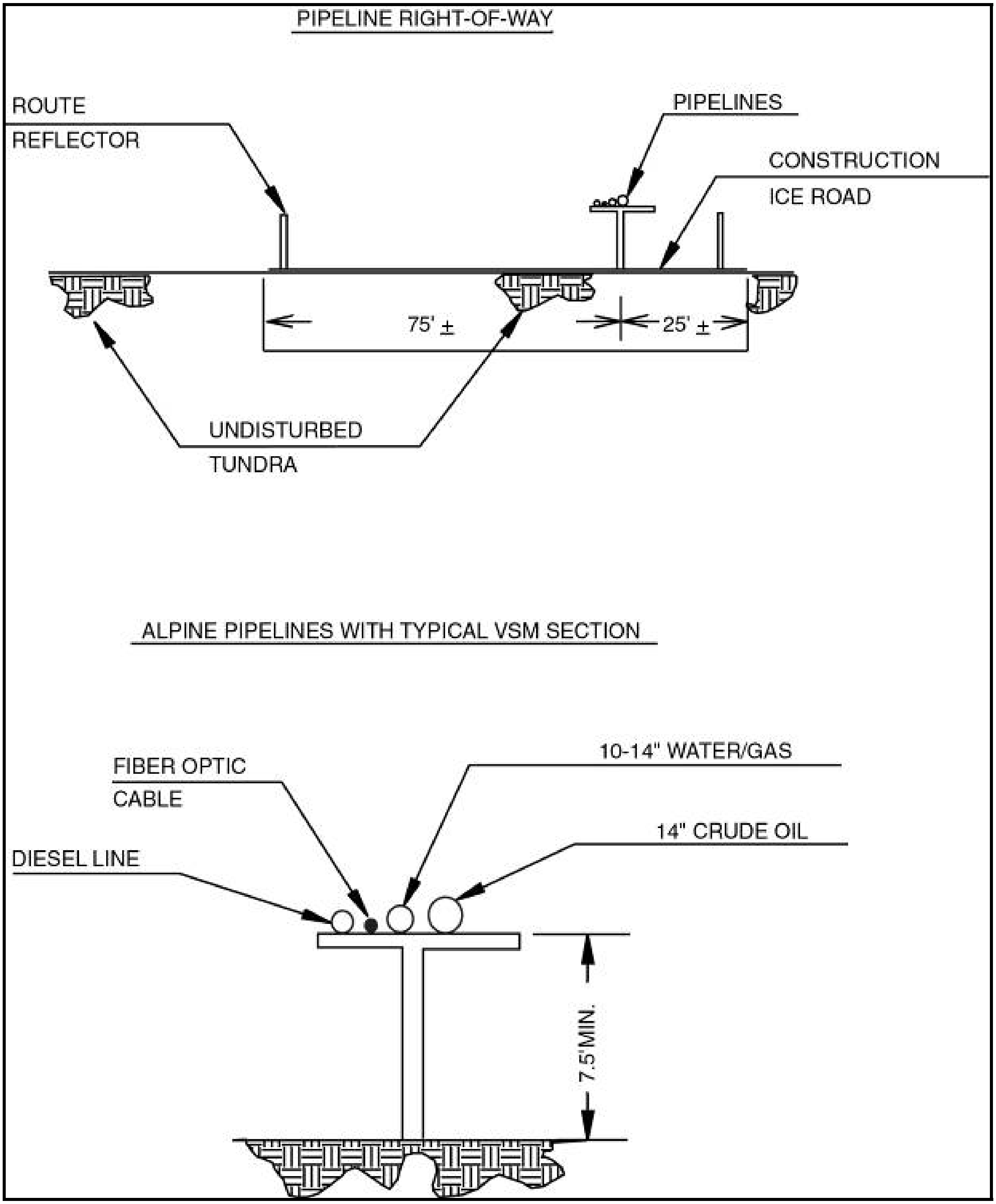

Figure 4-3. Sample Pipeline Layout.

Roadless development is a North Slope concept that was prompted by both economic and environmental concerns. The Badami and Alpine fields adopted "roadless" development, because it is cheaper and creates less environmental impact. It is assumed that future activities in the National Petroleum Reserve – Alaska would follow the example of these development projects for several reasons:

- The smaller field sizes predicted for the National Petroleum Reserve – Alaska probably could not support the high cost of long, permanent roads;
- The availability of road-construction material (gravel) is likely to be limited in the Planning Area;
- Field construction activities normally are scheduled for the winter months, when overland travel is possible and wildlife presence is lower; and
- Smaller fields in the National Petroleum Reserve – Alaska would not require the same level of supply/service operations as multibillion-barrel fields, such as Prudhoe Bay and Kuparuk River Unit.

From a safety standpoint, permanent roads would allow direct monitoring of pipelines and more rapid response time, should repairs be necessary. However, "roadless" development would not preclude access for pipeline inspection; rather, the mode of transportation would change with the seasons. During the winter months, visual inspections could be conducted by nearby ice roads, by snowmachines where ice roads were not present, and by aircraft. In summer months, visual inspections would be conducted primarily using aircraft and possibly Rolligons. Seasonal restrictions on aircraft operations would likely be enforced to protect waterfowl from disturbance. It is likely that pipeline repairs would involve the same forms of transportation. Hovercraft might be used for emergency repair work, particularly during periods when the tundra was wet (as opposed to frozen). Should an emergency pipeline repair be necessary, an on-site coordinator would consider the tradeoffs associated with various remediation strategies. It should be noted that pipeline monitoring on the North Slope is now done largely using remote instrumentation. Numerous monitoring and safety systems are installed to provide redundancy in these electrical and mechanical safety 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.

Although "roadless" development is a requirement of Lease Stipulation 48 in the 1998 Northeast IAP/EIS ROD, a permanent bridge with a road crossing is being considered at the Alpine field (USDOI BLM 2004c). In addition, the State of Alaska is proposing to construct an all-season gravel road from the Spine Road to and across the Colville River to the border of the National Petroleum Reserve – Alaska (Petroleum News Alaska 2002), just south of Nuiqsut. The primary candidate is an 18-mile route that would exit the Spine Road at the far western terminus (near the Tarn development) of the Kuparuk River Unit road system and proceed westward to a crossing of the Colville River 3 miles south of Nuiqsut (Map 3-44). The Spine Road would connect this road to the Dalton Highway.

Development Scenarios

Resource Potential and Related Activities

A variety of activities are associated with petroleum development, beginning with tract leasing and concluding decades later with abandonment of depleted fields. A general time frame for exploration, development, and production activities on the North Slope is shown in Table 4-2. For the purposes of environmental analysis in this amendment, future petroleum-related activities are assumed to be correlated to the economic resource potential made available through leasing. This implies that all of the modeled petroleum resources would be discovered and developed by industry, which is very optimistic since all of the possible economic resources may not be attractive to industry. Typically, larger and more profitable fields are discovered earlier in the exploration cycle. Smaller and less profitable fields may not be of interest to companies driven by profit motives. Companies may view the geologic or economic opportunities differently, and industry perceptions of economic potential may differ from those represented in our scenarios.

Readers should be fully aware that the environmental analyses in this amendment are based on hypothetical development activities associated with estimates of undiscovered oil and gas fields. There are many uncertainties in attempting to predict future activities. An accurate accounting of oil reserves is possible only after the production cycle is completed, perhaps decades into the future. Given that environmental analyses and decisions regarding leasing must be done now, the BLM is projecting these future production estimates based on the data currently available.

Conventionally-recoverable (or geologic) resources refers to the oil and gas resources that are recoverable by current technology without regard to economic feasibility. The conventionally recoverable resource estimate provides a maximum theoretical limit for production, but does not accurately reflect realistic commercial activities. Engineering, economic, and environmental factors are included in evaluating the commercial viability of oil and gas prospects. When economic realities are considered, the amount of resources expected to be leased and commercially produced is lower than the largely unattainable geologic potential. For the purposes of this Amended IAP/EIS analysis, it is more reasonable to use resource volumes that are economically producible under the constraints appropriate to the area, rather than the full geologic endowment.

Resource production estimates are strongly influenced by oil prices, but opinions of economists about future oil prices are quite variable. The oil prices used to define reasonable limits for environmental analyses are average, long-term price trends that do not acknowledge short-term spikes. Recent EISs for the National Petroleum Reserve – Alaska used price scenarios of $18 and $30 per bbl for oil and $2.56 and $4.27 per Mcf for natural gas (USDOI BLM and MMS 1998, 2003). At $18 per bbl of oil, projected activities are negligible. The development of gas resources also is not economic at these prices.

During fall 2004, oil prices exceeded $30 per bbl; however, oil prices are not expected to remain above $30 per bbl over the long term. The Alaska Department of Revenue uses a price assumption of $22 per bbl, and the Organization of Oil Exporting Countries (OPEC) has attempted to keep oil prices within the range of $22 to $28 per bbl, with a target price of $25 per bbl. In constant dollars, the historical price of oil has averaged approximately $22 per bbl; however, market forces may hold the average price closer to $25 per bbl for the foreseeable future (Winneke 2003). For this assessment, resources and activity estimates for the alternatives were developed at $20, $25, and $30 per bbl of oil.

As discussed in Chapter 3 (Affected Environment), estimates for the risked mean economically recoverable oil resources for the Northeast and Northwest National Petroleum Reserve – Alaska range from 634 MMbbl to 5,697 MMbbl, assuming $20 per bbl and $30 per bbl prices, respectively. The 2002 oil assessment estimated oil resources in the Planning Area to range from 435 MMbbl (at $20 per bbl) to 3,611 MMbbl (at $30 per bbl).

General Scenarios

The principal assumption for the multiple-sales scenario is that the total economic resource potential of the Planning Area could be discovered and produced, given the opportunity for exploration by industry. However, based on past experience, considerable effort could be required to discover all of the resources in this frontier province. As part of the USGS 1995 National Resource Assessment effort, Attanasi and Bird (1995) estimated the number of wildcat (exploration) wells needed to discover the total undiscovered oil resources in northern Alaska. For the central coastal plain subarea (containing the northern part of the Planning Area), it is estimated that between 40 and 180 wildcat wells would be required to discover all of the resources at prices ranging from $21 to $30 per barrel. From 1972 to present, only 35 exploration wells have been drilled in the Planning Area by industry and government programs.

For purposes of analysis, several general assumptions have been made:

- Multiple lease sales would be held;
- Industry would aggressively lease and explore the tracts offered, which could require large numbers of exploration wells and seismic surveys;

- Economic conditions (particularly oil price) would remain favorable to development in northern Alaska;
- New geologic information would not substantially change the present assessment of resource potential, high-potential plays would not be condemned by future drilling, and new high-potential plays would not be discovered;
- Projections of well numbers, facilities, and infrastructure do not include potential developments at the Alpine oil field;
- Learning curves would improve efficiencies over time for both prospect identification and engineering technology, and would lead to higher commercial success rates; and
- Future petroleum production would use existing North Slope infrastructure, most importantly the TAPS pipeline.

Time frames for the development scenario are not included, because a future lease-sale schedule has not been established. However, it is safe to assume that development activities associated with multiple future sales would continue for many years, as industry would require time to thoroughly evaluate existing leases before additional tracts would be leased. The complete inventory of petroleum resources in the National Petroleum Reserve – Alaska could take many decades. For instance, two lease sales have already occurred as a result of the ROD for the 1998 Northeast IAP/EIS, and 17 exploratory wells have been drilled, with reports of unconfirmed discoveries of oil. However, 6 years after publication of the 1998 Northeast IAP/EIS ROD, it is still not certain if the unconfirmed discoveries are commercially viable, nor has the resource potential of the Planning Area been fully explored.

Development Scenarios

Several leasing alternatives are considered in this amendment, each providing a different level of protection for environmental and cultural resources. The No Action Alternative (Alternative A) is used as a basis for comparison and is unchanged from the alternative contained in the 1998 Northeast IAP/EIS ROD for Northeastern National Petroleum Reserve – Alaska. The final Preferred Alternative and Alternative B represent an intermediate level of resource protection between the more restrictive 1998 Northeast IAP/EIS Preferred Alternative (Alternative A) and Alternative C in this EIS, which would open the entire Planning Area to leasing and development. The Full Economic Potential (FEP) is provided as a basis for comparison, but is not analyzed because it is unreasonable to expect that there would be no regulations for petroleum-related activities.

The oil development scenarios discussed below assume that oil prices will range between \$20 and \$30 per bbl (in constant dollars) in the foreseeable future, with the long-term price most likely averaging \$25 per bbl. It is estimated that between 435 million and 3,611 million barrels of oil could be produced in the Planning Area at prices ranging from \$20 to \$30 per barrel of oil under the FEP scenario (Table 4-4). This development scenario assumes that all BLM-administered lands in the Planning Area (approximately 4.6 million acres) would be made available for leasing and that no regulatory restrictions would adversely affect leasing interest or the economic viability of any petroleum-related activity.

New commercial oil fields are most likely to be discovered in the northern portion of the Planning Area that has been designated as having high petroleum potential. This area encompasses approximately the northern one-third of the Planning Area (Map 3-4; USDOI BLM and MMS 1998). It is impossible to predict with certainty, however, what proportion of exploration and development could occur in the medium to low potential areas. Prospective offshore areas under National Petroleum Reserve jurisdictions could be reached using directional drilling techniques from onshore pads or from offshore artificial islands.

In the most likely (\$25 per bbl) development scenario under the FEP assumptions, up to 19 fields could be discovered and developed (Table 4-4). These fields could include a mix of large fields with CPFs and surrounding satellite fields that depend on the central facility. Table 4-5 depicts the levels of petroleum-related activities and infrastructure estimated for the various price scenarios and alternatives. Table 4-6 provides the estimated amounts of surface disturbance for each alternative for the various price scenarios. The infrastructure estimates are based on a general development plan modeled from the Alpine oil field, where a large CPF could have several satellite fields tied to it (see Table 4-3). The most likely ($25) scenario for the FEP includes three CPF fields and up to 16 satellite fields. Satellite fields would be located within 10 miles of a CPF field. Discovery of these new fields could require an estimated 140 exploration and delineation wells. This level of exploration is far greater than has occurred in the past. From 1972 to the present, approximately 35 wells have been drilled to test prospects in the Planning Area.

It is expected that the next lease sale in the Planning Area would take place in 2005, and that future lease sales would be scheduled bi-annually. Oil production resulting from leasing in 2005 would begin in approximately 7 to 9 years and peak approximately 10 years later at rates ranging from 14 to 77 MMbbls per year (final Preferred Alternative at $20 to $30 prices). Exploration wells have been drilled on leases awarded in lease sales since 1999, and there are reported discoveries of oil and gas, but there is no indication as to whether these discoveries are commercially viable. Therefore, it is not certain when or if production would begin from these leases.

Differences in Activity Levels for Leasing Alternatives

The FEP scenario assumes that all of the Planning Area is available for leasing and petroleum activities and that regulatory restrictions would not be impediments to leasing or subsequent development activities. This assumption means that the total hydrocarbon resource from each play would be available for production, subject only to economic and engineering constraints. Under the FEP scenario, oil resources would range from 435 MMbbl at $20 per barrel to 3,611 MMbbl at $30 per bbl, with 2,911 MMbbls at the mid-range price of $25 per bbl.

Table 4-4. Oil Resource Estimates for Each Alternative.

Alternative	Low Price Scenario		Medium Price Scenario		High Price Scenario	
	MMbbl ($20/bbl)	Number of Fields[1]	MMbbl ($25/bbl)	Number of Fields[1]	MMbbl ($30/bbl)	Number of Fields[1]
A	130[2]	1	NA	NA	600[2]	3
B	216	2	1,544	10	2,054	14
C	255	2	1,855	12	2,488	17
D	164	1	1,247	8	1,727	12
FEP[3]	435	3	2,911	19	3,611	24

[1] Number of fields includes large CPF fields with processing facilities and small satellites that share those facilities. Not every field includes both a CPF and multiple satellite fields, however.
[2] The 1998 Northeast IAP/EIS analyzed $18/bbl as a low price scenario. Adjusting for inflation, this price would be approximately $20/bbl in 2004. The high price scenario at $30 would be adjusted to approximately $34/bbl in 2004.
[3] FEP (Full Economic Potential) represents the total undiscovered, potentially commercial, petroleum endowment assessed in the Planning Area. The FEP development scenario is not analyzed here and is shown for comparison purposes only.
NA = Not analyzed. The 1998 Northeast IAP/EIS did not analyze a $25 per bbl scenario.

The resource estimates and associated activities for the FEP are reduced for the other leasing alternatives because there is an unavoidable trade-off between the level of protection and the feasibility of future petroleum operations. Total protection of the environmental and cultural resources is likely to require a total exclusion of petroleum-related activities. The effects of partial protection measures on future petroleum-related activities would depend on site-specific conditions. Ultimately, it is the industry perception of the opportunities for profitable operations that would set the level of future activities. Regulatory restrictions could affect several aspects of petroleum activities: leasing activity could be lower (fewer tracts leased, lower bonus bids), exploration effort could be reduced (fewer prospects drilled), and production could be delayed (project redesigns and biological studies). In some cases, potentially recoverable oil could be bypassed or marginal fields would not be developed.

Table 4-5. Estimated Levels of Oil-related Activities for Each Alternative.

Alternative	Exploration Wells[1]			Delineation Wells			Exploration/Delineation Drilling Rigs[2]			Production Drill Pads			Production and Service Wells[3]		
	L[4]	M[4]	H[4]	L	M	H	L	M	H	L	M	H	L	M	H
A	6	NA	21	4	NA	17	2	NA	3	1	NA	5	41	NA	180
B	6	43	57	4	32	42	1	3	5	2	12	16	80	420	580
C	7	52	70	5	39	52	1	4	6	2	14	20	80	500	710
D	6	34	48	4	26	35	1	2	4	2	10	13	61	336	489
FEP[5]	12	80	100	9	60	75	1	6	8	4	22	28	125	790	1,000

Alternative	Production Drilling Rigs			Staging Bases			Peak Oil Production[6]			Pipeline Miles[7]		
	L	M	H	L	M	H	L	M	H	L	M	H
A	1	NA	5	0	NA	1	13	NA	51	20	NA	110
B	1	6	9	0	1	2	19	68	92	110	220	220
C	1	8	11	1	2	3	22	82	111	110	220	330
D	1	5	8	0	1	2	14	54	77	110	180	190
FEP	2	12	15	1	3	5	34	128	159	110	330	440

[1] Exploration well totals include commercial discoveries and dry holes.
[2] Rig totals are the maximum number operating in any single year.
[3] Production to service well ratio is 2:1 (note that the Alpine oil field ratio is 1:1).
[4] Price Designation: $20/bbl, Low (L); $25/bbl Medium (M); and $30/bbl High (H).
[5] FEP (Full economic potential) represents the total undiscovered, potentially commercial petroleum endowment assessed in the Planning Area. The FEP is not analyzed here and is shown for comparison purposes only.
[6] Oil production in MMbbl per year.
[7] Pipeline miles do not include in-field flowlines, only gathering lines (from satellite fields) and overland sales lines connected to the exiting pipeline network on state lands to the east of the Planning Area.
NA = Not analyzed.

A precise evaluation of the economic impacts of regulatory restrictions is not possible because the magnitude of these effects would vary depending on the location of as-yet undiscovered oil fields. When and where these fields would be discovered, and which of these discoveries would prove to be of commercial size, cannot be accurately defined at the present time. At one extreme, if a prospect were located in an area unavailable for leasing, it obviously would not be leased or discovered. However, if an area was open to leasing and potentially commercial discoveries were made, compromises might be reached to mitigate impacts without undermining the viability of proposed projects. The effects on the amount of available oil resource from withdrawing areas from leasing or imposing regulations on future petroleum activities could range from minimal to severe, depending largely on the location of future discoveries.

A series of reductions are made to account for regulatory restrictions on future petroleum production. The first set of reductions is related to areas unavailable for leasing. This reduction is objective because affected play areas are measurable from maps. Because the exact locations of commercial fields are unknown today, it is assumed that the petroleum endowment in each geologic play is distributed evenly over the geographic extent of the play. Admittedly, this is a simplistic assumption because commercial fields would occur in localized pools. However, prior to extensive mapping and drilling, the opportunity to discover new fields is relatively uniform throughout a play area. The fraction of the petroleum resource available for leasing and possible future development is determined as the available portion of each play in the Planning Area. For instance, the estimated oil resource for the Beaufortian Barrow Arch Play in the Planning Area is 2,930 MMbbls. By scaling from play area maps, it was determined that 20 percent of the play area would not be offered for leasing. Multiplying this fraction by the total play resource indicates that 586 MMbbls would not be available and consequently would not contribute to future production. The economically recoverable resources in each play are adjusted by geographic scaling from the total play endowments to determine the available portions within the Planning Area, and then all play resources are summed to an area-wide total.

A second set of reductions is also objective, as it is based on areas affected by no-surface-occupancy (NSO) restrictions in setbacks (or buffers) that provide protection for sensitive localities. No-surface-occupancy restrictions could reduce industry interest in leasing, add costs to operations, or present difficult engineering challenges. Reductions for production estimates are valid even if the area underneath the buffer and enclosed area is technically reachable by directional drilling. In most cases, surface restrictions that would require directional drilling beyond 1 mile would cause economic burdens that could result in bypassed resource recovery or the elimination of marginal projects.

Table 4-6. Estimated Number of Facilities (and Acres of Surface Disturbance) for Different Levels of Oil-related Activities for Each Alternative.

Facility	Alternative A			Alternative B			Alternative C			Alternative D		
	L	M	H	L	M	H	L	M	H	L	M	H
Central Processing Facility (100 ac each)	1 (100)	NA	1 (100)	1 (100)	2 (200)	2 (200)	1 (100)	2 (200)	3 (300)	1 (100)	2 (200)	2 (200)
Satellite fields (10 ac each)	0	NA	3 (30)	0	6 (60)	10 (100)	0	8 (80)	11 (110)	0	4 (40)	8 (80)
Airstrip (11 ac each)	1 (11)	NA	1 (11)	1 (11)	2 (22)	2 (22)	1 (11)	2 (22)	3 (33)	1 (11)	2 (22)	2 (22)
Roads (miles; 7.5 ac per mile)	0	NA	30 (225)	0	60 (450)	100 (750)	0	80 (600)	110 (825)	0	40 (300)	80 (600)
Staging areas (50 ac each)	0	NA	1 (50)	0	1 (50)	1 (50)	0	1 (50)	2 (100)	0	1 (50)	1 (50)
Gravel pits (20-50 ac each)	1 (20)	NA	2 (90)	1 (30)	5 (170)	7 (230)	1 (30)	6 (210)	8 (300)	1 (20)	4 (140)	6 (210)
Total Acres of Disturbance	131	NA	506	141	952	1,352	141	1,162	1,668	131	752	1,162

NA – Not analyzed.

The economic resource potential would also be reduced by subjective factors to account for added costs of operations, delays, project design changes, and biological studies (primarily ROPs and Lease Stipulations A to J; see Section 2.6, Lease Stipulations and Required Operating Procedures). The overall effect of these factors is referred to as the "cost of mitigation." The cost of mitigation assumes that all regulations would be enforced and exceptions to these regulations would not reduce the protection provided by original intent of the regulation. The cost burden associated with mitigation increases at lower oil prices because operators can little afford added costs or delays to marginal projects. At lower oil prices, projects become less profitable (or uneconomic) and operators could bypass otherwise commercial projects when investment returns are too small. The "cost of mitigation" is accounted for by using a sliding scale of reductions ranging from 20 percent at $30 per bbl, to 25 percent at $25 per bbl, to 30 percent at $20 per bbl. In general, these reductions are based on the assumption that although most of the oil would be found in Alpine oil field-sized accumulations (128 to 512 MMbbl) that would be economically recoverable, about 30 percent of the oil found in the Northeast National Petroleum Reserve – Alaska would be found in smaller accumulations that would have a lower probability of being recovered. These reductions include the effects of specific regulations as well as the cumulative burden of overlapping regulations. Regulatory impediments can involve protective measures for both biological and cultural resources. Subsistence use protection refers to unavoidable or unresolvable conflicts with subsistence uses of the area. This factor is given a subjective reduction factor of 10 percent.

The petroleum resource assessment indicates that a few plays could hold a large majority of the total resource endowment. Restrictions affecting these “rich plays” would have a disproportionate affect on the future development potential of the area. For example, the Beaufortian-Barrow Arch play (with analogs to the Alpine oil field) could contain approximately 80 percent of the economic oil resources. The geographic extent of this play overlaps many of the biologically and culturally sensitive areas in the northern portion of the Planning Area. Restrictions affecting this play could have a large impact on future oil and gas production from the National Petroleum Reserve – Alaska.

Using these general concepts and reduction factors, new resource estimates are defined for each of the leasing alternatives. The specific reduction factors are identified by the following abbreviations: areas unavailable for leasing (UL), no-surface-occupancy buffers (NSO), cost of mitigation (CM), and conflicts with subsistence use (S).

No Action Alternative (Alternative A). The No Action Alternative would provide for protection of wildlife resources (waterfowl and caribou) and subsidence values by withholding approximately 600,000 acres from leasing and development. Surface facilities and development activities would not be allowed in buffers around the closed areas and along important river systems. Prescriptive-based lease stipulations developed for the 1998 Northeast IAP/EIS would mitigate for impacts associated with petroleum exploration and development (see Appendix E). Approximately 87 percent of the Planning Area would be available for leasing, but three-quarters of the area with high oil and gas potential would be affected by area withdrawals and restrictive regulations. Under this alternative, oil production of 130 MMbbl to 600 MMbbl is estimated to occur if oil prices average between $20 and $30 per barrel. This represents a 72 percent reduction from the FEP estimated at that time (2,200 MMbbl at $30 per barrel). Specific reductions are listed as UL (22 percent), NSO (15 percent), CM (25 percent), and S (10 percent). Under this alternative, from one to three fields would be developed. Natural gas resources would not be considered for development in the reasonably foreseeable future.

Alternative B. Under Alternative D, over 95 percent of the area would be offered for leasing, but 213,000 acres in the northern (high potential) part of the Planning Area would not be available for leasing. Performance-based lease stipulations and ROPs described in Section 2.6.3 (Alternatives B and C Lease Stipulations and Required Operating Procedures) would apply. Under this alternative, oil production of 216 MMbbl to 2,054 MMbbls is estimated to occur if oil prices average between $20 and $30 per barrel. For the $25 scenario, the estimated production is 1,544 MMbbl. This represents a 47 percent reduction from the current FEP case (2,911 MMbbl; Table 4-4). The specific reductions are listed as UL (11 percent), NSO (11 percent), CM (15 percent), and S (10 percent). Under this alternative, from two to 14 fields would be developed, including a mix of large fields and surrounding satellite fields.

Alternative C. Under Alternative C, the entire Planning Area would be available to leasing. Performance-based lease stipulations and ROPs described in Section 2.6 (Lease Stipulations and Required Operating Procedures) would apply. Under this alternative, oil production of 255 MMbbl to 2,488 MMbbl is estimated to occur if oil prices average between $20 and $30 per barrel. For the $25 scenario, the estimated production is 1,855 MMbbl. This represents a 36 percent reduction from the current FEP case (2,911 MMbbl; Table 4-4). The specific reductions are listed as UL (0 percent), NSO (11 percent), CM (15 percent), and S (10 percent). Under this alternative, from two to 17 fields would be developed, including a mix of large fields and surrounding satellite fields.

Final Preferred Alternative (Alternative D). Under the final Preferred Alternative, over 95 percent of the area would be offered for leasing, but the 211,000 acre Teshekpuk Lake would be deferred from oil and gas leasing. In addition, permanent oil and gas facilities (except pipelines and publicly-funded community roads) would not be allowed on approximately 347,397 acres and no permanent oil and gas facilities, pipelines, or publicly-funded community roads would be allowed on 16,950 acres. Performance-based lease stipulations described in Section

2.6.4 (Alternative D Lease Stipulations and Required Operating Procedures) would apply. Under this alternative, oil production of 164 MMbbl to 1,727 MMbbls is estimated to occur if oil prices average between $20 and $30 per barrel. For the $25 scenario, the estimated production is 1,247 MMbbl. This represents a 58 percent reduction from the current FEP case (2,911 MMbbl; Table 4-4). The specific reductions are listed as UL (9 percent), NSO (24 percent), CM (15 percent), and S (10 percent). Under this alternative, from one to 12 fields would be developed, including a mix of large fields and surrounding satellite fields.

This alternative is considerably more optimistic about future petroleum development in the Planning Area than the Preferred Alternative adopted in the 1998 Northeast IAP/EIS ROD (the current No Action Alternative). Oil resources increase from 130 MMbbl to 164 MMbbl in the low price scenario and from 600 MMbbl to 1,727 MMbbl in the high price scenario. The increase can be attributed to an increase in the total resource endowment in the 2002 assessment, opening new areas to leasing (particularly in the high potential area north of Teshekpuk Lake), and a change to performance-based lease stipulations from the prescriptive lease stipulations adopted in the 1998 Northeast IAP/EIS ROD.

Development of Natural Gas Resources

For all alternatives, the development scenarios do not include the recovery and sale of natural gas resources. When a new transportation system is constructed from the North Slope, this assumption will be revisited. In any case, gas development would probably not occur at prices below $3.00 per Mcf (equivalent to $20 oil prices). At an average price of $3.56 per Mcf (in constant 2004 dollars), natural gas resources could be profitably produced if largely contained as associated gas in established commercial oil fields or as satellites near existing facilities. At still higher gas prices of $4.27 per Mcf (equivalent to $30 oil prices), stand-alone gas fields could become economical to develop. At this high price level it is possible that industry would purposely explore for gas prospects in the southern half of the Planning Area, which is more likely to hold large gas fields than large oil fields. A discussion of efforts to get natural gas from the North Slope to markets is in Section 4.7.3.4 (Effects of the Cumulative Case; Speculative Development). Because gas production from the National Petroleum Reserve – Alaska is beyond the time period considered in the foreseeable analysis, effects from gas development and production are not addressed in this amendment.

Permanent Roads

The scenarios for the alternatives evaluated in this amendment assume that a permanent road connecting the Planning Area oil and gas fields to the coast of the Planning Area or to potential infrastructure to the east would be unlikely. However, because the BLM believes that such a road is feasible, this amendment does not forbid construction of such roads within the Planning Area. Under the 1998 Northeast IAP, permanent roads connecting the Planning Area facilities to outside infrastructure are prohibited, without exception. However, the ADOTPF is proposing to construct an all-season gravel road from the western terminus of the Spine Road to the National Petroleum Reserve – Alaska boundary and Nuiqsut via a bridge across the Colville River (Petroleum News Alaska 2002). The Spine Road is connected to the Dalton Highway. Other proposals to develop a road from the Dalton Highway to the National Petroleum Reserve - Alaska are also being considered. If the regulatory framework of the Planning Area were to change and permanent roads within the Planning Area were built and connected to the proposed road to Nuiqsut, such a road system could theoretically support oil and gas activities in the Planning Area. 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 4.12 (Possible but Unlikely Permanent Roads).

4.2.2 Oil Spills

This section summarizes the probability, behavior, and potential impacts that might result from a variety of oil spill scenarios. The spill scenarios used in this amendment, especially for larger volume spills, are likely to overestimate, in some cases substantially, the probability of a spill and/or the potential impacts.The probability of and impacts from oil spills on the North Slope have received extensive analysis and review in several recent EISs, EAs, and other reports. Though the details differ among several of the documents, the basic data and conclusions are generally similar. We incorporate these documents by reference and summarize the key points in this amendment. Referenced documents include the following:

- Northwest National Petroleum Reserve – Alaska Final IAP/EIS (USDOI BLM and MMS 2003)
- Northeast National Petroleum Reserve – Alaska Final IAP/EIS (USDOI BLM and MMS 1998)
- Alpine Satellite Development Plan EIS (USDOI BLM 2004c)
- Liberty Development and Production Plan Final EIS (USDOI MMS 2002a)
- Beaufort Sea Oil and Gas Development/Northstar Project Final EIS (USACE 1999)
- Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right-of-Way Final EIS (USDOI BLM 2002)
- Environmental Report for the Trans-Alaska Pipeline System Right-of-Way Renewal (TAPSO 2001)
- Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (NRC 2003)
- A Review of Oil Spill Risk Estimates Based on Current Offshore Development Technologies (NSB 2003a)

Spills could occur from pipelines, production and exploration pads, airstrips, roads, and bridges. Spills that leave the pads and roadbeds could reach one or more of several habitat types, including wet and dry tundra, tundra ponds, lakes, flowing creeks and rivers, and potentially the adjacent nearshore Beaufort Sea. Spills could occur anytime during the year.

In addition to hydrocarbon spills, spills of other types of materials are reported and tracked as well. For instance, seawater spills can be quite large and have the potential to effect large areas. Seawater spills to fresh water can have significant impact. Other types of spills that are reported and tracked include spills of sewage and hazardous materials. This analysis focuses on the probability and potential impacts of spills of hydrocarbons.

4.2.2.1 History of North Slope Oil Spills

The 30-year North Slope history shows that the vast majority of the oil, produced fluids, seawater, and other material spills that have occurred have been very small (less than 10 gallons; ¼ bbl) and very few have been greater than 100,000 gallons (2,380 bbl; NRC 2003). The probability of a very large spill greater than 1 million gallons is extremely low (USDOI BLM and MMS 1998).

The recent NRC (2003) report entitled *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* summarizes the history of North Slope oil spills: "Major oil spills have not occurred on the North Slope or adjacent areas as a result of operations [of the oil fields]… Many small terrestrial spills have occurred in the oil fields, but they have not been frequent or large enough for their effects to have accumulated. They have contaminated gravel, which has been difficult to clean up and has made the gravel unavailable for rehabilitation." Appendices F and G of the same NRC report provide the most recent detailed analysis of risk, size, type, and general impacts of North Slope oil spills. These analyses are the basis for the above-quoted conclusion.

Most Alaskan North Slope spills have been contained on gravel pads and roadbeds (NRC 2003), and most of those that have reached the tundra have covered fewer than 5 acres (USDOI BLM and MMS 1998). Upon detection, spills were promptly contained and cleaned up as required by state, federal, and NSB regulations (NRC 2003). Impacts that have occurred were judged to be minor, and natural and/or anthropogenic-assisted restoration has generally occurred within a few months to years.

A key conclusion of Maxim and Niebo (2001a, b, c) is that although there continue to be oil spills on the North Slope and the total annual volume of oil spilled fluctuates substantially, there is nevertheless a general decreasing trend over the 30-year oil field operating history in the total annual volume of oil spilled. This trend is occurring despite better reporting of all sizes of spills, especially the small spills, and despite aging of much of the oil field infrastructure. Maxim and Niebo attribute this trend to improved technology, better engineering design, greater focus on clean operations, and greater awareness on the part of all the oil field personnel. Increasingly stringent federal, state, and NSB regulatory requirements for reporting spills, as well as for preparation of response plans and training, have also contributed to the declining long-term trend in total spill incidents.

4.2.2.2 Northeast National Petroleum Reserve – Alaska Oil Spill Analysis

The information, models, and assumptions used to analyze the potential for oil spills are described in Appendix K. Predicting an oil spill is an exercise in probability, based on historic data. There is uncertainty in the location, number, and size of any spills, the chemistry of spilled oil, and the environmental conditions at the time of a spill. This analysis considers the entire life of the Planning Area and much of the information in this section is reflected in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998).

The oil-spill analyses in this amendment are based on three spill-size categories: 1) small spills (< 500 bbl); 2) large spills (≥ 500 to < 120,000 bbl); and 3) very large spills (≥ 120,000 bbl). Over the lifetime of exploration and development of the Planning Area, the probability of small spills occurring is high, and small spills are expected to occur. The probability of a large spill occurring is substantially less. Large spills are not expected to occur at the $20 per bbl price during the life of the Planning Area, given the low level of exploration and development activity that would occur at prices this low, but there would likely be at least one to two large spills during the life of the Planning Area with oil prices at $30 per bbl. The probability of a very large spill occurring is very low and considered extremely unlikely.

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 range from none to effectively all of the oil. By assuming no cleanup, the estimated effects to the resources would tend to be overestimated, or greater than what would actually occur.

Large Oil Spills

Of concern to stakeholders are the potential effects of oil spills on the environment. This section summarizes the key variables used for oil-spill analysis. For details on any of these points, please refer to Appendix K.

Information on large oil spills is based on historical data from the North Slope. This introduction summarizes the assumptions used to analyze large oil spills, which are a mixture of project-specific information, modeling results, statistical analysis, and professional judgment. Spills from TAPS are included in the analysis, including the spill that occurred in 2001 when a bullet punctured the 48-inch TAPS mainline. Approximately 6,800 bbl of crude oil were released from this intentional sabotage.

The estimated mean number of large spills assumed for each alternative at the $20, $25, and $30 price per barrel of oil are shown in Table 4-7. For the purposes of this analysis, no large spills are assumed to occur at the $20 per bbl price for any of the alternatives, given the low amount of exploration and development activity predicted to occur when prices are near this level. At the $25 per bbl price, one large spill is estimated to occur for alternatives B, C, and D. At the $30 per bbl price, the number of large spills estimated to occur from gravel pad facilities or pipelines anywhere in Planning Area is 0, 1, 2, and 1 for alternatives A, B, C, and D, respectively.

The estimated chance of one or more large spills occurring at the $20 per bbl price under alternatives A, B, C, and D is 8 percent, 13 percent, 15 percent, and 10 percent, respectively, for the life of exploration and development in the Planning Area. The estimated chance of one or more large spills occurring at the $25 per bbl price under the alternatives B C, and D is 63, 69, and 55 percent, respectively, for the life of exploration and development in the Planning Area. The estimated chance of one or more large spills occurring at the $30 per bbl price under the alternatives A, B, C, and D is 32, 73, 80, and 67 percent, respectively, for the life of exploration and development in the Planning Area. For all alternatives, the most likely number of large spills at the $30 per bbl price would be from zero to two.

Table 4-7. Assumed Large (≥ 500 barrels) Crude Oil Spills for Life of the Northeast National Petroleum Reserve – Alaska.

Alternative	Estimated Number of Large Spills	Estimated Total Large Spill Volume (bbl)	Percent Chance of One or More Large Spills
Crude Oil at $20/bbl			
A	0.08	0	8
B	0.14	0	13
C	0.16	0	15
D	0.10	0	0
Crude Oil at $25/bbl			
A	NA	NA	NA
B	0.99	500 or 900	63
C	1.19	500 or 900	69
D	0.80	500 or 900	55
Crude Oil at $30/bbl			
A	0.38	0	32
B	1.31	500 or 900	73
C	1.59	1,000 or 1,800	80
D	1.11	500 or 900	67

NA – Not analyzed in the 1998 Northeast IAP/EIS.
The estimated number of oil spills is based on the estimated volume of resources multiplied by the Alaska North Slope spill rate. See Appendix K for a detailed explanation.

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. For Alternative C, it is assumed that two such spills could occur. A large spill from a Planning Area facility or pipeline could happen at any time during the year. Scenarios were 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.

Based on modeling, the large spill scenario (500 bbl) assumes that after 30 days in open water or broken ice, 23 to 40 percent of the oil evaporates, 0 to 22 percent disperses, and 38 to 77 percent of the oil remains. After 30 days under ice in a lagoon or lake, nearly 100 percent 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 4-7;
- All the oil reaches the environment and 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 that of Alpine field oil;
- The spill could occur at any time of the year;
- A spill under a lagoon or lake ice from Planning Area facilities or pipelines does not move substantially until the ice breaks up; and
- Spill locations and dates used in the analyses are those that would result in the greatest impact.

Small Oil Spills

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 4-8. For this analysis, 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; and
- Small spills from pipelines are likely to reach the environment.

Onshore or offshore refined-oil spills could occur along ice roads, or from barges, helicopters, airplanes, gravel pad facilities, or trucks along the road system. Typical refined products spilled on the North Slope are aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. On the North Slope, diesel spills account for 61 percent of refined oil spills by frequency and 75 percent by volume.

At the $20 per bbl price, the estimated number of small crude oil/refined oil spills for alternatives A, B, C, and D, are 23/57, 38/95, 45/112, and 29/72, respectively. At the $25 per bbl price, the estimated number of small spills for alternatives B, C, and D are 275/679, 330/816, and 222/549, respectively. The assumed number and sizes of small spills occurring under the $30 per bbl scenario for alternatives A, B, C, and D are listed below.

Offshore or onshore crude oil:

- 79, 270, 327, and 227 spills less than 1 bbl;
- 26, 90, 109, and 76 spills greater than or equal to 1 bbl and less than 25 bbl;
- Two, five, six, and five spills greater than or equal to 25 bbl and less than 500 bbl; and
- An estimated total small crude oil volume of 321, 1,098, 1,329 bbl, and 921.

Onshore or offshore refined oil:

- 264, 904, 1,095, and 760 spills of 0.7 bbl (29 gallons) each; and
- An estimated total small refined oil spill volume of 185, 633, 766, and 532 bbl.

4.2.2.3 Spills Associated with Gas-Only Development

Gas-only development is not considered in this oil spill analysis. Nonetheless, it is not expected that a large oil spill would occur in association with natural gas production in the Planning Area. The effects of a release of small quantities of condensate liquids from a gas pipeline rupture would be expected to be the same as those associated with a small refined-petroleum spill.

Table 4-8. Assumed Small (<500 barrels) Crude/Refined Oil Spills for Life of Northeast National Petroleum Reserve – Alaska.

Alternative	Estimated Number of Small Spills[1]	Estimated Total Small Spill Volume (bbl) [1]	Percent Chance of One or More Small Spills
Crude Oil at $20/bbl			
A	23/57	69/40	>99.9
B	38/95	114/66	>99.9
C	45/112	135/78	>99.9
D	29/72	87/50	>99.9
Crude Oil at $25/bbl			
A	NA/NA	NA/NA	NA
B	275/679	825/475	>99.9
C	330/816	990/571	>99.9
D	222/549	666/384	>99.9
Crude Oil at $30/bbl			
A	107/264	321/185	>99.9
B	365/904	1,098/633	>99.9
C	442/1,095	1,329/766	>99.9
D	307/760	921/532	>99.9

[1] The first number is for crude oil spills, while the second number is for refined oil spills.
NA – Not analyzed in the 1998 Northeast IAP/EIS.
The estimated number of oil spills is based on the estimated volume of resources multiplied by the Alaska North Slope spill rate. See Appendix K for a detailed explanation.

4.2.2.4 Fate and Behavior of Spilled Oil

This section describes the properties and behaviors of spilled oil that must be considered when evaluating the potential effects of an oil spill in the various environments of the Planning Area.

Fate and Behavior

The primary processes that affect the fate of spilled oil are spreading, evaporation, dispersion, dissolution, and emulsification (Boehm 1987; Payne et al. 1987; Lehr 2001). These processes, collectively called weathering, dominate during the first few days to weeks of a spill, and, with the exception of 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. However, these 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 (i.e., occurring in 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 spreading of oil on water reduces the bulk quantity of oil present in the vicinity of the spill, but increases the spatial area over which effects from oil may occur. Thus, oil in flowing systems (as opposed to contained systems) would 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 the 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 major process controlling the oil's fate in the environment. However, 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, the incorporation of water into oil, is the opposite of dispersion. During emulsification, external energy from wave action causes small drops of water to become surrounded by oil. In general, heavier oils emulsify more rapidly than lighter oils. The emulsified 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 an important factor in causing the disappearance of a slick, especially one composed of lighter products and constituents; however, it is less important during cloudy days and can be nonexistent during the winter months on the North Slope. Photodegraded constituents of petroleum products tend to be more soluble and more toxic than their parent compounds. Therefore, extensive photodegradation, like dissolution, may increase the biological impacts of a spill event.

In the immediate aftermath of a spill, natural biodegradation of oil is not typically an important 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, because the environmental fate of released oil is controlled by many factors, its persistence is difficult to predict with great accuracy. Besides the primary processes discussed in the preceding paragraphs, 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. For example, because of their properties, both diesel and refined oil evaporate at a substantially faster rate than crude oil.

The characteristics of the receiving environment, such as type of land; the surface gradient; and whether it is marine or freshwater, surface or subsurface, spring ice overflow, summer open water, winter under ice, or winter broken ice, would affect how the spill behaves. In ice-covered waters, many open water weathering processes occur; however, the ice changes the rates and relative importance of these processes (Payne et al. 1991).

The time of year in which a spill occurs also has a major effect on the fate of the crude oil, as it is linked to 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 that it modifies the viscosity of the oil, limiting its spreading, and sometimes even causing it to gel. The lower the ambient temperature, the less crude oil evaporates, as demonstrated experimentally by both Prudhoe Bay and Endicott crudes (Fingas 1996). Frozen ground limits the depth of penetration of any spill, and ice acts as a barrier to penetration until it melts.

Spills on Tundra

Oil movement over the ground surface follows the topography of the land (i.e., oil flows downhill). In general, oil flows until it reaches a surface water body or a depression, or until absorption prevents further movement. Oil flowing over land can infiltrate vegetative cover, soil, and snow. If released onto tundra, oil can penetrate the soil as a result of the effects of gravity and capillary action, with the rate of penetration depending on the season, the nature of the soil, and the type of petroleum product. In summer, spills can penetrate the active layer (the layer of soil and rock that thaws each summer and freezes each winter, which overlies the permafrost layer of permanently frozen soil and rock) and then spread laterally on the frozen subsurface, accumulating in local downturns. From there, the oil can penetrate into the permafrost (Collins et al. 1993). Precipitation may increase penetration into thawed soils/active layer (Solntseva 1998 *in* Chuvilin et al. 2001).

In winter, when the ground and water surfaces are frozen, 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. Therefore, oil tends to spread on the surface of the frozen soil, and penetration of oil into the soil is limited. However, any soil pore space 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 much of 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 a depth of 0.5 to 2.3 inches (Miller et al. 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to limit the spread of oil, with both vegetation and peat functioning as sorbents that allow water to filter through, trapping the more viscous oil (Barsdate et al. 1980), but 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, pressurized 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). Additionally, in late May or early June, the ice in the northern Alaska rivers breaks up, causing a rapid flood event termed “breakup,” that, combined with ice and snow damming, can inundate large areas in a matter of days. A spill during breakup could be spread over a significantly larger area by the flooding water.

Spills into Water

Oil spreading on the water surface (but not necessarily the transport of oil by moving water) would be restricted in most Planning Area waters. Because of the increased viscosity (a property that reduces spreading) of oil in cold water, oil spills in Planning Area lake, river, and marine waters would spread less than those in temperate fresh or marine waters. The exception to this rule would be a spill in shallow, marshy, or ponded tundra or flooded lake margins during summer, which could spread similarly to a temperate spill. These shallower waters can reach temperatures up to 64 °F, which is generally warmer than other tundra waters (Miller et al. 1980), and warm enough to lower oil slick viscosity.

Oil spilled onto the ice surface is prevented from spreading rapidly by the presence of snow and natural small-scale ice roughness (Dickins et al. 2000). An oil spill in broken ice would not spread as far as one in open water. Oil would spread between ice floes into any gaps greater than about 3 to 6 inches (Free et al. 1982). Environmental conditions can be highly variable during fall freeze-up and spring break-up. The environmental conditions encountered during freeze-up are different than those encountered during break-up, and the behavior of ice during break-up and freeze-up is complex, varying greatly from year to year and from site to site. Additionally, at freeze-up and break-up, the timing and duration of ice break-up, and ice formation/decay processes differ greatly between shallow nearshore locations and deeper water sites (Dickins et al. 2000).

An oil spill under ice typically behaves in the general manner described below:

- The oil rises to the under-ice surface and spreads laterally, accumulating in the under-ice cavities. Because of under-ice storage capacity and low under-ice currents, oil spilled under stable landfast ice does not spread more than a few hundred feet from the spill site.
- For spills occurring when the ice sheet is still growing (typically from freeze-up until April), the pooled oil is encapsulated in the growing ice sheet. The presence of any substantial coverage of developing ice limits the spreading of spilled oil, as compared to a similar spill in open water.
- During break-up, as the ice begins to deteriorate, the encapsulated oil rises to the surface through brine channels in the ice (Glaeser and Vance 1971; Keevil and Ramseier 1975; NORCOR Engineering and Research 1975; Purves 1978; Martin 1979; Dickins and Buist 1981; Kisil 1981; Buist and Dickins 1983; Comfort et al. 1983; Dickins et al. 2000).

The spread of oil under ice can be affected by the presence of currents, if the magnitude of those currents is large enough. Laboratory tests have shown that currents in excess of 6 to 10 inches per second 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 4 inches per second during the winter (Weingartner and Okkonen 2001), speeds that were shown to be insufficient to strip oil from under an ice sheet after the oil had ceased to spread in field study near Cape Parry in the Northwest Territories (NORCOR Engineering and Research 1975). The area of contamination under ice could increase if the ice were to move. However, because the nearshore Beaufort Sea is in the landfast ice area, the spread of oil due to ice movement would not be anticipated until spring breakup.

With knowledge of the time of year and the expected ice conditions, one can predict the likely configuration of oil spilled under, in, on, or among ice with a fair degree of confidence, which can be used to plan appropriate strategies for monitoring and responding to spills (Dickins et al. 2000).

Weathering processes generally would be similar in freshwater and coastal marine regimes, with seasonal ice cover capable of greatly slowing weathering in both regimes. During winter, weathering of oil depends primarily on whether the oil is exposed to the atmosphere.

Evaporation of oil generally correlates to temperature, with lower temperatures linked to slower evaporation rates of crude oil (Fingas 1996). Oil between, or on, ice is subject to normal evaporation; oil that is frozen into the underside of ice, however, is unlikely to undergo any evaporation until the spring, when the deterioration of multi-year ice causes the encapsulated oil to rise to the surface through brine channels in the ice. For oil spilled during freeze-up, with the likely absence of wave action, evaporation is the only major weathering process (Dickins et al. 2000). Evaporation occurs as oil is released to the surface. Because freshwater and first year ice do not have enough salts to form brine channels, oil is released only as the ice surface melts to the level of the encapsulated oil. For freshwater ice, evaporation occurs when the ice becomes 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, oil typically does not surface until August, with some oil not released until the following summer.

Dispersion of oil spills in water 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 crude oil may adhere to porous ice floes, essentially concentrating oil within the floe field and limiting the oil dispersion. North Slope crude oil readily emulsifies to form stable emulsions, a process that is sometimes increased in the presence of ice. With floe grinding, Prudhoe Bay crude forms a mousse within a few hours and much more rapidly than in open water.

In most cases, the weathering processes acting on oil in and along streams or rivers are 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 begins to spread as in freshwater or marine spills, but the spreading motion is rapidly overcome by the surface current, at which point an elongated slick forms. The oil flows downstream at the speed of the current in the absence of wind effects. In general, oil tends 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 flows 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 remains 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 continuously exchanges 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 is 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 large 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.

The National Petroleum Reserve – Alaska Oil-Spill Experiment

In July 1970, 5 bbl of Prudhoe Bay crude was experimentally spilled in a 0.07-acre tundra pond in the National Petroleum Reserve – Alaska near Barrow (Miller et al. 1978; Barsdate et al. 1980; Hobbie 1982). The general behavior of this experimental spill is instructive about what would be expected from a small spill in the Planning Area during the summer, or from 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-foot 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 partway 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 substantial 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.

4.2.2.5 Spill Prevention and Response

Each permittee operating on the National Petroleum Reserve – Alaska is required to develop and operate in compliance with an approved Oil Discharge Prevention and Contingency Plan, as defined in Lease Stipulation 9 and ROP A-3. The plan must describe the spill prevention measures as well as spill response procedures. Each permittee is required to have sufficient trained personnel and clean-up equipment and supplies available to meet federal, state, and NSB regulations. Sufficient equipment and trained personnel must be available at the site of the activity to provide immediate spill response. Additional equipment and personnel from other locations can be used, such as equipment and personnel made available through Mutual Aid Agreements from other spill response contractors, other North Slope oil fields, North Slope communities, or other sources. Each permittee is also required to have proof of financial responsibility from the State of Alaska (18 AAC 75.240).

In the context of spill prevention, an activity site is an exploration site, drilling site, or production site, each with its ancillary facilities. Federal regulations that must be met include BLM oil and gas operating regulations (43 CFR § 3160, Onshore Order Numbers 1, 2, and 6). These regulations address the prevention and control of oil spills and releases. Regulations 40 CFR § 110 and 300 address responses to spills or releases of oil and gas. Spill response requirements would be thoroughly addressed at the site-specific permit level. For example, an Application for

Permit to Drill would be evaluated for spill response regarding chemicals on site and blowout prevention equipment. These requirements are addressed in Onshore Order No. 2. The Alaska Oil and Gas Conservation Commission (AOGCC) is responsible for hydrogen sulfide (H_2S) planning for drilling operations, and Onshore Order No. 6 addresses anticipated H_2S releases. These conditions are all very site-specific. U.S. Coast Guard regulations may also apply to the transportation and transfer of oil to or from barges or vessels. Alaska Statutes Title 46, chapters 3 and 4 provide the ADEC with the authority to prevent and respond to oil discharges. 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 the Alaska Administrative Code (18 AAC § 75).

A spill response plan includes an action plan and a list of contacts in local, state, and federal agencies with direct responsibilities in the event of a spill, as well as 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 the BLM and the AOGCC require an operator to maintain well control at all times during drilling and production. The BLM has been delegated the authority to ensure that a drilling well is under control. In the unlikely event that control of the well were to be lost (e.g., a blowout), the BLM would oversee 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 for specific violations. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or a participating area, the BLM has the authority to cite the operator and direct cleanup of the spill. However, cleanup would be completed in cooperation with other federal or state agencies.

For spills on most lands within the state, ADEC is responsible as the On-Scene Coordinator (OSC). The USEPA serves as the OSC for spills that reach inland waters, and the U.S. Coast Guard 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 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 on what additional measures must be taken.

An exploration or production facility operator is required to include plans for the control and containment of spills, including blowouts, in the 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 can be considered and may be used, upon approval, in appropriate circumstances. The 1999 U.S. Coast Guard Caps Review recognizes in situ burning as "the only effective countermeasure for broken ice conditions."

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 non-crude oil), an oil tank vessel or oil barge, a non-tank 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).

Facilities that must have an ADEC-approved contingency plan must meet oil discharge prevention requirements found in 18 AAC § 75.005 - 75.090. Required prevention measures include training programs, operating procedures, monitoring, inspections, and equipment/facility specifications. All crude oil transmission pipelines must meet the leak detection, monitoring, and operating requirements of 18 AAC 75.055.

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. Environmental conditions can sometimes limit response work. Severe weather conditions in the Arctic, such as broken ice and extreme wind, can pose challenges to spill cleanup and containment. Realistic maximum response operating limitations must be taken into account in spill planning (18 AAC 75.425(3)(D)).

Operators of facilities that must have an approved contingency plan and operators who drill for shallow natural gas (3,000 feet below ground surface or less) are also required by ADEC to provide acceptable proof of financial responsibility for the cleanup of oil spills (18 AAC 75.240).

4.3 Alternative A (No Action Alternative)

The following four sections described the likely direct and indirect effects to natural, cultural, and socioeconomic resources for the Planning Area under each alternative. For the resources discussed in the following sections, a single value, or a range of values, are given to describe the amount of area that could be impacted by oil exploration and development. If a range of values is given, it represents the level of oil exploration and development, and associated resource impacts, for oil prices of $20 per bbl and $30 per bbl. The range of values better describes the types of impacts that could occur if oil prices are higher, or lower, than predicted to occur during the life of the amendment. If a single value is given, or a value is enclosed in parentheses after a range of values, it represents the level of oil activity, and associated resource impacts, projected to occur if oil prices average $25 per bbl during the life of the amendment. As discussed in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), the development of natural gas fields in the Planning Area is unlikely in the foreseeable future. Thus, the impacts associated with gas development on the North Slope are not discussed in this amendment.

Alternative A, the No Action Alternative, is comprised of decisions established in the ROD for the 1998 Northeast IAP/EIS. The decisions constitute the existing management practices of the Northeast National Petroleum Reserve – Alaska. Under this alternative, management practices would emphasize prescriptive-based restrictions on surface activities, consultation with local residents, and coordinated scientific studies to protect wildlife habitat, subsistence use areas, and other resources. At the same time, approximately 87 percent (4 million acres) of the Planning Area's 4.6 million acres would be available for oil and gas leasing (Map 2-1). The prescriptive-based lease stipulations developed for this alternative in the 1998 Northeast IAP/EIS ROD are listed in Appendix E. Appendix F (Standardized Stipulations Applied to Mitigate the Impacts of Non-Oil and Gas Authorizations) lists lease stipulations that apply to all non-oil and gas-related activities conducted for the No Action and action alternatives. Table 2-2 compares and evaluated the effectiveness of the prescriptive-based lease stipulations developed for this alternative with the performance-based lease stipulations developed for the final Preferred Alternative and alternatives B and C.

4.3.1 Air Quality

4.3.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, the ground-impacting activities that would affect air quality would be the same as those described in the 1998 Northeast IAP/EIS: helicopter and fixed-wing aircraft activity. These activities would have only a transitory effect on local air quality. Approximately 1,250 non-operational flights (i.e., flights associated with environmental studies, environmental monitoring, surveys, and agency tours) currently occur each summer season at the Alpine field (USDOI BLM 2004c). Additional flights would originate out of Deadhorse, Prudhoe Bay, Barrow, and other airfields on the North Slope.

4.3.1.2 Oil and Gas Exploration and Development Activities

Effects of Routine Emissions

The following air pollutants would be produced during activities conducted under this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOCs).

Nitrogen oxides consist of both nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrogen oxides (NO_x) are formed from oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, slowly oxidizes in the atmosphere to form NO_2. Nitrogen dioxide and VOCs perform a vital role in the formation of photochemical smog, and NO_2 is recognized as a threat to human health. 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 VOCs to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with photochemical smog. Nitrogen oxides can slowly convert to form nitrates that are present in the atmosphere as fine particulates. These small particles form haze and reduce visibility, contribute to the formation of acid rain, and are potentially inhaled deep into lung tissue.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle 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 during the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce a 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 precipitation (acid rain) in the northeastern U.S.

Emissions of PM associated with combustion consist of particulates, especially those ranging in size from 1 to 3 microns in diameter, can cause health effects. Particulates in the atmosphere also tend to reduce visibility.

The types and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity. During the exploration phase, emissions would be produced by: 1) diesel-power-generating equipment required for drilling exploratory and delineation wells; 2) trucks and other vehicles used in support of drilling activities; and 3) intermittent operations such as mud degassing and well testing. Pollutants would consist primarily of NO_x (although both NO and NO_2, would be generated, ambient air standards are set only for NO_2), CO, and SO_2.

During the development phase, the primary emission sources would be: 1) piston-driven engines or turbines used to provide power for drilling; 2) heavy construction equipment used to install modules and pipelines; and 3) various vehicles and aircraft. The principal development-phase emissions would consist of NO_2 with lesser amounts of SO_2, CO, and PM. Based on estimates developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) for the No Action Alternative are projected as follows: NO_x (13.3), SO_2 (1.5), CO (3.0), and PM_{10} (0.7).

Construction and production activities can produce fugitive dust emissions. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations in the winter as well as during the summer months. Because excessive fugitive dust can adversely affect human health and the environment, concentrations are controlled by state and USEPA air quality standards. Control measures include posting speed limits and watering road surfaces.

Aircraft would bring materials and crew to the development sites. Based on assumptions developed for the Alpine Satellite Development Plan, an estimated 40 to 70 one-way aircraft flights each month would be needed initially to service a CFP and associated satellite fields (USDOI BLM 2004c). At the peak of construction activities, the number of flights occurring each month could increase to as many as 340. These flights could generate up to 0.6 tons of CO, 0.07 tons of NO_x, 0.4 tons of VOCs and other hydrocarbons, and 0.02 tons of SO_x annually.

During the production phase, the primary source of emissions would be power generation for heating, oil pumping, and water injection. The emissions would consist primarily of NO_2, with smaller amounts of CO and PM. Another source of air pollutants would be evaporative losses of VOCs from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOCs and SO_2. Clean Air Act standards would be used to establish the maximum concentrations of allowable pollutants for each operation proposed. For the Alpine Satellite Development Plan, maximum annual emissions (in tons) during operation are projected as follows: NO_x (742), SO_2 (9.7), CO (212), and PM_{10} (7.3; USDOI BLM 2004c). The amount of emissions generated under the No Action Alternative would be about half these levels.

Other sources of pollutants related to operations would include accidents such as blowouts and oil spills. Typical emissions from accidents consist of hydrocarbons; only fires associated with blowouts or oil spills produce other pollutants.

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Federal and state statutes and regulations define air quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (Table 4-9). 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_x, 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 classes (I, II, and III) of PSD areas, with Class I allowing the least degradation. Mandatory federal PSD Class I Areas allow only minor increases in air pollution. Class I Areas have special provisions to protect Air Quality Related Values (AQRV), such as visibility and atmospheric deposition (acid rain). The Planning Area is a Class II Area, which allows for an incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska prior to issuance of air quality permits. Air quality standards do not directly address all other potential air quality effects such as acidification of precipitation and freshwater bodies, or effects on non-agronomic plant species.

Effects of Accidental Emissions

Accidental emissions could result from gas blowouts and evaporation of spilled oil, and burning of spilled oil. Soot from a fire is considered to be the major contributor to pollution from a fire event. This soot, which would be deposited on plant materials in the vicinity of the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Accidental emissions, therefore, should have a minimal and temporary effect on onshore air quality.

Effects of Air Pollution

Other effects of air pollution from activities and other sources on the environment not specifically addressed by air quality standards include the possibility of damage to vegetation and acidification. Effects could be short term (hours, days, or weeks), long term (seasons or years), local, or regional (North Slope).

A large increase in ozone concentration would not be likely to result from the exploration, development, or production scenario associated with the No Action Alternative. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the sale area most of each day during the summer, temperatures remain relatively low. Also, activities that would occur as a result of the field-development scenario would be separated from each other, diminishing the combined effects.

Table 4-9. Relevant Ambient Air Quality Standards (measured in µg/m3).

Pollutant[1]	Averaging Time Criteria (µg/m^3)					
	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Carbon monoxide	*	*	10,000	*	40,000	*
Ozone[2]	*	*	157	*	253[3]	*
Nitrogen dioxide	100[4]	*	*	*	*	*
Class II[4]	25[4]	*	*	*	*	*
Inhalable particulate matter (PM_{10})[5]	50[6]	150[7]	*	*	*	*
Class II[4]	17	30	*	*	*	*
Lead	1.5[8]	*	*	*	*	*
Sulfur dioxide	80[9]	365	*	1,300	*	*
Class II[4]	20[9]	91	*	512	*	*
Reduced sulfur compounds	*	*	*	*	*	50

[*] Indicates that no standards have been established.
[1] Averaging times not to be exceeded more than once each year, except that annual means may not be exceeded.
[2] The state ozone standard compares with national standards for photochemical oxidants, which are measured as ozone.
[3] The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an “expected exceedance during a year.”
[4] Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations.
[5] PM_{10} is the particulate matter less than 10 micrometers in aerodynamic diameter.
[6] Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 µg/m^3.
[7] Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m^3, as determined in accordance with 40 CFR § 50, subpart K, is equal to or less than 1.
[8] Maximum arithmetic mean averaged over a calendar quarter.
[9] Annual arithmetic mean.
Source: State of Alaska (2004); 18, 80 AAC § 50.010; 18 AAC § 50.020; 40 CFR § 52.21 (43 FR § 26388); 40 CFR § 50.6 (52 FR § 24663); and 40 CFR § 51.166 (53 FR § 40671).

4.3.1.3 Effectiveness of Stipulations

There are no lease stipulations for air quality for the No Action Alternative.

4.3.1.4 Conclusion

The effects on air quality from the No Action Alternative should result in air emissions that are below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within state and federal air quality standards. Consequently, a minimal effect on air quality with respect to standards is expected. Air emissions associated with exploration and development would be approximately 50 percent less than those associated with the final Preferred Alternative and alternatives B and C. Air emissions associated with oil production would be approximately one-half to one-third those associated with the other three alternatives. Each new exploration or development activity, or production area, would result in an additive increase in air emissions. However, as exploration and development activities cease, or production sites are shut-down, there would be a corresponding decrease in air emissions.

4.3.2 Paleontological Resources

Paleontological resources (plant and animal fossils) are nonrenewable. Once they are impacted or displaced from their natural context, the damage is irreparable. While much of the Planning Area is underlain by paleontological resources, most of these resources are of the marine plant and invertebrate variety and are so numerous that the potential impacts addressed here do not present a substantial threat. Vertebrate fossils are much less common and are more likely to be impacted by the activities associated with oil and gas exploration and development.

4.3.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, some paleontological research and excavation could be conducted annually by permit within the Planning Area. Excavation is a destructive activity; however, it is necessary for the recovery of scientific data. Excavation and collection normally occur during the summer, and are typically the result of paleontological and geological research; however, on occasion paleontological material has been inadvertently discovered as a result of archaeological research. Most paleontological material is buried considerably deeper than archaeological material and is therefore not regularly encountered by chance. Some Pleistocene-age animal remains could be recovered in archaeological deposits if the deposit were old enough. In such situations, the remains would represent subsistence use of the animal(s) by humans. The faunal material would be considered part of both the archaeological record and the regional paleontological record.

Aircraft and watercraft traffic, summer camps, hazardous and solid waste material removal and remediation, overland moves, and recreation associated with non-oil and gas activities would all have effects on paleontological resources. Aircraft use would not directly affect paleontological resources; however, it could have an indirect effect by making paleontological resources more accessible to recreation and other users, which can lead to illegal collecting and inadvertent damage.

The temporary summer field camps commonly associated with scientific or resource assessment work, hunting, or river float trips generally impact relatively small areas. Therefore, such camps and the activities associated with them, such as aircraft use, on-the-ground survey and reconnaissance, hazardous and solid-waste material removal, site remediation, and recreation, would have only a minor effect on paleontological resources.

4.3.2.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

The drilling of exploration wells and delineation wells would occur during winter. Because of the limited availability of drill rigs, it is expected that no more than a few wells would be drilled at any one time. Drill pads, camp pads, roads, and airstrips made of ice and snow would be used, but no permanent pads, roads, or airstrips would be constructed; therefore, no major ground disturbance would occur and buried paleontological material would not be impacted. The only substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Were scientifically important paleontological material present at the site of the borehole, these resources could be impacted by the drilling practice. However, the likelihood of such an occurrence is negligible.

Surface disturbance from construction of CPFs and associated satellite pads, roads, airstrips, pump station, and gravel pits could impact from 130 to 505 acres. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. Extraction of gravel materials could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining operations on the North Slope. It is anticipated that the pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs were set it is possible, though highly unlikely, that paleontological resources would be impacted.

If a pipeline was placed underground, an additional 1.5 acres per pipeline mile would be disturbed. Overall, disturbance from development would have a very low probability of impacting paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities, as these areas would have been previously disturbed by construction and development activities.

Effects of Spills

An estimated 65 to 80 percent of all spills are confined to a pad, with the remainder generally confined to an area adjacent to the pad. During exploration, it is assumed that most spills would occur on an ice pad or ice road during winter conditions, resulting in cleanup that is less invasive than the cleanup required by a spill on land during summer. Paleontological resources typically 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 would occur during the snow-free months. Although cleanup from the spills could be more invasive because the ground surface would not be frozen, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological material could be impacted as well. However, since the occurrence of important paleontological remains is rare, the probability of an impact is minor.

4.3.2.3 Effectiveness of Stipulations

The lease stipulations associated with waste prevention, handling and disposal, spills, overland moves, and seismic work generally reflect the standard lease stipulations the BLM commonly attaches to permits for seismic survey activities in the Planning Area. The agency would generally continue to impose these restrictions under the No Action Alternative.

Lease Stipulations 24, 67, and 70 would provide protection from seismic and overland move activities that could potentially impact paleontological resources near the ground surface. Within the Planning Area, paleontological resources are most diverse and abundant along the Colville and Ikpikpuk rivers. Lease Stipulation 39 would prohibit the construction of permanent oil and gas facilities within and adjacent to waterbodies, which would protect exposed paleontological resources along the banks of the Colville and Ikpikpuk rivers. Lease Stipulation 74 would protect previously unknown paleontological resources by requiring a paleontological survey prior to any ground-disturbing activity. If paleontological material were discovered, all operations would be suspended until written authorization to proceed was issued by the appropriate authority. These lease stipulations would be highly effective in protecting known and previously unknown paleontological resources and preserving their research potential, and ensuring that impacts to paleontological resources would be minor.

4.3.2.4 Conclusion

Most paleontological material is deeply buried and is therefore not regularly encountered by chance. The drilling of exploration wells and delineation wells would occur during winter and these activities would have a minor impact on paleontological resources. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities, but surveys for paleontological resources would be conducted before excavation and similar ground-disturbing activities could take place. Overall, both non-oil and oil-related activities within the Planning Area have a very low probability of impacting paleontological resources.

Impacts to paleontological resources from non-oil and gas activities, and from oil and gas activities would likely be additive, except in those areas where the two activities overlapped. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to paleontological resources from oil development under this alternative would be about one-fifth of the potential for impacts under the action alternatives, although the potential for impacts would be greater if exploration and development activities occurred in an area with an abundance of paleontological resources.

4.3.3 Soil Resources

4.3.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Ground-impacting management actions within the Planning Area that could affect soils under the No Action Alternative include aircraft use (landing and take off), use of OHVs, and other ground-disturbing activities. Where activities did not alter vegetative cover, there would generally be only a small impact on soils. However, where these activities concentrated surface disturbance (e.g., foot traffic around a landing site or repeated snowmachine crossing of a drainage channel at the same site), there could be damage to the soils. If the vegetative cover or surface organic mat was removed or disturbed, soil erosion could occur. Soils naturally thaw during the warm months, resulting in an "active layer" to a depth of 10 to 18 inches, with variation based on location, aspect, vegetation type, soil makeup, and amount of contained water. Generally, the loss of vegetation cover would cause the greatest change in the thermal balance. Soils containing ice could lose volume when thawing, resulting in subsidence, thermokarsting, and gullying.

Upon removal of the organic mat, soils would be transported by wind and water, which could deposit sediment into sensitive areas. Impacts from soil excavation and removal activities would be localized and probably not widely distributed. For soils containing large amounts of ice, however, the impacts would be much broader. When warmed, ice-rich permafrost soils could slump and release melted water, which would then pond. Ponded water absorbs more radiant energy and increases the area of warming soils. This form of disturbance would continue well beyond the initial disturbance and take several years to stabilize.

Off-runway landings by private or commercial wheeled aircraft could cause short-term damage to soils on the landing sites. However, most wheeled aircraft landings would occur on sand or gravel bars, or possibly on dry gravelly ridges. Impacts from such landings should be minor and sporadic in occurrence.

The use of OHVs, such as four-wheel vehicles and snowmachines, could cause localized impacts to tundra. Use of snowmachines use during the winter, when the ground is frozen and there is adequate snow cover, would have little or no impact to the soils. The use of snowmachines during fall or spring, or in areas without adequate snow cover, could result in damage to soils, leading to thermokarst. Similarly, use of four-wheel vehicles on tundra could churn soil in the upper portion of the profile, leading to thermokarst in wet tundra.

4.3.3.2 Oil and Gas Exploration and Development Activities

Embankments, such as work and camp pads, roads, and pump stations made from sand, gravel, or rock fragments, completely cover the natural soils. Landscape scarring resulting from working material sites, conventional pipeline construction, digging, excavation and placement of fill is particularly damaging in the Arctic because of the slow rate of pedogenesis (soil formation). Soils in the Planning Area are subjected to cold and anoxic conditions that retard pedogenesis, allowing exposed mineral soil layers to persist for decades.

Effects of Disturbance

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months. Seismic exploration would cause impacts to soils similar to those described for exploration. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. The maximum area impacted by seismic lines could be approximately 6,060 acres (250 miles long by 200 feet wide), although it is likely that not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would be made by camp move vehicles, which would traverse about 30 miles. Trails would also be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer-lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance and thus would impact a path 30 feet wide. Assuming 30 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, 500 acres could be impacted during a 25-year period. Thus the total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys; camp move trails would impact about 500 acres of tundra per survey. It is anticipated that two to four 3-D surveys would occur in the Planning Area during a 25-year period, impacting 1,000 to 2,000 acres by camp move vehicles and 98,880 to 197,760 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soil than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, moderate and high-level disturbances would likely be more frequent with 3-D surveys.

Overland moves and seismic surveys could alter the thermal balance, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, surface travel could be come more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

Exploration

During exploration, the construction of ice pads for drilling exploratory or delineation wells and ice roads for accessing the pads could impact soils in the Planning Area. Placement of fill directly on the tundra surface would decrease the porosity and permeability of the underlying soil. Soil compaction resulting from on-road vehicle traffic could increase localized ponding and permafrost degradation. Degradation of permafrost beneath heated infrastructure would initiate or exacerbate any impacts to the structural integrity of the overlying improvements. In general, ice road and ice pad construction would have only localized impacts on soils, which would usually be limited to compression of the tundra under the roads and pads. It is estimated that, on average, there would be 50 miles of ice road through the Planning Area on an annual basis, impacting approximately 212 acres.

Multi-year ice pads could be used in a second winter, but would require insulation to prevent melting during the spring and summer. Some melting would likely occur around the perimeter of the pad, causing vegetation in this area to break dormancy. If plants breaking dormancy were covered by an insulating layer or by timbers or other material used to hold the cover in place, they would die from the lack of sunlight (Noel and Pollard 1996, Hazen 1997, McKendrick 2000). The death of plants around the perimeter of a typical ice pad (500 feet by 500 feet) would impact about 6 acres of soil. Furthermore, the construction of well collars during exploration would require a hole to be dug, destroying vegetation on approximately 16 square feet (0.006 acres) of ground. As a result, soil loss and thermokarsting would likely occur.

Under the No Action Alternative, it is assumed 6 to 21 exploration wells and 4 to 17 delineation wells, for a total of 10 to 38 wells, would be drilled from ice pads in the Planning Area. Minor impacts to soils would occur on 60 to 228 acres over a period of about 25 years.

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, roads, pump station, and airstrips would result in the loss of soil productivity in areas where gravel was placed. Under this alternative, one to three fields would be developed, resulting in a total of 110 to 415 acres of soil being covered by gravel.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in the soil near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, for a total of 200 to 600 acres under the No Action Alternative.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the National Petroleum Reserve – Alaska have been limited primarily to the sources near the Alpine field, including the ASRC Mine Site and Clover Potential Gravel Source (see Section 3.2.8.2, Gravel Mine Sites), but additional investigations would be initiated if discoveries of recoverable oil and gas were made. It is possible that one to three gravel mine sites could be necessary, impacting a total of 20 to 90 acres, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would impact soil productivity at gravel extraction sites.

Pipelines

Pipelines on the North Slope are typically built on VSMs with a diameter of 12 inches and a spacing of 55 to 70 feet. In addition to the vegetation displaced by the VSM, installation of VSMs would disturb a zone approximately 20 inches wide around the VSM. This zone of disturbance would result from overburden deposited around the VSMs and from thermokarst, which could result in a change in species composition around the VSMs. Approximately 0.03 acres of soil would be disturbed per pipeline mile. Under the No Action Alternative, 0.6 to 3 acres of soil would be disturbed by VSMs.

In areas where pipelines were buried, construction of a trench would impact soil and temporary storage of overburden in adjacent areas would alter soil in adjacent areas where temporary storage of the overburden occurred. The zone of impact would be approximately 12 feet wide for the length of the buried segment, and the total area of impact would be 1.5 acres per pipeline mile. Because pipeline burial under tundra has been the exception on the North Slope rather than the norm, it is expected that this activity would disturb only a small amount of area in the Planning Area.

Effects of Oil and Gas Development on Permafrost

Except for the active layer, which lies between the top of the permafrost and the ground surface and thaws each summer, the ground is permanently frozen to about 660 to 2,130 feet on the North Slope (NRC 2003). The permafrost contains a substantial fraction of ice, and it is this ice that supports buildings, roads, or pipelines placed on it. Thus, structures must be designed to avoid thawing their own foundations. Roadways and buildings must be elevated on thick gravel berms or pads, or on pilings. Gravel berms for roads can be as high as 6 feet above the tundra surface to ensure that the subgrade remains frozen. These roads have visual impacts on the landscape, and can intercept natural drainage and create ponds that thicken the active layer and initiate thermokarst (Walker 1996). Pipelines generally must be built on VSMs to ensure that the heat from the transmission of warm fluids does not thaw the surrounding permafrost, causing differential settlement. Heated buildings can also thaw the permafrost, leading to thaw settlement, if they are not elevated on pilings or their foundations insulated and refrigerated. On pads with closely spaced wells, extensive refrigeration with passive heat pipes and insulation is required to ensure that the heat from fluids does not melt the permafrost.

Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a minor impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Oil spills would impact soils only if the vegetation was altered. Oil alone would decrease the growth of vegetation growth, but oil spills would be likely to leave the surface organic mat intact. Heavy traffic and digging associated with spill cleanups would cause the greatest amount of damage to soils. Oil spill cleanup would mitigate impacts on soil only if cleanup methods and operations were carefully controlled to minimize surface disturbance.

4.3.3.3 Effectiveness of Stipulations

Many of the lease stipulations under the No Action Alternative directly or indirectly limit potential impacts to soils in the Planning Area. Lease Stipulations 1, 4, 5 through 16, and 24(m, n) relate to waste prevention, handling, disposal, spills, and public safety. These lease stipulations would ensure that waste materials associated with exploration and development activities were properly disposed of, and help prevent impacts to soil from spills and mishandling of materials. They would also provide for rapid cleanup of spills, which would decrease the likelihood of impacts to soils. Lease Stipulations 18, 22, and 24(c, f, g, h, i, j, l) would limit impacts to soils associated with overland moves and seismic work.

Lease Stipulation 27 would minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips and temporary platforms, unless permanent structures were absolutely required. Lease Stipulations 30, 31, 32, 40, and 48 would protect soils in the Planning Area by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, place restrictions on the development of gravel pits and permanent roads, and ensure resource issues were considered in the placement of facilities. Lease Stipulation 58 would provide for removal of all oil and gas facilities at the time of field abandonment. Lease Stipulation 63 would help to minimize resource conflicts by providing appropriate orientation programs and training for facilities workers.

4.3.3.4 Conclusion

Soil stability depends on vegetative cover; where vegetation is disturbed, impacts on soil follow. Impacts to soil from management actions under the No Action Alternative would involve either disturbance or destruction of relatively small areas. The duration of these impacts could range from several years (if the vegetation was disturbed) to decades (if the soil was destroyed). Short-term impacts could occur on approximately 6,600 acres of soil from 2-D seismic surveys, and 98,880 to 197,760 acres of soil from 3-D surveys during a 25-year period. Another 60 to 230 acres would be impacted by exploration and delineation wells.

Long-term impacts would occur on an estimated 310 to 1,015 acres of soils from field development, and 20 to 90 acres from gravel extraction activities. The placement of pipelines underground could disturb 30 to 165 acres. These activities could result in long-term impacts to approximately 0.03 percent of the Planning Area. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soil associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since it is located in the area having high oil potential. The overall impact to soil in the Planning Area would be minor.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to soil resources under this alternative would be about 50 percent less for exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.4 Water Resources

4.3.4.1 Surface Water and Groundwater Resources

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas exploration have the potential to impact water resources. However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Temporary tent camps would be located on existing pads or on well-drained soils along river terraces or uplands, set back from the stream or lakeshore with minimal surface disturbance. Excavation and collection activities would be done by hand shovel over several square feet, with replacement of the vegetative layer once completed. Recreational activities permitted by the BLM would follow the National Outdoor Leadership School's "*Leave No Trace, Alaskan Tundra*" program to minimize impacts to vegetation and to reduce wastewater, human waste, and solid waste disposal. Thus, permitted recreational activities would have minimal impacts on water resources in the Planning Area.

Winter occupation or travel would use low-ground-pressure vehicles and trailers (Rolligons) at temporary locations with adequate snow cover. All fuel, waste, and hazardous materials would be stored on site in accordance with ADEC guidelines, and removed seasonally. Gray water and human wastes would be handled in accordance with ADEC regulations, thus minimizing impacts to water resources.

Aircraft use could take place any time of the year in the Planning Area, but would be most common in the summer months because of better weather and the ability to use lakes for landing. Aircraft could be used to support recreation, surveying, scientific research, and transportation of personnel and supplies. The main impact expected from aircraft would be local fuel oil spills.

Under the No Action Alternative, permanent landing facilities would not be permitted on lakes or streams, and watercraft use would be limited to the summer months, for transportation, recreation, and supply purposes. As with aircraft, no permanent facilities to support watercraft refueling or repair would be permitted on lakes or rivers. Watercraft would have the same potential for local fuel oil spills or leaks as aircraft landing on lakes and rivers. Therefore, local impacts to water bodies from aircraft (float planes) and watercraft are possible, and would be expected to consist of local fuel oil spills. Aircraft and watercraft would be required to carry spill containment and clean-up materials, so these spills should be contained and removed relatively quickly.

Overall, non-oil and gas activities would have minor impacts to water resources under the No Action Alternative. In addition, fuel oil spills would be contained cleaned up quickly, in accordance with BLM and ADEC guidelines for use of aircraft and recreational vehicles in the Planning Area.

Oil and Gas Exploration and Development Activities

The main water resource issues for the Planning Area are discussed below. These issues have been raised and discussed in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), the Northwest IAP/EIS (USDOI BLM and MMS 2003), and the Alpine Satellite Development Plan EIS (USDOI BLM 2004C).

Seismic surveys. Seismic surveys have the greatest potential for thermokarst because they involve vehicles that cross the tundra during the winter months. Upon removing the organic mat, soils are exposed to erosion by wind and water. These forces could deposit sediment into water bodies. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). Observations by the BLM and others (NRC 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting land seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Important lease stipulations for thermokarst would be the restriction on bulldozing of trails, the requirement that snow depth average 6 inches before overland activities could commence, and the lease stipulation that trails could not be used repeatedly, to avoid formation of ruts. These lease stipulations, along with the minor impact of modern seismic equipment, should be highly effective in minimizing thermokarst erosion of the tundra and transport of soil to water bodies.

Effects of Disturbances from Exploration and Development

Ice Road and Pad Construction. Ice roads and ice pads are used extensively during the winter exploration season for access and for exploration drilling and testing. An average ice road is about 30 to 35 feet in width, and must be at least 6 inches thick to support heavy traffic. Ice roads require about 1 to 1.5 million gallons of water per linear mile and generally can be built at a rate of about 1.5 inches of thickness per day (USDOI BLM 1998b). Ice pads range in size from 3 to 10 acres and are usually about 1 foot thick to support the heavy drill rigs. An ice pad can require up to 2 million gallons of water to build. Water for ice roads and ice pads comes from lakes that are not completely frozen. An alternative to using water from lakes is to use aggregate ice chips from lakes. It takes less time to build an ice road or pad using the aggregate chips, but these chips require time to collect and transport.

Under the No Action Alternative, ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Water Withdrawal from Lakes. The only source of water during the winter months in the Planning Area is unfrozen water that lies beneath the ice caps of both shallow and deep lakes. This water is somewhat saline because of the exclusion of ions during the freezing of the upper part of the lake. Fish-bearing lakes often have fish living in the water beneath the ice cap during the winter months. Withdrawal of water from streams and riverine pools is not allowed by the AO in the Planning Area under any of the alternatives during the winter months.

Ice Road/Pad Water Use. Water from lakes may be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake depends on the depth of the lake and the depth of unfrozen water in the lake. Under all the alternatives, for fish-bearing lakes, water withdrawal would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet in depth if known to be fish-bearing or connected to a fish-bearing stream. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream. As an example of estimated water demand for ice roads and pads, BPXA used 84.5 million gallons of water in 2001 for ice road and pad construction, which is the same as 259 acre-feet of water. For a lake with a surface area of 184 acres, this amount of water withdrawal would cause a drawdown in lake level of about 1.4 feet based on a summer water withdrawal; withdrawal of water during winter months could result in a somewhat greater drawdown.

Drilling Water Use. Drilling requires water for making drill mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camp that accompany drill rigs. For example, a 10,000-foot drill test would require about 850,000 gallons of water for drilling and about 100 gallons/day per person (50 to 60 persons per camp) for the drill camp (USDOI BLM 1998b). During a 4 month drilling season, one well could require up to 1.65 million gallons of water. Drilling in the Alpine field used 21,000 to 63,000 gallons of water per day and 8.4 million to 14.7 million gallons of water over the 4 month drilling season (ARCO Alaska 1996).

Under the No Action Alternative, water withdrawal from lakes for drilling water would be governed by the same lease stipulations as those for ice roads and pads, discussed above. Therefore, it is expected that impacts to water resources would be minor because of lease stipulations governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased.

Under the No Action Alternative, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative is protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities.

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 in areas with low flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al. 1987 a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structure are needed to minimize drainage problems during the spring snow melt.

Under the No Action Alternative, drainages would be protected by the lease stipulations listed in Appendix E. These lease stipulations require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be kept to a minimum under this alternative as a result of these lease stipulations.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low-water and keeping culverts free of snow and ice (Walker et al. 1987 a, b).

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, and lake shoreline flow patterns, erosion and sedimentation, and ice damming (NRC 2003). Locating gravel pits at a safe distance from streams and lakes would minimize these impacts.

Under the No Action Alternative, gravel removal would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO (Lease Stipulation 40). The number and size of gravel mining sites would be kept to a minimum in the Planning Area, and, where possible, be designed so that wildlife could use them after mining was completed. These lease stipulations are protective of streams, rivers, and lakes and should keep impacts to floodplains to a minimum.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments and diversions that causes sedimentation of streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope (see Section 4.2.2; Oil Spills). Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

Lease stipulations 7, 9, 10, and 13 require that pipelines be designed to minimize leaks and that operators have spill prevention and clean-up plans and equipment in place. These lease stipulations are designed to minimize impacts to water resources from pipeline leaks. Therefore, impacts to water resources from pipeline leaks should be minimal under the No Action Alternative.

Effects of Spills

Oil spills onto the tundra surface or into water bodies are the result of accidents and leaks within and around drilling and production facilities, or along pipeline routes. The history of oil spills from Arctic drilling activities along the North Slope is available from the ADEC database and has been summarized in the Section 4.2.2 (Oil Spills) and in Appendix K. Oil spills result from leaks, faulty connections, and small spills around active drilling operations. Numerous spills of less than 25 bbl have been reported, with 99 percent of all oil spills being less than 25 bbl. It is likely that oil spills in the Planning Area would generally be less than 25 bbl in quantity and average around 3 to 5 bbls, and that blowouts would be rare. Most oil spills should occur during production operations, rather than during exploration drilling.

Surface Oil Spills. The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded, or flooded tundra during the summer months can reach temperatures of about 64 °F (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Shear-dominated flows can create a special type of oil slick in rivers and along shorelines. Shear in currents along river banks, river bottoms, and shorelines causes turbulence that results in mixing and dispersion of the oil and can drive large quantities of the oil below the surface (Overstreet and Galt 1995). This can lead to oil accumulation in sediments and along river bottoms and large quantities of oil moving below the surface and out of view of the clean-up crew.

Under-Ice Oil Spills. Oil spills under an ice cap have the added problem of the oil binding to the ice. Studies by Glaeser and Vance (1971), NORCOR Engineering and Research (1975), and Comfort et al. (1983) have shown that the oil rises to the under-ice surface and spreads laterally, accumulating in under-ice cavities. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice. The spread of an under-ice oil spill may be dispersed by currents in excess of 6 to 10 inches per second (Cammaert 1980; Cox et al. 1980). If the ice is marine ice and moves during spring breakup, the oil contained with the ice moves with the ice. Thus, under-ice oil spills can be quite difficult to detect and especially difficult to remediate.

4.3.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that fuel spills would be the main source of potential water quality impacts from activities not associated with oil and gas exploration and development. Float planes and watercraft have the potential for small fuel oil spills. These spills should be relatively easy to contain and remove, except under adverse weather conditions. Human activities such as scientific excavations, hunting, camping, and fishing of lakes and rivers could result in contamination by human waste and wastewater. This contamination should be very localized and disperse quickly in the water body. Fecal contamination by wildlife would be a more common and serious impact to water quality than occasional local human waste contamination.

Oil and Gas Exploration and Development Activities

Exploration activities that could affect water quality within the Planning Area under this alternative would be seismic surveys, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Oil spills would predominantly be attributable to development activities; therefore, spills will be discussed under the analysis of development impacts.

For all the alternatives, the average snow depth must be 6 or more inches prior to starting seismic operations. This depth, which is the current operating requirement on the North Slope, would be sufficient to protect waterbodies and water quality, as well as the tundra mat. However, it is expected that the tundra mat would experience some long-term impacts from seismic surveys. Approximately 1 percent of the acreage impacted by seismic lines would likely show some degree of damage from seismic surveys. Of that 1 percent, about 1 percent (up to 16 acres; assumes 250 miles of 2-D seismic surveys and three, 3-D seismic surveys) would likely suffer long-term impacts from seismic surveys conducted during a 25-year period.

Under the No Action Alternative, complete recovery of vegetative cover damaged during seismic studies could take years to decades. Thermokarst erosion and associated effects on water quality could occur in high impact areas, if damage were persistent.

Thermokarst erosion can result in water features with high turbidity and concentrations of suspended sediment. To cause high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils, and the mineral soils must be fine grained. These conditions would rarely occur, even where tracked vehicles were used in multiple summer passes. The total acreage affected by thermokarst erosion from seismic surveys is difficult to estimate, but should be less than 1 percent of the total seismic line-miles in a given area.

The use of water for ice-road construction could affect water quality in several ways. First, the winter extraction of water or ice from the Planning Area could change the water chemistry. However, since studies have not shown chemistry changes as a result of water extraction in other parts of the North Slope, impacts to water quality are not expected from withdrawal of water from lakes for ice roads and pads in the Planning Area. In coastal tundra waters, alkalinity is associated with the salt content, with increases and decreases in alkalinity paralleling 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, the removed waters would be replaced by less saline, less alkaline runoff water.

A second way that ice-road construction could affect water quality would be from the construction of roads over lakes that do not to freeze to the bottom. Many of these lakes are only a foot to a few feet deeper than the minimum 6-foot 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 to below the 5-ppm dissolved oxygen standard needed to protect resident fish (ADEC 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. The water withdrawn from lakes to construct the roadway would be more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice prior to its melting during snowmelt, increasing the initial salt content of the meltwater. This effect could be measurable during initial snowmelt, but the effect on water quality should be minimal and localized, most likely expressed as a slight buffering of pH during initial snowmelt.

The 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 and minor, lasting generally 1 season.

Impacts to surface water quality from exploration activities, including drilling, are expected to be minimal and both local and temporary in nature. Withdrawal of water from lakes should not affect water quality in the lakes. Construction of ice roads and ice pads could result in local saline surface water during spring melting, but dilution during spring flooding would prevent any long-term impacts from melting of saline ice roads. Drilling fluids and wastes would be stored and disposed of following guidelines established by the ADEC, and would not affect surface water quality and groundwater quality and impacts to water quality from disposal of drilling waste would be minor.

Historically, because clay is the standard liner for waste pits, it has been assumed that the clay in drilling muds on its own is 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 prior to spring breakup.

There would be a minor impact from drilling fluids used in development, as mud pits and discharge of drilling fluids and produced waters would be prohibited. Muds and cuttings would be either disposed downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters would be reinjected into the well. Some washed cuttings could be used in gravel-road or pad construction. Crude oil and waterflood pipelines would be aboveground, and their construction and physical presence would have a minor affect on water quality.

The primary water-quality effect from construction and placement of gravel structures would be related to upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion can result in water features with high turbidity and suspended-sediment concentrations. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downstream of thermokarst features. In flat, thaw-lake plains on the North Slope, it is anticipated that gravel construction would result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or from 200 to 600 acres for development under this alternative.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer-term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Lease stipulations listed in Appendix E limit hydrocarbon storage, major fueling activities, and facilities sitings within at least 500 feet from active floodplains of rivers, streams, and lakes. Because of these lease stipulations, refined-product spills of hydrocarbons should not reach and contaminate freshwaters. Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer.

The primary effect of a small spill on water quality in tundra ponds would be direct toxicity, rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill. Small waterbodies, such as tundra ponds and small lakes, are more susceptible to oil spills than larger lakes.

For the purpose of analysis, the effects of a 325-bbl spill reaching the Colville River in summer were analyzed. 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 the location where the spill entered the river. Some toxicity could persist in these initial reservoir pools for a few days to several 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 would also have a minor effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minor because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes, and because of the relatively unrestricted movement of the slick and underlying water. The spreading of the spill over about 60 acres (0.03 percent of the lake surface) could be considered an effect on water quality. This effect would persist for less than one summer, until the slick was either cleaned up or the oil stranded on the shoreline.

4.3.4.3 Effectiveness of Stipulations

Numerous lease stipulations were developed for the 1998 Northeast IAP/EIS ROD to reduce or avoid impacts to water resources. Lease Stipulations 5 through 16 are designed to ensure that activities that could result in the spill of materials into water bodies would not occur near water bodies, and that procedures are in place to clean up a spill, should it occur. Lease Stipulations 20 and 21 prohibit the removal of water from rivers and streams during winter, and restrict the amount of water that could be removed from lakes during winter for ice road construction to protect aquatic, fish, and waterfowl resources. Lease Stipulation 22 protects riparian habitat along waterways. Lease Stipulation 24 provides further protection to waterways from overland moves and seismic work. In most cases, exploratory drilling would be prohibited in rivers, streams, and lakebeds (Lease Stipulation 28), and permanent oil and gas facilities would also be prohibited in the Teshekpuk Lake Surface Protection Area (Lease Stipulation 31). Permanent oil and gas facilities are also prohibited near other important water bodies in the Planning Area to protect fish and other resources (Lease Stipulation 39), and within 500 feet of all other water bodies (Lease Stipulation 41). Lease Stipulations 42, 43, and 44 provide guidance on the use of bridges and culverts and best management practices to ensure that the natural drainage pattern would be maintained.

4.3.4.4 Conclusion

Impacts from oil development would include disturbance of streambanks and shorelines and subsequent melting of the permafrost. Other impacts include erosion and sedimentation associated with construction, road and pad building, and clearing activities.

The potential long-term impacts from exploration would be water removal from lakes, and during construction of ice roads and pads, water impoundments, diversions, thermokarst erosion, and sedimentation of up to 16 acres. Long-term impacts from development of gravel roads, pads, and pits could impact 330 to 1,105 acres. Both aboveground oil pipelines (not including infield lines) and buried pipelines could result in short-term impacts. After construction was complete, impacts from elevated pipelines should be minor. Buried pipelines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase, and result in about 1.5 acres of long-term moderate impacts per pipeline mile. If all work on gravel roads, pads, and pipelines were done during winter, impacts could be reduced.

Oil spills could result in the impacted waters being toxic to sensitive species. Water quality could be degraded over a few weeks along a short stretch of the Colville River from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03 percent of the lake surface) for a few weeks could be considered a moderate effect on water quality.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to water resources under this alternative would be about 50 percent less for exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.5 Vegetation

This section discusses the potential effects to vegetation that could result from management action in the Planning Area under the No Action Alternative. The following sections summarize the information previously presented in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), which has been amended with additional data from studies conducted since 1998, particularly for the Northwest IAP/EIS (USDOI BLM and MMS 2003).

4.3.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development could affect vegetation in the Planning Area. Off-runway landings by private or commercial wheeled aircraft could cause short-term damage to vegetation present on the landing sites. Most wheeled aircraft landings would occur on sand or gravel bars or possibly on dry gravelly ridges. Therefore, impacts from such landings would likely be minor and sporadic in occurrence.

Archaeological and paleontological digs could impact vegetation but would probably be limited to relatively small areas. Depending on the location of the dig, it could be possible to remove sod such that it could be replaced once activities at the site were concluded, resulting in a temporary disturbance. However, many digs would result in the destruction of vegetation at the site. Overall, the extent of these activities would likely impact only a few acres in the Planning Area.

Camps associated with scientific studies, recreational use and other activities could result in trampling of vegetation from foot traffic and tent placement, and in small spills of stove or generator fuel. These impacts would typically be temporary, lasting from less than one to several growing seasons. Recreational camps are often located on river bars where vegetation cover is low. It is likely that larger camps would be located existing gravel pads, which mostly lack vegetation. The total land surface impacted by camps is expected to be small (less than 10 acres) and the sites would be scattered.

Overland moves occurring in the Planning Area typically involve traffic between Deadhorse and Barrow. Moves would occur during winter when the ground was frozen and covered with snow. Impacts to vegetation associated with transport vehicles depend on the type of vehicle, the vegetation type, and the snow conditions. In general, low ground-pressure wheeled vehicles have less impact than do tracked vehicles or sleds on skids. In wetter tundra areas, impacts are usually limited to trails caused by compression of snow and dead plant material. Such trails are often visible for one to several growing seasons. These tracks can affect vegetation, soil chemistry, soil invertebrates, soil thaw characteristics, and cause small-scale hydrologic changes (Kevan et al. 1995). In general, wet areas may be less affected than dry areas (Walker 1996), and snow acts as a buffer against these impacts. Avoidance of areas with low snow cover, use of lightweight vehicles, dispersed traffic patterns, and minimizing sharp turns could help to minimize damage. However, tracked vehicles can disrupt the vegetation surface when making tight turns or by dropping the vehicle’s blade too deeply into the snow. In wet tundra this disruption can result in water accumulation and thermokarst. In drier tundra, travel over low shrubs can cause breakage and tussocks may be broken or crushed. If a trail across the Planning Area was about 100 miles in length, and 12 feet wide, it would impact about 150 acres of tundra. Severity of impacts would depend upon the actual location and type of habitat, but impacts could range from temporary to longer-term.

The use of OHVs such as four-wheel vehicles and snowmachines could cause localized impacts to tundra. Snowmachines used during the winter when the ground was frozen and there was adequate snow cover would have little or no impact to the vegetation. However, heavy use of a trail could cause compaction of vegetation. In addition, the use of snowmachines during fall or spring or in areas without adequate snow cover could result in damage to the vegetative mat leading to thermokarst. Similarly, use of four-wheel vehicles on tundra can disrupt the vegetation and churn soil in the upper portion of the profile, leading to thermokarst in wet tundra and damage or death of plants in drier areas. The use of airboats in shallow marsh areas could also impact vegetation and soil, although if confined to the river channel, airboats would have no impact on vegetation.

4.3.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Various activities associated with oil and gas exploration, development and production could impact vegetation in the Planning Area. These activities include seismic operations, exploration drilling, construction of ice roads and ice pads, gravel road, pad, and airstrip construction, and pipeline construction.

Exploration

Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months. Seismic exploration would cause impacts to vegetation similar to those described previously for overland moves. A 2-D survey area varies in size, but for this analysis a 600 mi^2 (384,000-acre) area was used. The maximum area impacted by seismic lines would be approximately 6,060 acres (250 miles by 200 feet wide), although not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which would traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Additional trails would be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and typically involves a camp train with two or three strings of trailers. All trailer strings could use the same trail, but the resulting damage to vegetation would be more severe and longer lasting than if separate trails were used by each trailer string. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, thus impacting a path 30 feet wide. Assuming 30 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, 500 acres could be impacted during a 25-year period. Thus the total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be less than those covered by 2-D surveys since a single move would occur down the center of the surveyed area. Camp move trails would impact about 495 acres of tundra per survey. It is anticipated that two to four 3-D surveys would occur in the Planning Area during a 25-year period, impacting 990 to 1,980, acres by camp move vehicles and 98,880 to 197,760 acres by seismic lines.

A study of tundra disturbance associated with seismic surveys on the eastern portion of the North Slope reported little to no disturbance of tundra on 11 percent of the study plots 1 to 2 years following a seismic survey (Jorgenson et al. 1996). Disturbance was considered minor on 64 percent, moderate on 23 percent, and high on 2 percent of the plots used in this study. Eight to 9 years following a survey, little to no disturbance was reported on 97 percent of the study plots, and no areas of moderate or high disturbance remained. Tundra under camp move trails showed little or no disturbance on 22 percent, low disturbance on 52 percent, minor disturbance on 24 percent, and high disturbance on 2 percent of study plots. Eight to 9 years of recovery reduced the disturbance level to little or none on 85 percent, minor disturbance on 10 percent, moderate disturbance on 4 percent, and high disturbance on 1 percent of plots. Using these approximations of disturbance, approximately 1,650 acres of vegetation would experience moderate to high impacts from 2-D seismic activities, and 12,500 acres of vegetation from each 3-D survey. In addition, moderate to high impacts following 9 years of recovery for activity due to camp move trails could be found on approximately 75 acres for 2-D and approximately 75 acres for 3-D surveys during the life of the project.

A study conducted in 2001 in the summer following seismic work found little to no impacts to tundra under seismic lines on 30 percent of the plots studied (Jorgenson et al. 2003). Minor impacts were found on 66 percent and moderate impacts were found on 4 percent of the plots; no plots were highly impacted. Camp move trails in this study had little or no impacts on 18 percent, minor impacts on 54 percent, moderate impacts on 29 percent, and high impacts on none of the plots.

The 2001 study suggests that improvements in the equipment and procedures used for seismic surveys has reduced the amount of impact to tundra, resulting in a higher percentage of tundra in categories of minor or little to no impacts and few if any highly-impacted sites. However, it is difficult to compare the 2001 study with the 1996 study because of differences in terrain types, snow cover, and observers estimating impacts. Calculations of area impacted by seismic operations in this amendment uses environmentally conservative numbers, but it should be noted that the projected impacts are probably greater than actual impacts would be.

During exploration, the construction of ice pads for drilling exploratory or delineation wells and ice roads used to access the pads could impact vegetation in the Planning Area. In general, construction of ice roads and ice pads would have only localized impacts on vegetation, usually limited to compression of the tundra under the roads and pads and a shortened growing season for the plants due to delayed melting of the ice in the spring. However, ice roads could also cause localized areas of plant death. Construction and use of ice roads and ice pads in drier habitats could also result in breakage of shrubs and breakage and crushing of tussocks. Greater impacts would be expected if ice roads traversed the same route each winter; varying the route annually would decrease impacts to vegetation. Recovery from impacts to vegetation would be expected within a few years. It is estimated that on average there would be 50 miles of ice road through the Planning Area on an annual basis, under the No Action Alternative. Therefore, ice roads would impact approximately 212 acres of vegetation assuming a 35-foot width for an ice road.

Multi-year ice pads allow use of the pad in a second winter, but require insulation of the ice pad to prevent melting during the spring and summer. Studies of vegetation recovery at an extended year ice pad found a the vascular plant cover was still 34 percent lower than pre-pad cover 2 years after the pad melted (Noel and Pollard 1996). Additionally, some melting often occurs around the perimeter of the pad, causing vegetation at the perimeter to break dormancy. If plants breaking dormancy are covered by the insulating layer or by timbers or other material used to hold the cover in place, they die from the lack of sunlight (Hazen 1997, McKendrick 2000). A typical ice pad (500 feet by 500 feet) would impact about 6 acres of vegetation. During the life of the planning process, it is assumed that six to 21 exploration wells and four to 17 delineation wells or a total of 10 to 38 wells would be drilled from ice pads in the Planning Area, under the No Action Alternative. Assuming that half the pads would be multi-year ice pads, impacts to vegetation could occur on 30 to 115 acres spread among five to 19 different sites over a period of about 25 years.

The construction of well collars during exploration requires the digging of a hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil may also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.06 to 0.2 acres of vegetation being destroyed under the No Action Alternative, assuming construction of 10 to 38 well collars.

Development and Production

During oil development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads. Impacts of ice roads were discussed previously under the “Exploration” subheading.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, and airstrips would result in the destruction of vegetation in areas where gravel was placed. The development scenario under the No Action Alternative assumes gravel that one to three fields would be developed, resulting in 110 to 415 acres of vegetation being destroyed by gravel placement.

The passage of vehicle traffic over gravel pads and roads would result in dust and gravel being sprayed over vegetation within about 30 feet of the pad or road, and a noticeable dust shadow out to 150 feet or more. Within 30 feet of gravel structures, the dust and gravel could smother vegetation. The effects of dust on vegetation include early snowmelt, reduced soil nutrient concentrations, lower moisture, an altered soil organic horizon, and higher bulk density and depth of thaw (Everett 1980; Walker and Everett 1987; Auerbach et al. 1997). These studies found that plant species richness was reduced near gravel structures, particularly in naturally acidic soils. A decrease in acidophilus mosses, some lichen species, and certain heath taxa altered species composition (Walker and Everett 1987). In areas that experience heavy dust fallout, native plant communities could be killed and replaced by early-successional colonizers and species more tolerant of the altered site conditions. The magnitude of these effects would depend on the duration of dust exposure (i.e., traffic intensity) and the distance from the source. Traffic volume and speed would generally be minor on in-field roads in the Planning Area, which would limit dust impacts to vegetation. Assuming an average of 5 miles of some combination of roads, pads, and airstrips with a potential for a 10-mile perimeter, 36 acres of vegetation per field could be impacted. Assuming one to three fields would be developed, the total potential impact to vegetation from roads would be 36 to 108 acres under the No Action Alternative.

The material used for gravel fill could also impact vegetation near gravel structures. Saline material used as fill increases the salinity of water draining off of or leaching through the structure. Increased salinity at a site could alter the species composition of the plant community in the immediate vicinity of the gravel structure, shifting the community toward one comprised of species that are more tolerant of saline conditions (McKendrick 2000).

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 200 to 600 acres under the No Action Alternative.

Blockage of natural drainage patterns can lead to the formation of impoundments. In the Prudhoe Bay oil field, impoundments covered 22 percent of a highly developed portion of the oil field and 3 percent of a broader portion of the oil field (Walker et al. 1987a). Impoundments, which would generally be confined to areas of wet and aquatic vegetation, could alter both the hydrology and species composition of wetlands. Plant productivity could increase biomass of a few species; or productivity may decrease, as a result of loss of plant communities to the development of deep, open water areas. In most cases, impoundments would lead to a decrease in plant species richness (Klinger et al. 1983; Walker et al. 1987a, b). The use of adequate cross drainage structures in gravel roads and attention to the natural drainage patterns during design of developments could help minimize impacts to vegetation from impoundments.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the National Petroleum Reserve – Alaska have not been conducted, but presumably would be initiated if discoveries of recoverable oil and gas were made. It is possible that one or more sites could be necessary, with impacts occurring on 20 to 90 acres, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would destroy vegetation at gravel extraction sites.

Pipelines. Pipelines on the North Slope are typically built on VSMs with a diameter of 12 inches and a spacing of 55 to 70 feet. In addition to the vegetation displaced by the VSM, installation of VSMs disturbs a zone around the VSM that is approximately 20 inches wide. This zone of disturbance results from spoil material deposited around the VSMs and from thermokarst, which may result in a change in species composition around the VSMs. Approximately 0.03 acres of vegetation would be disturbed per pipeline mile. Under the No Action Alternative, 0.6 to 3 acres of vegetation would be disturbed by VSMs.

Pipelines could also impact vegetation indirectly by altering snow accumulation patterns and by shading vegetation. Pullman and Lawhead (2002) found that most sites under the Alpine field and Tarn pipelines did not differ substantially from nearby background areas located upwind. At about 25 percent of the sites sampled, substantially more snow accumulated under the pipeline, and at about 18 percent of the sites substantially less snow accumulated under the pipeline. In general, the snow pack was most likely to be deeper under pipelines with an east-west orientation, and when pipeline clearance was reduced to below 5 feet.

Vegetation under a pipeline receives less direct sunlight during the growing season than does vegetation that is not under a pipeline. Therefore, there could potentially be a decrease photosynthesis in plants growing under pipelines, and a reduction in heat absorption by the ground cover, leading to a shallower active layer. However, there are no data that specifically address these questions. In general, Arctic plants are limited by nutrient availability rather than photosynthesis, and it is unlikely that pipeline shading substantially impacts vegetation physiologically (Tieszen 1978, Billings 1987, Bliss 2000).

In areas where pipelines were buried, impacts to vegetation would be different. Pipeline burial would destroy vegetation where the trench was constructed and would alter vegetation in adjacent areas where temporary storage of the overburden occurred. The zone of impact would be approximately 12 feet wide for the length of the buried segment, and would impact 1.5 acres per pipeline mile. Pipeline burial under tundra has been the exception on the North Slope rather than the norm, and it is expected that pipeline burial would disturb approximately 30 to 165 acres; however, burial of substantial lengths of pipeline is an unlikely event.

Air Pollution. Various activities associated with oil development and production emit air pollutants, including NO_x, NO_2, NO, O_3, and SO_2. Numerous studies have addressed the impacts of these pollutants on both vascular and non-vascular plants, but there are few studies of air pollutant impacts on tundra vegetation. Kohut et al. (1994) measured air pollutant concentrations and their effects on vegetation adjacent to the Central Compressor Plant (CCP), where gas powered turbine pumps compress natural gas prior to injection, in the Prudhoe Bay oil field. The CCP is the largest source of nitrogen oxides in the Prudhoe Bay oil field, producing NO_x, NO_2, and NO, as well as O_3 and SO_2. Emissions from the CCP did not have effects on the local vegetation. Results did show an increase in foliar nitrogen near the CCP, but no visible injury to plants was found. Physiological changes (photosynthesis and respiration) in plants were not apparent in either field or growth chamber experiments for any of the pollutant gases, even at concentrations greater than those measured near the CCP. It is unlikely that pollutant emissions associated with development in the Planning Area would exceed those of the CCP; therefore, detrimental effects on vegetation around these facilities would not be expected. Primary productivity in Arctic tundra, however, is often limited by nutrient supply, particularly nitrogen and phosphorus (Chapin 1978; McKendrick and Mitchell 1978; Chapin et al. 1980; Chapin and Shaver 1985). Fertilization leads to higher productivity and changes in the structure of Arctic plant communities (Chapin and Shaver 1985, McKendrick 1997) and may alter carbon balance at the ecosystem level (Billings et al. 1984).

Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, water impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place, would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrips could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth, although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, and complete restoration to preexisting conditions is improbable.

Effects of Spills

Spills of refined oil could occur during overland moves and seismic surveys. These spills would likely be small, averaging 3 to 5 gallons or less, and would affect small areas (less than 50 square feet). Contaminated snow would be cleaned up immediately upon discovery. A spill from a large storage tank, which would be much less likely, could impact up to 500 square feet. Overall, past spills of this size and type on Alaska’s North Slope have caused minor ecological damage and ecosystems have generally recovered, with wetter areas recovering more quickly than drier areas (Jorgenson 1997, McKendrick 2000).

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 of a spill would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on vegetation. Approximately 20 to 35 percent of past crude oil spills have reached areas beyond pads. For this analysis, it was assumed that 27 percent of all spills would occur or reach beyond gravel pads. Most spills would happen during the winter and could be cleaned with minimal impacts to vegetation. If it is assumed that 60 percent of all spills would occur during the winter, approximately 11 percent of all oil spills would affect vegetation.

Most oil spills would cover less than 500 square feet (<0.01 acres). However, a spill event that includes an aerial pressured discharge can cover substantially more area as occurred at an ARCO drill site in 1993 when crude oil misted over an estimated 100 to 145 acres (Ott 1997). Assuming the average spill would cover 0.1 acre under the No Action Alternative, approximately 37 acres would be impacted during the lifetime of development in the Planning Area.

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 could persist for several years if the site were not rehabilitated. The length of time a spill would persist would be dependent upon soil moisture and the 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. Overall, past spills on Alaska’s North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery because most of the habitat is wet (Jorgenson 1997).

If seawater were used for enhancement of oil production, a saltwater spill could occur within the Planning Area. 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 saltwater spill would have effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be limited to a few acres or less. In the case of a saltwater spill on tundra, the water would likely be adsorbed into the vegetative mat or, in wet habitats, diluted with fresh water.

Oil spill response training and cleanup may also impact vegetation. Trampling of vegetation and stockpiling of materials for use during the response may impact vegetation. The amount of impact would depend on the size and location of the spill, but in most cases would be temporary and plants would recover in one to several years.

4.3.5.3 Effectiveness of Stipulations

Lease stipulations described in the 1998 Northeast IAP/EIS ROD should effectively reduce the impacts of development on vegetation under the No Action Alternative. Specific lease stipulations on solid and liquid-waste disposal, fuel handling, and spill cleanup would be expected to reduce the potential effects of oils and other waste on vegetation. Lease stipulations on overland moves and seismic work would also effectively minimize impacts to vegetation.

Lease stipulations on activities associated with oil and gas exploration and development, such as facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, are expected to effectively minimize the amount of habitat that would be altered by gravel pads and other surface disturbances. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.3.5.4 Conclusion

Under the No Action Alternative, impacts to vegetation from activities other than oil development would include minor impacts to vegetation from aircraft landings, archaeological or paleontological excavations, camps, and overland moves and would affect approximately 165 acres of vegetation. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 to several years.

Impacts to vegetation from oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling and the construction of ice roads and ice pads. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 150 acres (assuming 250 miles of 2-D surveys and three, 3-D camp move trails over a 25-year period). Effects of well collar construction would also be permanent, but would impact less than 1 acre of vegetation.

The effects of oil development and operation would include destruction of vegetation during construction of gravel pads, roads, and airstrips, from excavation of material sites, and construction of VSMs and underground pipelines. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snow drifts, and blockage of or change to natural drainage patterns. These impacts would be long term and would impact from 365 to 1,215 acres, or up to 0.03 percent of the Planning Area.

Spills of oil, other chemicals, and saltwater could occur and would have long-term impacts, except for those associated with small-size spills, which would be cleaned up immediately, allowing recovery within a few years to 2 decades.

Under the No Action Alternative, development would be unlikely to affect plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast

National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the No Action Alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to vegetation resources under this alternative would be about 50 percent less for exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared an impact analyses on those areas within Planning Area that are considered to be wetlands or floodplains, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Under the No Action Alternative, oil and gas development would be prohibited in areas that are predominantly wetlands around Teshekpuk Lake and the Goose Molting Area to the north of Teshekpuk Lake. The Goose Molting Area, in particular, contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to wetlands and floodplains under this alternative would be about 50 percent less for oil and gas exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.6.1 Soils

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 also be minor to negligible. Development could cause the loss or disturbance of 330 to 1,105 acres of soil. Assuming that 95 percent of the area impacted is wetlands, approximately 310 to 1,050 acres of wetland soil would be impacted. The duration of these impacts would be permanent and would impact approximately 0.01 to 0.03 percent of the Planning Area. Oil spills would be cleaned up immediately, causing minimal disturbance to soil. Impacts from development activities to soils would be minor.

4.3.6.2 Water Resources

Water Resources

Impacts from seismic surveys are expected to be minimal. Impacts to water resources from oil development activities in the Planning Area would occur as a result of constructing gravel roads, pads, and structures. The potential short-term impacts from exploration would occur as a result of water removal from lakes, construction, increased water impoundments, diversions, thermokarst erosion, and sedimentation. Long-term impacts from exploration would impact up to 15 acres, while long-term impacts associated with water diversions and impoundments from development of gravel roads, pads, and pits could impact from 330 to 1,115 total acres, and 310 to 1,050 acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water from lakes. Gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long-term (decade or more) effects from development of gravel roads, pads, and pits could occur on 310 to 1,050 acres of wetlands. Oils spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes, and could cause ponds or small lakes to remain toxic to sensitive species for several years. Discharges of drilling and human waste would be prohibited near the coastline; no unregulated discharges of produced water would be allowed; and no effects on kelp or special benthic communities from construction of ice islands or ice roads are expected. The effects of gravel-island construction and buried-pipeline construction would probably be minor and temporary. A short dock or jetty in marine waters probably would not affect hydrologic conditions, but a long causeway with inadequate breeches would probably have minor, long-term impacts.

4.3.6.3 Vegetation

Impacts from activities other than oil exploration and development would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor.

Impacts from oil exploration would include vegetation disturbance on up to 6,980 (2-D) and 47,500 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 140 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about 205 acres, and ice pad construction would impact about 29 to 110 acres of wetland vegetation per year; these impacts to vegetation would be short term. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, and pipelines, would cause the destruction of vegetation on approximately 105 to 395 acres of wetlands and the alteration in plant species composition on another 225 to 675 acres of wetlands. 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). Long-term impacts to wetland vegetation would occur on approximately 0.01 to 0.02 percent of the Planning Area.

Lease stipulations would be effective in limiting the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980, NRC 2003). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Under the No Action Alternative, approximately 20 to 85 acres of wetland vegetation would likely be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska. Gravel required for development in the Planning Area could be mined from existing sites east of the National Petroleum Reserve – Alaska, or could be extracted from new sites developed within the Planning Area. The most likely sources of gravel for development may occur in the floodplains of rivers in the Planning Area.

4.3.6.4 Effectiveness of Stipulations

Lease stipulations identified above for soil, water, and vegetation resources would apply to wetlands. These lease stipulations would be effective in minimizing impacts to wetlands from waste discharges and spills, and from direct and indirect surface impacts associated with non-oil and gas and oil and gas activities. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.3.6.5 Conclusion

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. This area would be closed to leasing under the No Action Alternative.

Impacts from oil exploration would include disturbance on up to 6,980 (2-D) and 47,500 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 85 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about 200 acres annually, and ice pad construction would impact about 130 acres during the life of the project.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, and pipelines, would cause the destruction of approximately 105 to 395 acres of wetlands and the alteration in soil, water, and plant species characteristics on another 225 to 675 acres of wetlands. 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). Long-term impacts to wetland vegetation would occur on approximately 0.01 to 0.03 percent of the Planning Area.

Lease stipulations would be effective in limiting the amount and type of development that could occur within active floodplains in the Planning Area. Under the No Action Alternative, approximately 20 to 85 acres of wetland vegetation would likely be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska. Some of these sites, however, could provide overwintering habitat for fish.

4.3.7 Fish

4.3.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

Ground camps associated with non-oil and gas activities include small groups of people involved in scientific research or recreation. These camps range in size from small mobile parties that remain at a site for a few days to larger camps that are set up for long portions of the summer field season. Small mobile camps, which could be located throughout the Planning Area, would likely have only small quantities of stove fuel or gas for boat motors. Larger camps or camps located at established sites like the Inigok and Ivotuk airstrips or the Lonely DEW-Line site could store fuel in drums or in large bladders of up to 5,000 gallons. Large camps with caches of jet fuel in excess of 50 gallons would be required to store the fuel in containment dikes equipped with clean-up materials.

Recreational hunting and fishing activities occur primarily along the Colville River under a BLM permit. Float trips from the headwaters down to Umiat are permitted in August and September. A limited number of permits would allow float planes access to lakes within the Planning Area. Most camp or travel spills should be small (less than 5 gallons), and would most likely occur during fuel transfers. For the reasons described in the "Effects of Spills" section below, impacts of fuel spills under the No Action Alternative are expected to be minor and have a minor effect on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

The following discussion addresses the potential impacts of oil and gas activities on freshwater, anadromous, and amphidromous fish and fish habitat found within and adjacent to the Planning Area under the No Action Alternative. These habitat areas include streams, rivers, lakes, and the coastal zone.

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys use acoustical energy pulses to locate subsurface geological formations that might contain oil or gas. The energy pulses are generated by vibrator equipment mounted on trailers and towed on sleds. Surveys would be conducted during the winter (early December through mid-May) when the frozen snow-covered tundra would allow for extensive vehicle access to different locations within the Planning Area. Seismic crews would operate from mobile camps that form multi-vehicle "cat trains" of trailer sleds pulled by tractors. Individual surveys would typically last about 100 days and cover survey areas of up to 600 mi^2.

Because seismic surveys would be conducted in winter, potential threats to overwintering fish in the Planning Area would primarily stem from 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools; and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas, although they are not required to do this. Overall, any affects to overwintering fish caused by winter seismic surveys would be localized and would not be likely to have any measurable effect on fish populations within the Planning Area.

With surveys commencing no earlier than December, ice and snow cover should be sufficient, in most cases, to prevent physical damage and disruption to overwintering pools from vehicle traffic. Lease Stipulation 24(i) states that operations may begin only after the seasonal frost in the tundra and underlying soil reaches a depth of 12 inches and average snow cover is 6 inches. The exact start date would be determined by the AO. Lease Stipulation 24(j) requires that operations cease with the beginning of the spring melt, the exact date of which would be determined by the AO. Lease Stipulation 24(f) requires that all activities be conducted with low-ground-pressure vehicles. While these lease stipulations were designed to protect the underlying tundra and vegetation, they would also offer some protection to fish overwintering pools.

Other restrictions that are specifically designed to protect fish habitat during winter operations include Lease Stipulation 24(e), which mandates that waterways be crossed at shallow riffles when possible to avoid additional freeze-down of deep water pools harboring overwintering fish. Lease Stipulation 24(c) encourages that operators crossing waterways travel a minimum of 100 feet from overwintering streams and lakes.

Overall, it is not expected that seismic activity disturbances occurring winter under the No Action Alternative would have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Seismic Surveys in Teshekpuk Lake. Seismic surveys utilizing vibrator equipment (Vibroseis) would be conducted in winter, and potential threats to overwintering fish in Teshekpuk Lake would stem primarily from stress associated with acoustic energy pulses transmitted into the lake directly over schools of fish. In general, large overwintering pools, including large lakes like Teshekpuk, allow fish to flee immediate areas of intense stress. Depending on proximity, adult fish could suffer no more than temporary discomfort. In contrast, intense acoustical pulses could be lethal to juveniles. Overall, any affects to overwintering fish caused by seismic surveys on the lake during winter would be localized and likely have no measurable effect on fish populations in Teshekpuk Lake or within the Planning Area.

Under the No Action Alternative, seismic surveys utilizing airgun arrays would also be allowed on Teshekpuk Lake during the open water period in the summer. Typically, an airgun array is towed behind a boat at a depth of about 12 feet. Shots are typically fired every 50 to 150 feet, or about once every 10 seconds. Because the array is configured to focus sound toward the bottom, effective source levels for sound propagation in the horizontal direction are lower than those below the array. In water, injury and death of organisms exposed to seismic energy depends on two features of the sound source: 1) an extremely high, received peak pressure, and 2) a relatively short time for the pressure to rise and decay (Wardle et al. 2000). Considering the peak pressure and rise/decay time characteristics of seismic airgun arrays used today, the zone in which fish and invertebrates would be harmed should be within a few feet of the seismic source.

The two primary types of potential impacts of seismic exploration on fish are direct physical damage and behavioral effects. Physical damage can include death, injury, or retardation of development. There have been a few studies of the effects of seismic pulses on various life stages of fish (reviewed by Turnpenny and Nedwell 1994). In general, the studies indicate that fish eggs and larvae would suffer mortality at zero-peak noise levels of 220 dB. These levels occur only at distances of up to 4 to 10 feet from airguns used during seismic exploration, and some mortality of eggs and larvae could occur up to about 18 feet below large subarrays. Adult fish only suffer mortality at received levels of 240 dB, which occur at distances of less than 3 feet from an airgun. Since it is likely that fish move to avoid the passage of the seismic boat, it is probable that few fish would occur close enough to an airgun to be killed (Davis and Thomson 1999). Small fish could be injured at distances of up to 4 to 10 feet from individual airguns.

Exposure to seismic pulses could also elicit behavioral reactions by fish, but there is little information on the effect of noise-induced behavioral changes on the well-being of fish. Furthermore, there are no data on the effects of seismic pulses on the behavior of fish eggs and larvae (Davis and Thomson 1999). Underwater sound can scare some fish. Sudden changes in noise level can cause fish to dive or change direction to avoid an area. Fish react to boats and to seismic operations; avoidance reactions are quite variable and depend on the species, life history stage, time of day, whether the fish have fed recently, and the sound propagation characteristics of the water.

Exposure to seismic pulses can affect fish behavior in the short term by causing some fish to school closer to the bottom or to move laterally away from the path of the seismic array. In cases where habituation has been studied, normal behavior is resumed soon after passage of the array (Chapman and Hawkins 1969). There could also be short-term minor effects on the ability to catch fish that would negatively impact fishing in Teshekpuk Lake.

Effects from Water Demand. Construction-related activities with the potential to affect Arctic fish include water withdrawal for construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling.

Water is required for drilling operations, camp use, and the construction of ice roads and pads. Up to 1.5 million gallons of water are required to construct a single mile of ice road, and construction of an average 6-acre ice pad requires approximately 500,000 gallons of water. A 10,000-foot exploratory well might require 850,000 gallons of water for drilling. The high water demand associated with these activities would require the tapping of deepwater bodies within the Planning Area. Substantial water demand during winter could affect the overwintering habitats of freshwater and amphidromous fishes.

Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989a). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Moving waters may deter the thickening of ice, thereby providing overwintering habitat at shallower depths; areas within the Colville Delta may adequately overwinter fish at depths of 5 feet. The amount of overwintering habitat also varies with the severity of winter conditions. Colder temperatures and a lack of snow cause increased ice formation, which further reduces the amount of under-ice-free water. Overcrowding can increase stress, deplete oxygen supplies, and increase the concentration of metabolic byproducts to a point that may be fatal to the fish (Schmidt et al. 1989). The limited amount of available overwintering habitat may be the single most important factor affecting fish population size and cyclical fluctuations in abundance (Craig 1989a, Reynolds 1997). Competition for limited overwintering space has been suggested as a major cause of population fluctuations in North Slope broad whitefish stocks (Gallaway et al. 1997). Because of the importance of limited overwintering area to Arctic fish, lease stipulations for the No Action Alternative specifically regulate the winter withdrawal of water from lakes, rivers, and streams.

Lease Stipulation 20 prohibits the withdrawal of water from rivers and streams during winter. Withdrawal would also be prohibited in lakes less than 7 feet deep if those water bodies were connected to, or seasonally flooded by, fish-bearing streams or rivers. Winter water withdrawal from lakes greater or equal to 7 feet deep would be limited to 15 percent of the estimated under-ice free water. Unlimited winter water withdrawal would be permitted for any lake, at the discretion of the AO, if it could be demonstrated that the lake contained no fish. Further protection of fish overwintering sites would be provided by Lease Stipulation 19, which prohibits the compaction or removal of snow from fish-bearing water bodies except at approved areas. Such actions could alter ice thickness in fish-bearing water bodies.

The provisions under the No Action Alternative regarding lakewater withdrawals are set conservatively in an attempt to adequately protect fish overwintering habitat. Regulated lake water withdrawal could kill small numbers of fish but would not be expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in general.

Effects from Exploratory Drilling. Drilling operations require large amounts of water for blending into drilling muds, and also produce large amounts of rocks and cuttings. If an exploratory well were to be abandoned, drilling muds and cuttings would be re-injected into the bore hole. If the well were to go into production, muds and cuttings would be removed to an approved disposal site at Prudhoe Bay. Any chemical leaching into surrounding waters by cuttings temporarily being stored at the drill site could affect nearby fish habitat. This potential threat would be reduced by Lease Stipulation 28, which prohibits exploratory drilling in rivers, streams, and lake beds, as determined by the highest high water mark. Exceptions could be authorized by the AO in cases of shallow lakes that freeze to the bottom, do not support large fish populations, and are hydrologically isolated. Regulations would also require the proper handling of all well-waste products.

In general, exploratory drilling under the No Action Alternative is not expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Gravel Extraction. Oil field development requires the construction of stable, elevated gravel pads to hold well heads, pipelines, production facilities, support buildings, and roadways. Gravel has historically been the preferred material for pad and road construction. Construction of a typical gravel pad requires from 8,000 to 12,000 cubic yards of gravel per acre of footprint while the typical roadway requires 30,000 to 50,000 cubic yards of gravel per mile. Unlike in development areas east of the Colville River, gravel deposits are scarce in the Planning Area (USDOI BLM and MMS 1998); they are most commonly found in riverbeds and floodplains. Potential sources gravel for future development might include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, or using sand/silt/foam composites. Gravel sites within the Planning Area would be most commonly found in riverbeds and floodplains.

In general, gravel extraction within the Planning Area would not be likely to have an effect on overwintering and spawning grounds, since those habitats represent only a small (less than 5 percent) portion of the Planning Area. However, if mining activities were conducted in these sensitive areas, the localized impacts could be substantial, possibly resulting in spawning failure and high mortalities of overwintering fish. Other detrimental affects that could occur during the open-water summer season include the blocking and rerouting of stream channels and increased silt concentrations resulting in reduced primary production, loss of invertebrate prey species, and disruption of feeding patterns for sight-dependent feeders (USDOI BLM 1989).

One of the beneficial aspects of mining in or near riverbeds and floodplains is that it creates deepwater pools. Extensive studies by the ADFG have shown that these pools may be used by fish to overwinter and spawn once the active site is abandoned (Hemming 1988, 1990, 1991, 1993, 1994, 1995; Hemming et al. 1989). Site reclamation could include constructing or enhancing access channels from surrounding streams and rivers. Therefore, properly planned and placed gravel extraction sites could provide fish with substantial and sustainable overwintering habitat in the future.

With the aforementioned considerations in mind, Lease Stipulation 40 prohibits gravel mine sites within the active floodplain of any river, stream, or lake unless the AO determines that there is no other alternative or that the site would ultimately enhance fish habitat. Mine site development and rehabilitation would follow the procedures outlined in *North Slope Gravel Pit Performance Guidelines* (McLean 1993).

Given the scarcity of gravel sites within the Planning Area, and the well-defined procedures in place for assessing the potential impact of site development on existing overwintering habitat and migratory corridors, any negative effect of mining on fish stocks would likely be minimal and very localized. Gravel extraction and use associated with the No Action Alternative would not be expected to have a measurable effect on Arctic fish populations in general, and could even have a positive effect by creating new overwintering areas.

Effects from Pad, Road, and Pipeline Construction. Improper placement and construction of drill pads, roadways, pipelines, bridges, and culverts could affect fish and fish habitat by eliminating, diverting, or otherwise impeding flow from small tributaries that connect rivers, streams, and lakes. Altering water flow characteristics could interfere with fish migrations to and from overwintering, spawning, and feeding grounds. Obstructions to fish movement are most common when culverts or low water crossings are not properly sized to allow for the passage of fish during these critical migration periods (Elliott 1982). Movement can be obstructed during periods of either high or low stream flow. Obstruction to stream and river flow and fish migrations may also occur if ice bridges are still in place once spring breakup begins.

Lease Stipulation 42 states that bridges, rather than culverts, be used for road crossings on all major rivers, and that any culverts that are necessary on smaller streams be large enough to avoid restricting fish passage or affecting natural stream flow. Lease Stipulation 24(d) requires that snow bridges be removed or breached immediately after use or before spring breakup. Lease Stipulation 41 prohibits the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain, unless otherwise permitted by the AO (special habitat zones identified in Lease Stipulation 39 have their own designated restrictions). Lease Stipulation 43 mandates that should the AO approve construction within a floodplain (road and pipeline crossings), natural drainage patterns would be identified prior to and maintained during and after construction.

Other threats to fish and fish habitat associated with gravel-based structures are erosion and subsequent in-stream sedimentation. Heavy sediment loads could silt out spawning areas and smother eggs, or interfere with respiration of newly emergent fry (Cairns 1968). Heavy sedimentation could also affect invertebrate communities that serve as food sources for fish. Whether the sediment loads attributable to pad and roadway erosion would be sufficient to affect invertebrate and fish communities is presently unclear. Denbeste and McCart (1984a, b) found that the excessive introduction of sediments from pipeline-related activities in Atigun Pass did not appear to have any detrimental effect on Atigun River benthic invertebrate communities or local fish communities. With the exception of a seasonal shift in the density in the stonefly *Podmosta*, the invertebrate benthic communities in the North Fork Chandler River were unaffected by heavy sediment loads associated with pipeline activities (Denbeste and McCart 1984a, b). In fact, chironomid larvae, which are the dominant food item for fish in the North Fork Chandler River, were actually more abundant in turbid waters than correspondingly clear tributaries. Given that high sediment loads characterize many North Slope rivers and streams during breakup and flooding, it is likely that fish and benthic invertebrate communities inhabiting them are somewhat adapted to frequent exposure to heavy sedimentation.

Erosion and sedimentation would also be controlled through the use of road surfacing techniques, adequate drainage configurations, adequate cross-drainage, and vegetation. Furthermore, Lease Stipulation 41 provides for a buffer zone by prohibiting the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain, unless otherwise permitted by the AO (special habitat zones identified in Lease Stipulation 39 have their own designated restrictions). Any 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.

Pipeline construction within the Planning Area would depend on the location and sequence of commercial-sized discoveries. Narrow streams could be crossed using elevated pipelines on suspension spans. Wider, shallow rivers could be crossed by trenching and burying insulated pipelines in the riverbed. All entrenched crossings would be constructed in the winter at locations selected to minimize disturbances to overwintering fish habitat. Once installed, suspended and entrenched pipelines would have no effect on stream and water flow characteristics within the Planning Area. All pipelines would be routed to avoid lakes, where feasible. The effects of pipeline leaks are discussed below under the “Effects of Spills” subheading.

Collectively, the lease stipulations and design requirements described above should provide adequate protection to the integrity of natural flow characteristics and water quality within the Planning Area. The construction and placement of drill pads, roadways, pipelines, bridges, and culverts under the No Action Alternative is not expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Causeways. The construction of solid gravel causeways along the coast has long been a sensitive fisheries issue (USACE 1980, 1984). These structures, which can extend several miles out to sea, are used for offshore drilling, year-round seawater extraction, and as docking facilities for sea-born supply. Their solid construction enables them to withstand the immense pressures of shifting coastal ice in late winter and spring. They also have the potential to physically block fish moving along the shore and/or alter coastal circulation and mixing patterns such that hydrographic conditions becomes inhospitable for anadromous and amphidromous fishes. The nearshore coastal zone is a prime summer feeding ground for these species. Studies conducted at Prudhoe Bay have documented some instances in which causeways have indeed altered, impeded, and even completely blocked anadromous and amphidromous fish from migrating along the coast (Fechhelm 1999; Fechhelm et al. 1989, 1999).

The BLM discourages the use of solid-fill causeways, preferring instead alternatives such as onshore directional drilling, elevated structures, or buried pipelines. Lease Stipulation 30 prohibits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas, and the construction of artificial gravel islands and bottom-founded structures in active stream channels, unless otherwise approved by the AO on a site-specific basis. If any such structures were approved, they would be designed, sited, and constructed in a way that would prevent large changes in nearshore hydrography and maintain free passage of marine, anadromous, and amphidromous fishes. Prohibiting causeways and docks in river mouths and deltas would offer further protection to migratory and marine fish species feeding in nearshore waters. Given the position of the BLM, any future construction of a causeway or dock would be approached with great caution. Overall, the construction of causeways under the No Action Alternative is not expected to have a measurable effect on anadromous and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Waterflooding. Waterflooding is a process that can increase oil recovery from production wells. Water is injected into selected areas of the reservoir to maintain subsurface pressure and promote fluid flow up to the surface. The process requires such vast amounts of water that the high demand usually overwhelms local freshwater sources. Therefore, seawater is used instead. Waterflooding systems consist of seawater intake and treatment plants located on the coast and an insulated pipeline that carries the seawater from the plant to production wells in the field. Oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area. The Prudhoe Bay Waterflood facility, constructed in 1981, can supply 92.4 million gallons of seawater per day. There are also seawater intakes at Endicott (11.6 million gallons per day), and Kuparuk (25.2 million gallons per day).

One of the initial issues surrounding the construction of these seawater intake facilities was the number of anadromous, amphidromous, and marine fish that might be entrained by the seawater intake. Seawater intakes are constructed with ports fronted by a concrete wall that descends from the surface of the water to a depth of 23 feet. These ports are designed to exclude ice from being entrained, but their presence also means that fish must pass under the 23-foot-deep barrier to reach the intake ports. Intakes are fitted with filter and diversion screens to prevent fish from entering them (Dames and Moore 1985-1988). The filter and diversion screens also contribute to very low velocity intake currents (Moulton 2004). Monitoring of the intakes and marine bypass systems was conducted for the Prudhoe Bay and Kuparuk waterflood facilities from 1984 to 1987 to assess entrainment and impingement effects on fish (Dames and Moore 1985-1988). Fish were rarely observed during the monitoring studies, and most of those that entered the system passed successfully. The results indicated that the intakes were performing as designed, and monitoring was discontinued after 1987.

The seawater intake facilities that would serve much of the Planning Area have been operational for years, and have apparently had no serious effects on fish migrating or foraging in the intake area. If seawater intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. It is not expected that seawater intake systems would have a measurable effect on anadromous and amphidromous fish under the No Action Alternative.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, bridge approaches, pads, and roads could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

The effects of oil spills on fish have been discussed in previous Beaufort Sea EISs (e.g., Sale 144 Final EIS; USDOI MMS 1996c), 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), and Northwest IAP/EIS (USDOI BLM and MMS 2003), that are incorporated here by reference and summarized. Oil spills have been observed to have a range of effects on fish (Malins 1977; Hamilton et al. 1979; Starr et al. 1981). 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 sub-lethal 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 [LC_{50}]) for fish generally are on the order of 1 to 10 ppm. Concentrations measured under the slicks of oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations of oil 1½ to 3.3 feet beneath a slick from the Tsesis spill ranged from 50 to 60 parts per billion (ppb; Kineman et al. 1980). Extensive sampling following the Exxon Valdez oil spill (about 260,000 bbl in size) also found hydrocarbon levels that were well below those known to be toxic or to cause sub-lethal 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, fish-containing body of water with restricted water exchange, lethal and sub-lethal effects would be expected on most of the fish and food resources in that waterbody. Mortality would be higher for larval fish because they are relatively immobile and are often found at the water's surface where oil concentrations would be high. Substrate contamination in spawning areas could result in high egg morality. Sublethal effects would include changes in growth, feeding, spawning, and reduced fitness. Adults 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 an isolated overwintering pool. Even lightly contaminated water, which might otherwise be insufficient to elicit lethal or sub-lethal effects in fish in an open-water environment, could have more detrimental impacts in confined overwintering areas. If sub-avoidance levels of contamination allowed fish to converge on an overwintering site, those fish would be forced to endure low-level conditions continuously over the entire winter. The time frame of contamination could also be highly variable. Stream flow begins in late May to early June as a rapid flood event that, in conjunction with ice and snow damming, can inundate extremely large areas in a matter of days. The flushing effect of the spring runoff could purge contaminants from rivers and streams, and possibly low-lying or open access lakes.

It is estimated that from 65 to 80 percent of crude oil spills associated with oil production would occur on a drilling pad (USDOI BLM and MMS 1998). Drilling pad oil spills are typically small and easily cleaned up. Lease Stipulation 41 prohibits the construction of all permanent oil and gas facilities within 500 feet of any active floodplain unless otherwise permitted by the AO. This buffer zone is designed to provide protection to surrounding water bodies. Crude-oil spills occurring on production pads are likely to have little or no effect on the surrounding environment and fish communities. The approximately 20 to 35 percent of crude-oil spills that occur off pads are typically associated with pipeline leaks. These spills generally remain restricted to an area of the tundra where they are more easily contained and cleaned up. Many off-pad spills make contact with snow, which can then be cleaned up before the oil reaches the tundra or waterways. Some spills could reach nearby streams, rivers, or lakes, but the volume of these spills would typically be small. Some fish in the immediate area of a spill could be affected, but the impact would largely remain localized. If the flow characteristics of surrounding waterbodies were sufficient to disperse the spill over a wider area, it would also have a diluting effect on what is already likely to be a small volume spill. Further, oil spill contingency plans and rapid response mechanisms are an integral part of the leasing process. These include required contingency plans that established procedures to insure prompt response, notification, and cleanup of any spill (Lease Stipulations 7, 8, 9, and 13), annual spill response-training (Lease Stipulation 11), and spill-response field drills (Lease Stipulation 12) for all spill-response personnel. Lease Stipulation 38 requires that all pipelines be constructed with the best technology for detecting corrosion and leaks. Because of the small volumes involved, management practices, and the substantial emphasis that is placed on oil-spill response plans and procedures, crude-oil spills associated with the No Action Alternative would have only a minor effect on freshwater, anadromous, or amphidromous fish populations in the Planning Area.

Typical refined-oil spills consist of aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills constitute 61 percent of refined-oil spills by frequency, and 75 percent by volume. Refined-oil spills occur in conjunction with oil exploration, and production and spill rates correlate directly with the volume of crude oil produced. Based upon oil-spill estimates, the average refined-oil spill is 29 gallons (USDOI BLM and MMS 1998). As described above for crude-oil spills, the small volume involved would, at worst, have a very localized effect on the surrounding environment and fish communities. There are also a number of lease stipulations that would further guard against refined-oil discharges. In addition to Lease Stipulations 7, 8, 9, 11, 12, and 13 described above for crude-oil spills, Lease Stipulation 10 requires that oil-clean-up material be stored at all fueling points and vehicle maintenance areas, and be carried by all vehicles moving overland. Lease Stipulation 14 requires that, except during overland moves and seismic operation, fuels and liquid chemical in excess of 600 gallons (single tank) and 1,320 gallons (multiple tanks) be stored within impermeable liners capable of containing 110 percent of stored volume. Fuel stations would have impermeable protection against overfills and spills. Excluding small caches of up to 210 gallons for boats and float planes, fuel storage areas would not be located within 500 feet of any waterway. Lease Stipulation 15 prohibits fuels from being stored on an active floodplain or on lake or river ice. Lease Stipulation 17 requires that all fuel containers be properly marked and contents identified. Lease Stipulation 16 prohibits refueling within 500 feet of any water body or in any active flood plain, but with exceptions for boats, float planes, and ski planes. Lease Stipulation 24(n) prohibits fueling equipment from entering the active floodplain of any waterbody. Given the small quantities of fuel involved and the safety requirements for operations on the oil field, it is not expected that refined-oil spills associated with the No Action Alternative would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area.

Lease Stipulation 5 protects fish and their habitats by regulating the intentional discharge and disposal of wastewater. Unless authorized by a NPDES permit, disposal of domestic wastewater into freshwater bodies would be prohibited. Surface disposal of reserve-pit fluids would also be prohibited unless otherwise authorized by the AO. Only subsurface disposal of produced fluids would be allowed in upland areas and wetlands unless otherwise authorized by the AO. Therefore, it is not expected that intentional discharges would have a measurable effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area under the No Action Alternative.

Effectiveness of Stipulations

Numerous lease stipulations were identified in the 1998 Northeast IAP/EIS ROD to effectively protect water quality and fish. Lease Stipulation 5 protects fish and their habitats by regulating the intentional discharge/disposal of wastewater. Lease Stipulations 7 through 17 and 24(n) would provide increased protection to fish and fish habitat from oil spills and during use, handling, and storage of refined oil products. Lease Stipulations 19 and 24 provide guidelines for, and limit the extent of, winter activities that could harm fish overwintering habitat. Lease Stipulation 20 protects overwintering fish and their habitat by limiting the withdrawal of water from rivers and streams during winter. Lease Stipulation 28 prohibits exploratory drilling in rivers, streams, and lakebeds. These steps would provide increased protection to fish habitat from unexpected drilling discharges, spills, and well waste. Lease Stipulation 30 limits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas; and the construction of artificial gravel islands and bottom-founded structures in active stream channels. Lease Stipulation 40 protects fish habitat by restricting the mining of gravel within the active floodplain of any river, stream, or lake. However, mining could be approved if it could be demonstrated that the site would ultimately enhance fish habitat. Lease Stipulations 41, 42, and 43 require that natural drainage patterns within the Planning Area be identified and maintained during and after construction of all permanent oil and gas facilities, roadways, airstrips, pipelines, bridges, and culverts. Lease Stipulation 41, which prohibits the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain unless otherwise permitted by the AO, also establishes a buffer zone to protect fish habitat from unplanned spills or discharges and sedimentation from gravel-based structures. Lease Stipulation 38 requires that all pipelines be constructed with the best technology for detecting corrosion and leaks.

Conclusion

The potential impacts to freshwater, anadromous, and amphidromous fish from oil exploration and development activities within the Planning Area under the No Action Alternative include winter seismic activities near sensitive overwintering habitats; loss of overwintering habitat from water withdrawals; degradation or blockage of water bodies used as fish migratory corridors or feeding grounds resulting from the construction and placement of pipelines, pads, ice and gravel roadways, airstrips, and causeways; loss or degradation of habitat from gravel extraction; crude and refined-oil spills; and loss or degradation of habitat from gravel structure erosion. Rigorous management and safety practices, planning requirements, and adherence to federal and state operational guidelines, procedures, and lease stipulations, including those specifically targeted for the Planning Area, are sufficient to minimize impacts from these sources (USDOI BLM and MMS 1998). While impacts from any of the above activities could affect small numbers of fish in a localized area, oil exploration and development activities that would occur under the No Action Alternative are not expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area.

The threat of localized oil and gas activities affecting local fish populations would increase if these activities occurred in particularly sensitive habitats, such as Teshekpuk Lake (least cisco and broad whitefish), the Tingmiaksiqvik River (broad whitefish and Arctic grayling), the Ikpikpuk and Miguakik rivers (broad whitefish, burbot, and Arctic grayling), Fish and Judy creeks (least cisco, broad whitefish, and Arctic grayling), and the deep water lakes. Although adjacent to, but not directly in, the Planning Area, the lower reaches of the Colville River Delta, including the Nigliq Channel, serve as the primary overwintering area for Arctic cisco and should be considered an especially sensitive area for planning purposes. Channels in the Colville River also serve as the primary migratory pathways for Dolly Varden.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production cease in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the smaller disturbance area, the potential for impacts to fish under this alternative would be about 50 percent less for oil and gas exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.7.2 Marine Fish

Nearly all of the 49 species of marine fish reported to inhabit the Beaufort Sea have a predominantly offshore, marine distribution year round. Eight species, identified in Section 3.3.5 (Fish), move onshore into coastal waters adjacent to the Planning Area during summer. The most abundant of these are Arctic cod, fourhorn sculpin, and Arctic flounder; fourhorn sculpin and Arctic flounder may travel considerable distances upriver.

As a preface to the following, it should be noted that marine fish species that inhabit nearshore coastal water during summer have extensive and widespread distributions along the coast. Fourhorn sculpin and Arctic flounder are typically among the most abundant species collected along the Beaufort Sea throughout Alaska and Canada (Kendel et al. 1975; Woodward-Clyde Consultants 1984; Bond and Erickson 1985, 1987; Moulton et al. 1986a; Philo et al. 1993a; Underwood et al. 1995; Griffiths et al. 1996; Fechhelm et al. 2000). Arctic cod are so abundant in marine waters of Arctic Canada and Alaska that Frost and Lowry (1983) believe that they are the most important consumer of secondary production in the Alaskan Beaufort Sea. Given their widespread distribution and abundance throughout the Beaufort Sea, it is highly unlikely that any point impact associated with oil and gas development could affect these marine species at the population level. The exception might be a catastrophic oil spill that was non-lethal to marine species in general, but which could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population.

Activities Not Associated With Oil and Gas Exploration and Development

As described above for freshwater, anadromous, and amphidromous fishes, non-oil and gas activities would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas activities occurring under the No Action Alternative would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

The following discussion of impacts from oil and gas activities includes impacts to marine fish and habitat within and adjacent to the Planning Area. This area is largely limited to the coastal zone and the lower reaches and deltas of some of the larger rivers during the open-water summer season.

On June 19, 1997, the U.S. Supreme Court decided in *U.S. v Alaska* No. 84 that the National Petroleum Reserve – Alaska included tidally influenced waters and the submerged lands underlying them. Given the relatively small tidal fluctuations characteristic of the Beaufort Sea, most of the coastal tidal area of the National Petroleum Reserve – Alaska is shallow and lies within the landfast ice scour zone in winter. For some of the following discussions, it is assumed that the marine habitat and the fish occupying it are outside the National Petroleum Reserve – Alaska proper during winter.

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys would be conducted within the Planning Area during the winter months from early December to mid-May. Because marine fish and their habitat lie outside the Planning Area in winter, seismic activities associated with the No Action Alternative are not expected to have a measurable effect on marine fish populations.

Effects from Water Demand. The source of water for building drill pads, roads, and airstrips would likely be freshwater bodies near the site of construction. Therefore, water withdrawal activities would have no effect on marine fish and their environment. Water withdrawal for the purposes of waterflooding does have implications for the marine system and is discussed separately below under the "Effects from Waterflooding" subheading.

Effects from Exploratory Drilling. Exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, it is not expected that exploratory drilling activities associated with the No Action Alternative would have a measurable effect on marine fish populations.

Effects from Gravel Extraction. If gravel extraction for pad and roadway construction were required in the Planning Area, it would likely occur in or near riverbeds and freshwater floodplains. Under Lease Stipulation 48, lessees are required to minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minuscule segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Under the No Action Alternative, it is unlikely that gravel extraction within the Planning Area would have a measurable effect on marine fish. In addition, gravel extraction would not potentially create overwintering habitat as it might for freshwater fish, since all marine fish overwinter at sea.

Effects from Pad, Road, and Pipeline Construction. Pad, road, and pipeline construction would largely be limited to freshwater habitat regions of the Planning Area, and would not establish a footprint in marine or coastal habitats. Lease Stipulation 48 requires that lessees minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. Future exceptions could be the construction of docking facilities along the coast of the Planning Area, although it seems likely that sea borne re-supply would involve the already operational docking facilities at West Dock. The BLM's position on causeway construction along the coast is described below. Pad, road, and pipeline construction under the No Action Alternative would not be expected to have a measurable effect on marine fish populations.

Effects from Causeways. The construction of solid gravel causeways along the coast is less of an issue for marine fish than it is for anadromous and amphidromous fish. The major migration for two of the most dominant species, fourhorn sculpin and Arctic flounder, is inland soon after breakup. Once in coastal waters, these sedentary species do not undergo the extensive alongshore migrations up and down the coast that are characteristic of Arctic cisco and the amphidromous species. Potential blockage to alongshore movement is less critical. Arctic cod are so abundant throughout Arctic waters that any localized disruption to their movement would not have a lasting impact on the species. Considering the BLM's regulations on the use, design, and monitoring of causeways that might be constructed along the coast in the future (see "Freshwater and Anadromous/Amphidromous Fish" above), it is not expected that the construction of causeways under the No Action Alternative would have a measurable effect on anadromous or amphidromous fish populations in and adjacent to the Planning Area.

Effects from Waterflooding. It is not expected that waterflooding would have a measurable effect on marine fish, for the same reasons that were given above for anadromous and amphidromous fish.

Effects of Spills

Hydrocarbon spills can impact marine fishes of any life history 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 could be impacted. Hydrocarbons may be introduced into the coastal/marine environment as a result of marine vessel overboard discharges or facility spills. A detailed and extensive discussion of the potential lethal and sublethal effects of oil toxicity on finfish and other marine organisms is provided in the Northwest IAP/EIS (USDOI BLM and MMS 2003).

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field (see "Freshwater and Anadromous/Amphidromous Fish" above), there is a very low likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically important or measurable impact to marine fishes. Therefore, Lease Stipulations 7 through 17 and 24(n), which provide increased protection to freshwater, anadromous, and amphidromous fish and fish habitat from oil spills and during fueling use, handling, and storage of refined oil products, would also serve to protect marine fish and their habitat. Lease Stipulation 5 prohibits the discharge of produced waters into open or ice-covered marine waters less than 33 feet in depth. However, discharge in deeper water could be approved by the AO.

Effectiveness of Stipulations

In general, most of the lease stipulations associated with the No Action Alternative are designed to protect the freshwater, anadromous, and amphidromous fish within and adjacent to the Planning Area. Lease Stipulation 48 provides some protection to the marine environment by requiring that lessees minimize the impact of development on wetlands, which includes basin-complex wetlands and coastal wetlands. Lease Stipulations 7 through 17 and 24(n), which provide increased protection to waterbodies within and adjacent to the Planning Area from oil spills and during fueling use, handling, and storage of refined oil products, would also protect marine fish and their habitat. Lease Stipulation 5 protects the marine habitats by regulating the discharge of produced waters into open or ice-covered marine waters.

Conclusion

In general, marine fishes of the Beaufort Sea are insulated from many potential environmental impacts associated with oil development in the Planning Area. Most of the coastal tidal area of the Planning Area is shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters. The bulk of the population would not be directly subject to the effects of river gravel extraction, pad, road, and pipeline construction, sedimentation from gravel erosion, and the potential blockage of migratory corridors. Rigorous management and safety practices, planning requirements, and adherence to federal and state operational guidelines, procedures, and lease stipulations, including those specifically targeted for the Northeast National Petroleum Reserve – Alaska, would further minimize the potential for impacts to marine fish from these sources.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil development in the Planning Area (the occurrence of which is unlikely) could affect these species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and stringent oil-spill-response safety requirements for operations on the oil field would be in place, such an event is unlikely.

Overall, it is not expected that oil exploration and development activities under the No Action Alternative would have a measurable effect on marine fish populations in or adjacent to the Planning Area. Since nearly all exploration and development activity would occur onshore under all alternatives, impacts to marine fish resources under the No Action Alternative would be minor and similar to, or slightly less than, those that could occur under the final Preferred Alternative and alternatives B and C.

4.3.7.3 Essential Fish Habitat

Although there are no federally-managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. The Magnuson-Stevens Act calls for direct action to stop or reverse the continued loss of fish habitats for species that are under this jurisdiction. Therefore, EFH is a specific classification term that only applies to Pacific salmon and not to any other species in the Planning Area. Freshwater Essential Fish Habitat for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Salmon EFH in the fresh waters of Alaska includes virtually all coastal streams south of about 70° North latitude (USDOI BLM and MMS 2003). Marine EFH includes all estuaries, tidewater, and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone (EEZ). Salmon EFH in marine waters is designated as an area within the EEZ down to a depth of 1,640 feet (500 meters; North Pacific Fishery Management Council 1999).

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites have been identified for these species. Although both species are taken in the Colville and Itkillik rives fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

For the reasons described above under “Freshwater, Anadromous, and Amphidromous Fish,” the proposed development activities under the No Action Alternative would not be likely to affect salmon EFH.

4.3.7.4 Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities were to jeopardize the fish species upon which the fisheries depend. For the reasons outlined in the “Freshwater, Anadromous, and Amphidromous Fish” section above, non-oil and gas activities are not expected to have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

The potential effects of oil development on local subsistence fisheries is a critical issue in determining the extent to which the Planning Area might be opened to exploration and production, and in establishing the guidelines under which development might proceed.

The Iñupiat community of Nuiqsut operates subsistence fisheries in the Colville River Delta year-round, with most fishing effort occurring in summer and fall. Summer fishing is concentrated in the Nigliq Channel in the western Colville River Delta, in the Colville River just upstream of Nuiqsut in the Tiragruag area, and in Fish Creek. The primary target is broad whitefish, but Dolly Varden, humpback whitefish, pink salmon, and chum salmon are also taken incidentally. There is heavy broad whitefish, burbot, and grayling fishing in the lower Ikpikpuk and Miguakiak rivers, and south of the fork with the Chipp and Ikpikpuk rivers (George 2004). The major fishery is the Colville River under-ice gill net fishery that occurs during autumn. Fishing effort is concentrated in the upper

Nigliq Channel near Nuiqsut, the lower Nigliq Channel near Woods Camp, and the Nigliq Delta. Arctic cisco is the principal species targeted, accounting for nearly 70 percent of the total annual harvest. Other targeted species include least cisco, broad whitefish, and humpback whitefish.

Because of the importance of subsistence fishing to Native communities, special areas within the Planning Area have been designated as off limits to many development activities. By virtue of their long-standing subsistence use, or because they may serve as important migratory or overwintering habitat for fish species that support the subsistence fisheries, the areas listed below receive special consideration. No permanent oil and gas facilities, except essential transportation crossings (roads and pipelines) are allowed within the following setback designations, as identified in Lease Stipulation 39 (USDOI BLM and MMS 1998):

Ikpikpuk River - Within ½ mile from the bank along its entire length within the Planning Area (eastside only).

Miguakiak River - Within ½ mile from either bank of the river along its entire length.

Teshekpuk Lake - Within ½ mile from the bank around its entire perimeter.

Fish Creek - Within 3 miles from either bank of the creek downstream from the eastern edge of Section 31, Township 11 North, Range 1 East, U.M., or within ½ mile of the creek farther upstream.

Judy Creek - Within ½ mile from either bank of the creek extending from the mouth to the confluence of an unnamed tributary in Section 8, Township 8 North, Range 2 West, U.M.

Colville River - Within 1 mile of the western bluff or bank of the river extending along its entire length as described in the Raptor, Passerine, and Moose LUEA.

Deep Water Lakes - Within ¼ mile from any fish-bearing lake within the deep lake zone III, as identified in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998).

Kikiakrorak River - Within 1 mile from each bluff or bank downstream from Township 2 North, Range 4 West, U.M. Designated for raptor, passerine, and moose resources, but would also provide additional protection to fish resources.

Kogosukruk River - Within 1 mile from each bluff or bank (including the four tributaries off the southern bank) downstream from Township 2 North, Range 3 West, U.M. Designated for raptor, passerine, and moose resources, but would also provide additional protection to fish resources.

On a case-by-case basis, essential pipeline and road crossings could be permitted by the AO within these setback zones. However, pipeline and road crossing are prohibited within the Teshekpuk Lake setback, with no exceptions. In addition, road crossings are prohibited within the Colville River setback, without exceptions.

In addition to the setbacks described above, Lease Stipulation 61 mandates that exploration, development, and production operations be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities. The lessee is required to consult with subsistence communities, the NSB, and the Subsistence Advisory Panel to discuss potential conflicts that might arise from any proposed exploration, development, or production operations. Parties of interest would attempt to resolve issues to the benefit and acceptance of all. Unresolved conflicts would be resolved by the AO in consultation with all parties involved.

As part of this consultation process, additional considerations would be given to the special areas described above. In addition to listed setbacks, consultation would be required for any planned activity within the following spatial designations as identified Lease Stipulation 62 (USDOI BLM and MMS 1998):

Ikpikpuk River - A 2-mile zone from the east bank of the river along its entire length.

Miguakiak River - A 3-mile zone from either bank of the river along its entire length.

Fish Creek - 1) A 3-mile zone from either bank of the creek downstream from the eastern edge of Section 31, Township 11 North, Range 1 East, U.M., and 2) a 2-mile zone around the creek farther upstream.

Judy Creek - A 2-mile zone from the east bank of the river along its entire length.

Colville River - A 2-mile zone from the east bank of the river along its entire length; from the western bluff or bank of the river extending along its entire length as described in the Raptor, Passerine, and Moose LUEA.

Subsistence issues are also covered by Lease Stipulation 59, which states that during exploration, development, and production, the lessee must develop and implement a plan to monitor the effects of these activities on subsistence. Lease Stipulation 60 requires that lessees not unreasonably restrict access by subsistence users in oil field development areas.

Subsistence fisheries are also protected by all of the lease stipulations outlined in the "Freshwater and Anadromous/Amphidromous Fish: Effects of Oil and Gas Activities" section above. Some of these lease stipulations provide general protection for species that are targeted by the fisheries, including lease stipulations that protect fish and their habitat from winter activities (Lease Stipulations 19, 20, and 24), disruption to natural drainage characteristics of the region (Lease Stipulations 41, 42, and 43), gravel mining (Lease Stipulation 40), drilling and production discharges (Lease Stipulation 28), the construction of causeways, docks, artificial gravel islands, and bottom-founded structures (Lease Stipulation 30), and oil spills (Lease Stipulations 7 to 17 and 24[n]).

Effectiveness of Stipulations

Taken collectively, the lease stipulations discussed above serve as the guidelines for oil industry development within the Planning Area, coupled with the development and consultation setbacks that have been established for special subsistence habitat, are sufficient to protect subsistence fisheries over the long term. Therefore, it is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the No Action Alternative.

Conclusion

Any general increase in exploration and development activities would not likely have a high direct effect on fish subsistence issues. Lease Stipulation 39 specifically protects areas deemed important to subsistence fisheries from additional exploration and development. Exploration within these areas is under the rigorous oversight of the AO, under consultation with federal, state, and NSB regulatory and resource agencies, the Subsistence Advisory Panel, Native communities, and subsistence users themselves.

In general, impacts to fish subsistence species from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish subsistence species from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the smaller disturbance area, the potential for impacts to fish subsistence species under this alternative would be about 50 percent less for oil and gas exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.8 Birds

This section discusses the potential effects to non-threatened and non-endangered bird species that could result from management actions in the Planning Area under the No Action Alternative; a discussion of effects to threatened bird species is given in Section 4.3.10 (Threatened and Endangered Species). Approximately 80 species of birds commonly or regularly occur in the Planning Area. Most of these species, including loons, waterfowl, shorebirds, raptors, passerines, seabirds, and ptarmigan, are migratory and occur in the Planning Area only during the summer breeding season. Most of the activities that could potentially affect birds in the Planning Area would result from oil and gas exploration and development. Other activities that could potentially affect birds in the Planning Area include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could affect tundra nesting birds by causing: 1) temporary or permanent habitat loss; 2) various types of disturbance related to equipment and facility noise, vehicular and air traffic, and pedestrian activities, which could result in displacement from foraging, nesting and/or brood-rearing habitats; 3) increased predation from predators attracted to areas of human activity; and 4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills. Under the No Action Alternative, Teshekpuk Lake and virtually all of the Goose Molting Area north and east of the lake would be unavailable for oil and gas leasing, and no surface activity would be allowed in a 5 to 6 mile band around the southern portion of the Goose Molting Area (Map 2-2). In addition, lease stipulations have been designated under this alternative that would help to mitigate potential negative impacts that could result from the various activities.

4.3.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects of Disturbance

Summer Camps

Various types of disturbances could affect tundra nesting birds near summer camps. Noise and ground activities could disturb feeding, nesting, or brood-rearing birds, causing temporary or permanent displacement from feeding or nesting areas and potentially affecting energy budgets and productivity. Although pedestrian traffic has been shown to be particularly disruptive to some waterfowl and raptors (Roseneau et al. 1981; Ritchie 1987; Johnson et al. 2003b), some birds may also acclimate to predictable daily activities of camp personnel. Disturbance to birds from aircraft traffic and camp activities would likely have the greatest affect within approximately 2,280 feet of the camps and little or no effect beyond 6,500 feet (Johnson et al. 2003b). Ward et al. (1999) also studied brant response to fixed-wing and rotary-wing aircraft and reported brant response to aircraft at a lateral distance to 3 miles, although the majority of birds responded to aircraft that were within a lateral distance of ½ mile or less. The greatest response to aircraft altitude occurred between 1,000 and 2,500 feet. Tundra-nesting birds near summer camps could suffer mortality or egg loss due to predation by predators attracted to anthropogenic sources of food at camps. However, the lease stipulations associated with this alternative would require proper handling of food and waste to eliminate predator attraction to areas of human activity. If possible, summer camps should be located in areas away from habitats used by species of special agency concern, such as yellow-billed loon and buff-breasted sandpiper, and species with declining population trends on the ACP, such as red-throated loon and Sabine’s gull, to minimize potential effects of disturbance (Larned et al. 2003).

River Transport

Summer boat traffic could occur on the Colville, Kogosukruk, Kikiakrorak, and Ikpikpuk rivers for recreational or subsistence activities, or to re-supply camps along these rivers. Numerous studies have reported on the effects of boat disturbance to birds (e.g., McGarigal et al. 1991; Steidl and Anthony 1996); this activity could potentially affect nesting gyrfalcons, peregrine falcons, and rough-legged hawks in the Colville River Raptor, Passerine, and Moose LUEA and the Ikpikpuk River area. The current levels of boat activities on these rivers have apparently not impacted raptors negatively, as some populations, particularly the peregrine falcon population, have been increasing on the ACP in recent years (Ritchie and Wildman 2000).

Subsistence Hunting

Subsistence hunting would result in bird mortality during spring or fall hunts, as well as potential loss of productivity due to egg collection. Other subsistence hunting and fishing activities could cause disturbances in areas where activities occurred. However, these activities would probably occur in localized areas, and would therefore be unlikely to adversely affect bird populations.

Wildlife Surveys

Aerial surveys for wildlife in the Planning Area could include fixed-wing aircraft surveys for waterfowl and caribou, or helicopter surveys for tagging and subsequent radio-tracking of grizzly bears or caribou. Low-level fixed-wing aerial surveys would probably have little effect on birds due to the short amount of time during which aircraft would be in a particular area. Ward et al. (1999) reported a decreasing level of response to aircraft overflights by brant with increasing lateral distance of aircraft. The majority of birds responded at lateral distances of ½ mile or less. Wildlife telemetry studies involving the use of helicopters could cause greater disturbance to birds due to the potential for prolonged periods of hovering over target animals, and take-offs and landings required for deploying ground personnel for attachment of transmitters. Additionally, pedestrian traffic has been shown to be more disruptive to some waterfowl species than other types of disturbance (Johnson et al. 2003b). The effects to birds from these activities could range from temporary displacement from preferred feeding habitats to nest abandonment and loss of production for the breeding season.

Waste Removal

Clean-up activities at abandoned sites in the Planning Area could involve the use of fixed-wing aircraft or helicopters to access remote areas. The effects of this traffic would be similar to those described above for conducting aerial surveys or for mobilizing and re-supplying summer camps. Ground activity by workers on foot could be more disruptive to some bird species than other types of disturbance (Johnson et al. 2003b).

Summer Camp Support

Aircraft activity to mobilize and re-supply summer camps could disturb birds along continually-used flight corridors and near airstrips during take-offs and landings. Effects of this type of visual and noise disturbance could range from temporary displacement from preferred habitats to nest abandonment. Fixed-wing and helicopter flights for mobilization and re-supply of summer camps would be intermittent, and could occur several days or weeks apart. It may be easier for birds to acclimate to flights that occur on a regular daily basis than to flights that occur on a more random basis. Birds could also suffer mortality due to collisions with aircraft.

4.3.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Most seismic surveys and exploration drilling activities would occur during the winter months when most birds are not present in the Planning Area. Therefore, these activities would have no direct impacts on most species. A few species, including snowy owl, gyrfalcon, ptarmigan, and common raven, which could be present in the Planning Area during winter, could be temporarily displaced from preferred feeding areas by oil and gas exploration activities. There is also a potential that ravens could be attracted to seismic camps.

The use of airguns for boat-based seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Disturbance may result not only from airgun use but also from boat activity (Rodgers and Smith 1995). Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to birds nesting near the lakeshore, only birds using habitats in the open water of the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities, such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting surveys after the completion of the nesting and brood-rearing period would eliminate the potential for nest abandonment and loss of productivity.

Winter exploration activities could indirectly affect tundra-nesting birds during the summer breeding season. Ice-roads and ice-pads are sometimes used for transportation and storage of drilling and exploration equipment. Construction of these ice-roads and ice-pads could temporarily alter tundra habitats by compressing standing-dead vegetation or delaying the growth and development of vegetation, due to protracted ice melt. The altered vegetation could reduce the amount of suitable habitat for nesting birds, but these impacts would be small and would be likely to persist for 1 or 2 years (Walker et al. 1987a, b). In areas where winter ice-roads and ice-pads were constructed annually, varying the location of the roads and pads as directed under the lease stipulations could help mitigate potential impacts to tundra vegetation and nesting birds.

In some cases, equipment could be stored on ice-pads specially designed and constructed to last through the summer and into the following winter. The tundra under the footprint of these ice-pads would be lost as feeding, nesting, or brood-rearing habitat during the course of that season. Locating these summer ice pads in drier areas would help to reduce potential impacts to loons, waterfowl, and some shorebird species associated with wetter habitat types, but could increase the potential impacts to species that use upland habitats such as plovers and buff-breasted sandpiper.

Water used in the construction of ice roads and pads would be withdrawn from deep lakes in areas adjacent to the road and pad locations. Winter water withdrawal could alter lakewater levels and adjacent habitats, although flooding and recharge during spring break-up would likely minimize the potential for long-term effects (Rovansek et al. 1996). Lake recharge during spring would probably limit affects on invertebrate populations used for food by birds in the spring though this has not been studied directly. Bergman et al. (1977) and Derksen et al. (1981) reported that lakes with pendent grass had high levels of use by birds and seemed to be important to loons and waterfowl. Avoiding water withdrawal from lakes with pendent grass may reduce potential effects on waterfowl.

Rolligons and track vehicles used during seismic exploration could leave tracks on tundra habitats that would be observable for several years (Kevan et al 1995). These tracks could affect vegetation, soil chemistry, soil invertebrates, and soil thaw characteristics, key components of bird habitat. The most noticeably affected areas would include terrain with considerable microtopographic relief caused by mounds, tussocks, hummocks, and high-centered polygons. Wet areas are less likely to be affected than dry areas (Walker 1996). Snow acts as a buffer against these impacts; therefore avoiding areas with low snow cover, in addition to using lightweight vehicles, dispersing traffic patterns, and minimizing sharp turns, could help to minimize damage to vegetation used by birds (Walker 1996).

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment. Garbage and shelter associated with winter exploration activities could also attract predators such as Arctic foxes and ravens, which may cause increased predation pressure on tundra-nesting birds. However, lease stipulations would require proper handling of non-hazardous waste to avoid human-caused changes in predator populations. This policy has apparently been successful at the Alpine field, where Johnson et al. (2003b) reported no increase in the numbers of most predator species after development. The one exception was common raven, which became more common and nested at the Alpine field after development.

Development and Production

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, heavy equipment use, and oil-spill clean-up activities could cause disturbances that would affect tundra-nesting birds. These disturbances could result in temporary or permanent displacement from preferred foraging, nesting, and brood-rearing habitats, decreased nest attendance, nest abandonment, and increased energy expenditures that could affect the physiological condition of birds and avian survival or reproduction. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the species and number of individuals in the area, and the time of year. Impacts would be most likely to occur if facilities were located in habitats with high bird concentrations, or if species with low population numbers or declining populations were disturbed. Species of particular concern include yellow-billed loon, red-throated loon, Sabine's gull, long-tailed duck, and buff-breasted sandpiper (Lanctot and Laredo 1994; Brown et al. 2000; Donaldson et al. 2001; Larned et al. 2003; Mallek et al. 2003). The Goose Molting Area and the Colville River are areas with high wildlife values that would be unavailable for oil and gas leasing and development under the No Action Alternative.

Most construction activities, including pipeline installation, and gravel mining and placement for oil field infrastructure (i.e., roads, airstrips, and pads, camps, staging areas, and processing facilities), would be conducted during the winter. With the exception of a few resident species, most birds are not present in the Planning Area during winter; therefore, there would be little disturbance to most birds.

During the summer, birds could be subjected to disturbances caused by vehicular and pedestrian traffic, and by noise from equipment on roads or at facilities, including large trucks hauling cranes and other equipment and road maintenance equipment on access roads and pads. In the North Slope oil fields, these types of disturbances have been documented for waterfowl, and have been shown to have greater effects on geese feeding close to roads than on geese feeding further away from them (Murphy et al. 1988; Murphy and Anderson 1993). Disturbances would be most prevalent during the pre-nesting period when birds gather to feed in open areas near roads, and during brood-rearing and fall staging when some geese exhibit higher rates of alertness in areas near roads than do birds in undisturbed areas (Murphy and Anderson 1993). Disturbance would occur most often within 160 feet of roads. However, Murphy and Anderson (1993) reported disturbances to birds as far as 500 to 685 feet from roads. Troy (1988) reported that most common shorebird species occurred in lower densities near roads in the Prudhoe Bay oil field than in areas away from roads. This apparent avoidance of roads, however, may have been related to an avoidance of heavily dusted areas on tundra adjacent to roads with high traffic levels rather than an avoidance of vehicular activity itself. Disturbance from vehicular traffic could affect activity and energy budgets and have negative impacts on nest density and success for some birds. Higher shorebird densities may occur in areas near the coast compared to inland areas and disturbance that occurred in coastal areas may have a greater impact on shorebirds than inland disturbances (see Map 3-19).

Some evidence suggests that pedestrian traffic may have a greater impact on some birds than vehicular traffic. During a study of the effects of disturbance related to the Lisburne Development in the Prudhoe Bay oil field, Murphy and Anderson (1993) reported that of the more common sources of disturbance, humans on foot elicited the strongest reactions from geese and swans. Ritchie (1987) reported that pedestrians caused greater disturbance to nesting raptors than other sources of disturbance. Johnson et al. (2003b) reported that aircraft and pedestrians elicited higher responses by nesting geese at the Alpine field than other sources of disturbance. Restricting or reducing the level of foot traffic on gravel roads and pads could help to reduce the potential for disturbance to foraging, nesting, or brood-rearing birds.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The potential for disturbance to waterfowl from aircraft is well documented (e.g., Schweinsburg 1974; Ward and Stehn 1989; Derksen et al. 1992; McKechnie and Gladwin 1993; Ward et al 1999). Johnson et al. (2003b) conducted the most thorough study of aircraft disturbance to waterfowl in the Arctic at the Alpine field. Responses of birds to aircraft included alert postures, interruption of foraging behavior, and flight. Aircraft disturbances could displace birds from feeding habitats and negatively impact energy budgets. Gollop et al. (1974b) and Ward et al. (1999) suggested that helicopters may be more disturbing to wildlife than low-flying fixed-wing aircraft, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 feet AGL often caused spectacled eiders to flush, while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. In a simulation study, Miller (1994) suggested that altering direct helicopter routes in the Goose Molting Area would likely reduce the impacts of potential weight loss on molting brant substantially. The greatest disturbance to brant would result from flights parallel to the coast and 1 mile inland. Other studies have reported little response by molting waterfowl to aircraft over-flights (Gollop et al. 1974a). Under the No Action Alternative, permanent oil and gas facilities would be prohibited in high value waterfowl habitat surrounding Teshekpuk Lake and most aircraft overflights in this area would likely be at altitudes sufficiently high to avoid disturbance to waterfowl. Aircraft disturbance would be likely to affect waterfowl and other bird groups in portions of the Planning Area open to development, although under the No Action Alternative, the effects of aircraft disturbance would likely be lower than that of the other alternatives.

The potential effects of routine aircraft flights into airstrips would range from bird avoidance of certain areas to abandonment of nesting attempts or lowered survival of young. The likelihood that noise associated with aircraft would have a negative impact on birds would probably be greatest during the nesting period, when the movements of incubating birds are restricted. The highest levels of aircraft noise would occur during takeoffs as engines reached maximum power levels. During landings, aircraft noise levels would be reduced as engine power decreased. In the Planning Area, aircraft activity would likely be greatest during the construction period, when more personnel and equipment would be transported to areas being developed than during the production period, when activity levels would be reduced (Johnson et al. 2003b).

The Alpine field avian monitoring program was a multi-year project designed to identify the potential effects of noise and disturbance from aircraft on birds nesting near the airstrip and on large waterbirds during brood-rearing (Johnson et al. 2003b). Other sources of disturbance included vehicle and pedestrian traffic, and predators. When compared to pre-construction numbers, waterfowl nests near the airstrip declined in the area within 3,250 feet of the airstrip after construction began (Johnson et al. 2003b). However, the number of post-development nests increased in the area between 3,250 and 5,000 feet from the airstrip. The decline could not be directly linked to disturbance, as other factors, such as lower temperatures and more severe flooding later into the breeding season during construction years, may also have influenced nest densities. During years of heavy construction, white-fronted goose nest sites were apparently displaced to habitats similar to those used prior to construction, but located further from the airstrip. Johnson et al. (2003b) suggested that preferred white-fronted goose nesting habitats in the Alpine field area had not been saturated with nests prior to development, and that suitable nesting habitat was available in areas away from the airstrip.

White-fronted geese showed some changes in distribution in relation to sources of disturbance at the Alpine field, including increased noise levels, aircraft, vehicles, and pedestrians. However, when comparing the nest densities of shorebirds and passerines on intensively studied plots near and away from the airstrip, nest densities of both groups were higher on study plots near the airstrip than on plots greater than 5,000 feet from the airstrip (Johnson et al. 2003b).

At the Alpine field, white-fronted geese at failed nests were more likely to take incubation recesses than geese at successful nests. A higher frequency and duration of recesses may allow for increased predation by jaegers, gulls, ravens and foxes at unattended nests. The probability of taking a recess increased as noise level increased, when aircraft were present, when the number of vehicles decreased, and when pedestrians were present. Geese nesting less than 6,500 feet from the airstrip were more likely to take a recess than birds greater than 6,500 feet from the airstrip. Of the various disturbance types, helicopters were the least predictable because they did not have a restricted flight pattern. Incubating white-fronted geese and tundra swans showed similar response to helicopters and fixed-wing aircraft, although monitored nests were closer to the airstrip than to the helipad. Airplanes and pedestrians elicited the highest rates of response from incubating geese, and vehicles elicited the lowest. Nevertheless, successful white-fronted goose nests were generally closer to the Alpine field airstrip, the flight path, and the nearest gravel source than unsuccessful nests, although most comparisons were not substantially different (Johnson et al. 2003b).

Johnson et al. (2003b) also reported on tundra swans and yellow-billed loons nesting in proximity to the Alpine field airstrip. There was no difference among years in the mean distance of tundra swan nests relative to the airstrip, closest gravel source, or aircraft flight path. In 1998, a tundra swan nested successfully 520 feet northeast of the airstrip, despite daily helicopter activity near end of the airstrip during late June and early July. Another pair of tundra swans nested successfully from at least 1997 through 2002 at a site approximately 1,470 feet southwest of the airstrip and 470 feet from the infield road. These nests were successful despite their proximity to the airstrip and their locations under the takeoff and approach patterns of aircraft. Disturbance effects of the various components of the Alpine field apparently were not severe enough to cause major changes in tundra swan nest-site selection. Similarly, no evidence was found that the development affected the distribution and abundance of yellow-billed loon nests located near the airstrip, although the sample size was small. Johnson (1984) reported that at least three successful common eider nests were located within 975 feet of a helicopter pad on Thetis Island that averaged approximately 12 trips per day. Although the potential exists for displacement of some nesting birds near routinely used aircraft landing sites as a result of numerous overflights, landings, and takeoffs, some birds may habituate to routine air traffic.

During post-breeding studies in southwest Alaska, Ward et al. (1999) studied brant response to fixed-wing and rotary-wing aircraft and reported brant response to aircraft at a lateral distance to 3 miles, although the majority of birds responded to aircraft that were within a lateral distance of ½ mile or less. The greatest response to aircraft altitude occurred between 1,000 and 2,500 feet. Derksen et al (1992) also reported that molting brant in the Teshekpuk Lake Goose Molting Area were disturbed by helicopter overflights and that brant did not habituate to the overflights. Low-level helicopter survey flights to monitor pipelines for potential oil spills or leaks could also disturb tundra-nesting or post-breeding birds. Routine flights would be of short duration and occur in a particular area, and would likely cause minimal disturbance to birds. However, temporary displacement from preferred feeding, brood-rearing, or molting habitats could affect energy budgets of some birds, and incubating birds could be temporarily displaced from nests.

Watercraft. Several types of watercraft could be used during the summer for transportation of equipment and supplies and for oil spill response training drills. Summer barge traffic, which would transport equipment and supplies to staging areas along the coast and could temporarily displace molting and staging waterfowl, would likely occur in offshore waters of the Planning Area from mid-July through October. Displaced waterfowl would probably move to adjacent habitats or return to their original habitats after the barges passed through the area. There are also documented accounts of staging waterfowl hitting barges in low/poor light conditions late in the year associated with storm events. Barge traffic would not be expected to substantially impact molting waterfowl. Most of the area adjacent to the coastline would not be available to oil and gas leasing, and the potential for barge traffic to displace waterfowl under this alternative would likely be lower than under the final Preferred Alternative and alternatives B and C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The vessels used would likely be small, maneuverable crafts, suitable for work in shallow waters. Spill response training activities would have the potential to disturb foraging, nesting, or brood-rearing waterfowl and other birds. Boat activity could cause alert postures, disruption of feeding behavior, and flight in waterfowl, shorebirds, and raptors (Burger 1986, Belanger and Bedard 1989, Steidl and Anthony 2000). Rodgers and Smith (1995) and Rodgers and Schwikert (2001) determined the required set-back distances for minimizing the potential for boat disturbance to various bird groups. Suggested buffer zones around areas of activity ranged from 325 feet for shorebirds to 600 feet for wading birds. Establishing buffer zones around known areas of waterfowl and shorebird activity, during oil spill response training activities, or conducting these activities in areas not frequented by these birds, could help to reduce negative impacts to birds.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would cause the loss of tundra-nesting bird habitat. During construction of oil field roads and pads, tundra covered by gravel, as well as tundra associated with gravel mine sites, would be lost as nesting, brood-rearing, and foraging habitat. This loss of habitat would continue through the duration of the operation of the proposed development, and would be permanent unless habitat restoration measures were successfully implemented after abandonment of the oil/gas field. However, the development scenario indicates that at abandonment of the field, gravel would not be removed but would be allowed to bed naturally. The potential long-term impacts associated with habitat loss could be minimized by locating gravel roads, pads, airstrips, and mine sites away from areas with high concentrations of tundra-nesting birds and areas that may be critical to species of special concern or species with declining populations. Under the No Action Alternative, Lease Stipulation 39 would provide for setbacks from lakes in the Deep Water Lakes Area south of Teshekpuk Lake; permanent oil and gas facilities could be prohibited within these setbacks, to be determined on a case by case basis. Although this lease stipulation was designed primarily to protect fish habitat, it could also help to mitigate potential impacts to bird habitats.

Under the development scenario for the No Action Alternative, the gravel footprint for roads, pads, airstrips, staging areas and gravel extraction sites would range from approximately 20 to 90 acres. Some birds that nest at sites covered by gravel would be displaced and may not be able to find suitable habitat for breeding. Others would likely move to adjacent areas to nest. Troy and Carpenter (1990) reported that at least some shorebirds displaced by winter gravel placement may nest in adjacent habitats in subsequent years, and Johnson et al. (2003b) reported that waterbirds nesting near the Alpine field that were displaced from nesting sites by gravel placement probably moved their nests to nearby adjacent habitats. In addition, there may be a functional loss of habitat in areas near roads and pads if development-related disturbances preclude birds from utilizing these habitats. Impacts related to habitat loss may be more severe for species that have specific habitat requirements or are species of special concern due to low population numbers, such as buff-breasted sandpipers that use dry, upland sites, should these sites be lost due to gravel placement. Under the No Action Alternative, no permanent oil and gas facilities would be located in areas considered to be of high value to birds in the entire area surrounding Teshekpuk Lake, including the Teshekpuk Lake Goose Molting Area (Lease Stipulations 21 and 24[k]). Therefore, the number of birds displaced from feeding, nesting, or molting/brood-rearing habitats due to gravel placement and mining activities under the No Action Alternative could be lower than under the final Preferred Alternative and alternatives B and C. However, the potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. Without specific information on locations of potential developments, it is difficult to make comparisons on the effects of habitat loss among alternatives. Lease Stipulation 39 provides for setbacks for permanent oil and gas facilities along specified rivers and creeks to protect nesting raptors.

Temporary Habitat Loss. In addition to permanent habitat loss, temporary loss of habitat associated with gravel placement could occur on tundra adjacent to gravel structures, where accumulated snow from snow plowing activities or snowdrifts would become compacted and lead to a delayed snowmelt. Delayed snowmelt persisting into the nesting season could preclude tundra-nesting birds from nesting in those areas. Delayed snowmelt resulting from the construction and use of ice roads during winter activities could also cause temporary habitat loss. Ice-roads could also cause compaction of vegetation, thereby reducing the availability of cover for nesting birds in the ice-road footprint. Potential impacts to tundra nesting birds from ice-roads could be reduced by alternating ice-road routes annually and by avoiding routes near known areas of high bird concentration. Lease Stipulation 18 would require that ice roads be offset from year to year to minimize impacts to vegetation.

Water withdrawal from lakes during ice-road construction could lower the level of lakes and affect waterfowl and shorebirds that use adjacent habitats, particularly small islands and shoreline areas that are used for nesting by loons and waterfowl. Changes in the surface levels of lakes due to water withdrawal would be dependent on the amount of water withdrawn, the volume of the lake, and the recharge rate. Lease Stipulation 20 places restrictions on the amount of water that could be withdrawn from individual lakes. In most cases, spring flooding during break-up would likely be sufficient to restore water levels (Rovansek et al. 1996).

Dust deposition can affect bird habitat by causing early green-up on tundra adjacent to roads and pads, which could attract waterfowl and shorebirds early in the season, when other areas were not yet snow free. Dust deposition could also increase thermokarst and soil pH, and reduce the photosynthetic capabilities of plants in areas adjacent to roads (Walker and Everett 1987; Auerbach et al. 1997). Traffic levels, air traffic (including helicopters), and wind can all influence the amount of dust that may be deposited adjacent to roads and pads. Troy (1988) reported higher densities of birds on lightly dusted sides of roads in the Prudhoe Bay oil field than on heavily dusted sides, although red-necked phalarope was an exception to this generality. Rodrigues (1992) also reported that red-necked phalarope nest densities were higher on tundra near abandoned gravel pads than in areas away from pads, and suggested that phalaropes may be attracted to areas of thermokarst near the edges of gravel pads.

Impoundments created by gravel structures could cause temporary or permanent flooding on adjacent tundra. Impoundments could be ephemeral, drying up early during the summer, or they could become permanent water bodies that would persist from year to year (Walker et al. 1987a, b; Walker 1996). Tundra covered by impounded water could result in a loss of nesting habitat for some birds. However, impoundments could also create new feeding and brood-rearing habitat that would be beneficial to some bird species. Noel et al. (1996) reported that the areas occupied by impoundments in the Prudhoe Bay area generally supported higher waterfowl densities than the same areas did prior to development. Kertell (1993, 1994) reported few differences in invertebrate numbers and numbers of Pacific loons when comparing use of natural ponds and impoundments in the Prudhoe Bay area. He also reported that ducks were more abundant on impoundments than natural ponds, although this difference was not statistically significant. Although the formation of impoundments could be beneficial to some species associated with water, impoundments that flooded upland habitats could negatively impact species such as plovers and buff-breasted sandpiper that use upland habitats for nesting or as courtship displaying areas. The effects of impoundments could be minimized or eliminated with culverts to allow for adequate cross-drainage at gravel structures. However, culverts blocked by snow or ice could prolong the spring flooding period (Walker 1996).

Mortality. Bird mortality could result from road kills due to collisions with vehicular traffic. Within the TAPS, road kills were the greatest source of bird mortality, particularly along the Dalton Highway where dust shadows caused early green-up along the road that attracted birds (TAPS 2001). The primary groups affected were grouse and passerines. Although the number of birds killed was not quantified, the level of mortality was probably minor when compared to the size of local populations. Reduced speed limits along roads, particularly during periods of poor visibility, could help to reduce the potential for bird collisions with vehicles.

Some bird mortality could also result from collisions with structures such as elevated pipelines, buildings, towers, boats, or bridges. However, visibility is generally good during long summer daylight hours in the Arctic, and collision has apparently been only a minor source of bird mortality associated with the TAPS (TAPS 2001). Bird collisions with powerlines in the Prudhoe Bay oil field have also been reported (Anderson and Murphy 1988).

Some predators, such as ravens, gulls, Arctic fox, and bears, would be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites are present (Eberhardt et al. 1982, 1983a, b; Day 1998; Burgess 2000). The availability of anthropogenic food sources, particularly during the winter, could increase winter survival of Arctic foxes and contribute to increases in their population. Increased levels of predation due to elevated numbers of predators could in turn impact nesting and brood-rearing birds. Major negative impacts have occurred at the Howe Island goose colony in the Sagavanirktok Delta from predation by Arctic fox and grizzly bears (Johnson 2000a), and Arctic foxes and glaucous gulls are predators of common eider and brant eggs and young on the barrier islands (Noel et al. 2002). Arctic fox predation can also impact tundra nesting shorebirds and passerines (Day 1998, Rodrigues 2002). In recent years, oil field operators have installed predator-proof dumpsters at camps and implemented new refuse handling techniques to minimize the attraction of predators to the landfill. In addition, oil field workers undergo training to make them aware of the problems associated with feeding wildlife. At the Alpine field, Johnson et al. (2003b) reported that numbers of predators and levels of predation after development did not increase in the area compared to pre-development levels. Lease Stipulations 1, 2, and 3 require proper disposal of refuse to avoid human-caused changes in predator populations.

There has been speculation that researchers conducting studies on avian nest density and success may inadvertently affect the results by attracting predators to nests and broods (Bart 1977, Strang 1980, Johnson 1984, Götmark 1992). Birds that are flushed from their nests during surveys may be more susceptible to nest predation than undisturbed birds. However, Vacca and Handel (1988) reported that covering eggs with down after incubating geese were flushed from nests essentially negated the effect of attracting predators during nest visits. Nonetheless, ongoing activities with repeated disturbance by researchers could cause some mortality to eggs and chicks of tundra nesting birds.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation of oil fields on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads, compared to the surrounding tundra, could also cause either complete loss of nesting habitat for a season or compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as that caused by traffic during construction and operations. If pads, roads, and airstrips were not revegetated, their value to birds would be lessened. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that currently existing in the area could be created and used by birds, though the precise mix of habitat types would likely not be the same as what prevailed at the time of disturbance. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material’s toxicity and the amount ingested, ingestion of foam could cause sickness or mortality, though the number of birds harmed would likely be very small.

Effects of Spills

Oil spills or leaks onto tundra or marine habitats could negatively impact birds in numerous ways. Oil could come in contact with and adhere to birds’ feathers, causing the feathers to lose their insulating capabilities and result in hypothermia (Patten et al. 1991). This effect would be particularly severe for birds that come in contact with water where feather integrity is necessary to maintain water repellency and buoyancy. Birds could also suffer toxic effects from ingestion of oil by consumption of food contaminated by an oil spill or from oil ingestion resulting from preening of oiled feathers (Hansen 1981). Oil contacting bird eggs could cause toxic effects to embryos (Patten and Patten 1979, Stickel and Dieter 1979). Oil could come in contact with eggs directly as a result of a spill, or indirectly from oiled feathers of incubating adults.

Topographical features could confine oil spills and leaks from pipelines located in terrestrial habitats. Spilled oil could also enter a lake or pond and be contained by the banks of these waterbodies. McDonald et al. (2002) developed a hypothetical spill scenario involving terrestrial and aquatic spills in the Prudhoe Bay area that covered 24 and 186 acres, respectively. Assuming a nest density of 0.6 nests per acre on 145 acres of tundra covered by a terrestrial oil spill, approximately 87 nests would be affected by the spill.

During spring flooding, an oil spill could spread to a much larger area, depending on the amount of oil spilled, surface topography, and the extent and duration of flooding. Oil entering a river or stream would have the potential to spread into delta or coastal areas, where impacts to waterfowl (including sensitive species such as yellow-billed and red-throated loons, eiders, long-tailed duck, and brant) could be more severe. The potential for an oil spill to enter major rivers or streams would be minimized by Lease Stipulation 39 that provides setbacks of ½ to 3 miles from specified rivers. Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, would be prohibited within these setbacks, although pipelines could be permitted for water crossings in some of these areas.

In marine habitats, wind and currents would have the potential to spread spilled oil over a larger area than in terrestrial habitats; therefore, birds residing in marine habitats could be particularly susceptible to the negative impacts of an oil spill. Offshore development has not been proposed for the Planning Area; however, a potential spill from an onshore source could spread to offshore marine areas, or a fuel barge could spill oil in offshore waters. A spill occurring during the summer breeding season would have a greater impact on birds than a spill occurring during the winter, when most birds are on wintering grounds. An oil spill spreading into offshore waters from Harrison Bay to Smith Bay could affect molting and staging waterfowl, including yellow-billed and red-throated loons, long-tailed ducks, scoters, and eiders (Fischer et al. 2002). An oil spill in coastal zone habitats of the Colville River Delta, which support thousands of post-breeding shorebirds, could affect large numbers of birds, particularly dunlin, although 17 other species have been reported from the area (Andres 1994). An onshore spill along the coastline could affect molting and brood-rearing brant and other geese and waterfowl, although very little coastline would be available for oil and gas leasing and development activities under the No Action Alternative.

Cleanup of spilled oil during ice-covered periods or periods of broken ice may be difficult, and lingering oil may be present and may be hazardous to spring migrating birds. Lingering effects from a winter spill could impact returning birds during the following breeding season if clean-up activities did not adequately remove contaminants from bird habitats. In addition, oiled carcasses of dead birds washing up on beaches or shorelines could also be hazardous to scavenging birds such as gulls, golden eagle, gyrfalcon, and peregrine falcon, and to mammals such as Arctic fox and grizzly or polar bear, that feed on these carcasses.

4.3.8.3 Effectiveness of Stipulations

Numerous lease stipulations were developed to protect birds and their habitats within the Planning Area. These include Lease Stipulations (1 through 17) to ensure that solid, liquid, and hazardous wastes do not impact birds or their habitats, and to reduce the potential for garbage to attract animals that may prey upon birds to exploration and development sites. Lease Stipulation 21 ensures that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while Lease Stipulation 24(k) prohibits seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting period. Disturbances caused by aircraft are controlled within the Goose Molting LUEA under Lease Stipulations 53 and 54. Wetlands used by shorebirds and other birds are given special protection (Lease Stipulation 46). In addition, there are numerous Lease Stipulations that regulate the types of activities that can occur near water bodies, including rivers and streams, types of equipment that can be used, and types of exploration and development activities that can be conducted in the Planning Area, to protect birds and their habitats.

4.3.8.4 Conclusion

Bird groups that could be affected by activities in the Planning Area include loons, waterfowl, shorebirds, raptors, passerines, seabirds, and ptarmigan. Most species in these groups migrate to wintering areas located outside of the Planning Area and would not be directly affected by winter exploration or construction activities, although their habitats could be affected. A few species, such as ptarmigan, gyrfalcon, and snowy owl, could remain in the Planning Area during the winter and could be temporarily displaced from preferred feeding or hunting habitats by winter exploration or construction activities. During the exploration period, summer fixed-wing or helicopter aircraft activity could result in disturbance to tundra-nesting birds, causing temporary or permanent displacement from preferred feeding, nesting, or brood-rearing habitats in localized areas near areas of activity. Aircraft support for summer research camps or for cleanup of abandoned sites in the Planning Area could also impact birds near these sites. Most aircraft disturbance would be confined to the area within approximately 2,300 feet of the site, and little disturbance would be likely beyond 6,500 feet. Predators attracted to areas of human activity could also impact tundra-nesting birds by causing depredation of eggs and young; however, lease stipulations designed to eliminate attraction of predators to camps or equipment maintenance sites would help to mitigate potential increases in predators. Although lease stipulations promote practices to discourage bird nesting at facility sites, it may be difficult to prevent ravens from nesting on buildings or other structures.

Activities related to oil development and production, such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities, could cause disturbances that would affect tundra-nesting birds. Most vehicle disturbance would likely be confined to areas within 160 to 685 feet of roads and pads. Disturbance related to aircraft activity would likely be confined to areas within 2,300 feet of landing strips, and little disturbance would be likely beyond 6,500 feet. Pedestrian traffic would be likely to cause more disturbance than other activities, as birds may acclimate to routine aircraft or vehicular activity and to equipment or facility noise.

Barges and other vessels could temporarily displace loons and waterfowl from preferred offshore feeding, staging, or molting areas. However, birds would likely move back to preferred areas after vessels passed through the area or continue to use adjacent areas, and the effects of vessel traffic would likely be minimal. Smaller watercraft on rivers or lakes used during oil spill training exercises also cause disturbance to tundra-nesting birds. Surveys conducted prior to development would help identify areas with low levels of bird use that would be suitable for oil spill training activities and cause the least impact to tundra-nesting birds. Conducting activities during time periods of low bird activity may also reduce the potential impacts of spill exercises.

Permanent habitat loss would result from gravel placement for roads and pads, and at gravel mine sites. Temporary habitat loss or alteration could also occur in areas adjacent to gravel roads due to snow and/or dust deposition, thermokarst, and the formation of impoundments. Some types of habitat alteration, such as the formation of impoundments, could be beneficial to some species while having a negative impact on others. Withdrawal of water from source lakes during winter construction of ice-roads could impact tundra-nesting birds if water levels in source lakes were affected. Lake surveys conducted prior to water withdrawal, state regulations limiting the amount of water that may be withdrawn from specific lakes, and the ability of lakes to naturally recharge, would likely eliminate any potential negative impacts related to water withdrawal.

Bird mortality could result from collisions with vehicular or vessel traffic, or collisions with towers, buildings, pipelines, bridges, or other facilities. However, it is expected that collisions would only be a minor source of bird mortality. Bird mortality could also result from the attraction of predators to areas of human activity. Lease stipulations that require proper disposal of garbage to avoid human-caused changes in predator populations would likely minimize potential impacts to tundra-nesting birds from increased predation pressure. Additional bird mortality could result from subsistence hunting activities if oil field infrastructure were to provide hunters with access to previously inaccessible areas.

An oil spill could impact tundra-nesting birds on terrestrial or marine habitats. Potential impacts to tundra-nesting birds would depend on the location and size of the spill and on the time of year. Due to the actions of wind and currents, a marine spill would have a greater potential to spread to a large area than a terrestrial spill. A marine spill could impact molting and brood-rearing waterfowl and loons.

The expected number of fields and the level of development under the No Action Alternative would be lower than under the other alternatives. Therefore, the potential effects of disturbance, habitat loss and alteration, and bird mortality due to development would also likely be lower under the No Action Alternative than the other alternatives.

In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to birds under this alternative would be about 50 percent less for oil and gas exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives.

4.3.9 Mammals

4.3.9.1 Terrestrial Mammals

Terrestrial mammals that could be affected under the No Action Alternative include species such as caribou from the TLH, CAH, and WAH, moose, muskox, grizzly bear, wolf, wolverine, red fox, Arctic fox, and small mammals (e.g., Arctic ground squirrel, ermine, least weasel, lemming, voles, and shrews). For most species, effects would be localized (e.g., in close proximity to seismic lines, pipelines, gravel pads, and other facilities).

Activities Not Associated With Oil and Gas Exploration and Development

Activities such as resources inventories, aerial surveys, and research camps would have short-term effects on terrestrial mammals.

Effects of Disturbances

Non-oil and gas activities that could disturb terrestrial mammals include aerial surveys and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps, seismic operations, and overland moves. Overland moves and seismic activities would occur during the winter on frozen tundra, ice roads, or stable shorefast ice. Other activities would occur from summer to early autumn (June-September). Potential causes of disturbance to terrestrial mammals from seismic and inventory activities and overland moves would be helicopter traffic (1 to 2 round trips per day for 3 to 6 weeks per survey party), fixed-wing aircraft traffic (2 trips per week per party), surface-vehicular traffic on ice roads, and humans on foot. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of approximately 160 feet and to exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150 to 1,000 feet (Calef et al. 1976). These documented reactions were responses to aircraft that circled and repeatedly flew over caribou groups. While aircraft associated with aerial wildlife surveys might circle or fly over a group of caribou more than once, aircraft associated with support of survey and inventory camps would pass over caribou only once on any given flight to or from a camp. Recreational and research camps could result in short-term displacement (24 hours to several weeks) or harassment of terrestrial mammals and minor disturbance to the vegetation and soil due to trampling. Potential habitat disturbance from large camps would be reduced by using existing sites whenever possible. Impacts would likely be localized and restricted to within about a mile of activities.

In some cases, recreational camps could attract grizzly bears and Arctic and red foxes, resulting in the shooting of bears that learn to associate humans with food sources, or the shooting of foxes that present a risk to personnel safety because of rabies. Any such losses would be minor to the bear or fox populations on the North Slope, but would contribute to cumulative effects.

Small rodents, such as lemmings and voles, and their predators, such as ermines and least weasels, would likely be affected locally, with direct mortality and loss of habitat possibly resulting from paleontological excavations and by overland moves. However, any such losses should be minor to populations of these species on the North Slope.

Effects of Spills

Very small fuel spills (probably less than 1 bbl) could occur in association with resource-inventory surveys, recreational activities, and overland moves. These spills would likely 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. Under current BLM regulations, fuel spills would be cleaned up immediately, if possible. However, it is not clear how many spills go unreported. Small spills associated with non-oil and gas activities would not be expected to have a substantial effect on terrestrial mammals in the Planning Area.

Oil and Gas Exploration and Development Activities

Under the No Action Alternative, approximately 87 percent of the Planning Area would be available for leasing and possible development. The development scenario under the No Action Alternative assumes that one to three oil fields would be discovered and developed south of the Teshekpuk Lake area. Impacts to terrestrial mammals are expected to come from motor vehicle, foot, and aircraft traffic; seismic operations; oil spills; gravel mining; and construction. The primary impacts to terrestrial mammals would likely be those associated with disturbance and habitat alteration.

Effects of Disturbances

Seismic. Impacts to habitat used by terrestrial mammals would be minor, as most seismic activities would occur during the winter on frozen tundra or ice. Potential causes of disturbance to terrestrial mammals from seismic activities would include surface vehicular traffic on frozen tundra or ice and fixed-wing aircraft traffic. In most cases, these activities would cause short-term (a few minutes to greater than 1 hour) displacements of and/or disturbance to terrestrial mammals. Where 3-D seismic exploration survey lines were located only 500 to 2,000 feet 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 would likely be greater in extent, frequency, and duration. During winter, moose move to the riparian areas of large rivers; in the Planning Area they are most likely to concentrate along the Colville River. The TLH caribou are present throughout much of the Planning Area during the winter, with large numbers congregating in the central and eastern portions. Therefore, caribou would likely be encountered regularly during seismic surveys in the Planning Area.

Previous studies of the effects of oil and gas exploration on muskox in Alaska and Canada focused on disturbances associated with winter seismic operations. Some muskox reacted to seismic activities at distances up to 2½ miles 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 muskox away from the seismic operations did not exceed 3 miles and had no apparent effect on muskox distribution (Reynolds and LaPlant 1986). Unlike caribou, muskox are not able to travel and dig through snow easily. In the winter, they search out sites with shallow snow, and greatly reduce movements and activity to conserve energy (USDOI USFWS 1999). Muskox survive the winter by using stored body fat and reducing movement to compensate for low forage intake (Dau 2001). Because of this strategy, muskox may be more susceptible to disturbances during the winter. Repeated disturbances of the same animals during winter could result in increased energetic costs that could increase mortality rates. Depending upon the location of the seismic exploration, impacts on muskox would be non-existent to minor. Mixed-sex groups of muskox have occurred in the Planning Area, but there is currently no evidence of year-round occupancy. However, potential habitat occurs throughout, and populations outside of the Planning Area are gradually expanding their range. Most likely, seismic operations would be expected to encounter no more than one to a few bulls. Breeding groups would more likely be affected, if at all, by seismic crews accessing the Planning Area from overland routes from the Kuparuk River area.

Exploration activities and human presence pose potentially serious disturbances to denning bears. In one study, seismic activities within 1.2 miles of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds et al. 1986). The investigators suggested that seismic testing activities within about 600 feet of a den may cause abandonment of the den. Under the No Action Alternative, Lease Stipulation 75 prohibits exploration activities within ½ mile of occupied grizzly bear dens. If den locations were known in the areas in which seismic work occurred, impacts to hibernating bears would be reduced. Overall, it is expected that impacts to bears would be minor, since the level of proposed seismic work is low. In addition, the area of highest potential for oil is the lowest density bear habitat (the highest bear density is located in the extreme southern portion of the Planning Area).

Seismic camps could result in localized disturbance and/or displacement of terrestrial mammals for up to a few days. Bears and foxes could also be attracted to camps, and in rare instances mortality could result. However, no impacts are anticipated. Since seismic camps generally move at least once a week and proper handling of wastes would be regulated by lease stipulations, the potential for bears or foxes to be attracted to human food sources would be minor. In addition, most seismic activity would occur when bears were hibernating.

The potential effects of oil and gas activities on wolverines would include disturbance from air and surface-vehicle traffic, and increased human presence. Wolverines are considered a shy and secretive species that is present at very low densities and 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 (Brower 1997 *in* USDOI BLM 1997). Wolverines have been sighted to the west of Teshekpuk Lake, along the Colville, Kikiakrorak, Kogosukruk rivers, and Judy and Fish creeks.

Small rodents could be locally affected through direct mortality and by minor loss of habitat from overland traffic associated with seismic operations. Their predators, such as short-tailed weasels, could be indirectly affected in local areas due to a reduction in prey. These losses would likely be minor at the population level.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Impacts to terrestrial mammals from exploratory drilling would be similar to those caused by seismic activity, though affecting a smaller area and lasting longer. Habitat impacts would be minimal, as exploratory drilling would occur during the winter on frozen tundra, packed snow roads, and ice roads, when most terrestrial mammals would be absent from the area, dormant, or present at low density.

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 would be expected to cause short-term (a few minutes to 1 hour) displacements of and disturbance to terrestrial mammals. Camps at drill sites could result in localized disturbance and displacement of terrestrial mammals for several weeks to months.

Exploratory drilling operations and ice roads would traverse TLH caribou wintering areas and could encounter some wintering caribou from the WAH, although most WAH caribou winter a considerable distance to the south of the Planning Area. 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 would be temporary, it is not expected that there would be any long-lasting effects on caribou.

The winter distribution of muskox and moose is such that exploratory drilling activities would be unlikely to have any impacts on these species unless they occurred in the southern portion of the Planning Area. Under such a circumstance, impacts would include short-term displacement or disturbance of animals, as described above. Impacts to Arctic fox, grizzly bear, and wolverine would be similar to impacts from seismic activities, but would be more frequent and/or longer in duration. There would be a greater potential for foxes to be attracted or habituated to camps associated with drill sites, as they would be in place for several months, rather than a week or less. Small rodents could be locally affected due to direct mortality and minor loss of habitat from snow compaction or ice road construction. However, these losses should be minor at the population level.

Oil Development. The primary effects of oil development on terrestrial mammals would result from the 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 habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of the movement of TLH caribou from insect-relief habitat to foraging areas.

<u>Caribou</u>

Although much of the construction associated with oil development would occur primarily during winter, development would bring year-round facilities and activities within caribou range. Caribou could be disturbed by traffic, humans on foot, and low-flying aircraft (Calef et al. 1976; Horejsi 1981; Shideler 1986; Tyler 1991). The response of caribou to disturbance would be highly variable, ranging from no reaction to violent escape reactions depending on: 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 (Johnson and Todd 1977; Davis et al. 1980). 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 (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 caribou herds, however, and have had less exposure to human activities and are less likely to be tolerant of disturbances than animals habituated to activities at Prudhoe Bay.

Some displacement of the CAH caribou from a portion of the calving range near the Prudhoe Bay and Milne Point facilities has been documented (Cameron et al. 1981, 1983, 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 the 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 apparent. Ground observations of caribou within the Kuparuk area from 1978 to 1990 indicated that caribou increasingly avoided zones of intense activity, especially during the calving period (Smith et. al. 1994). Lawhead et al. (2004) reported that maternal caribou with calves were displaced from areas near both the Tarn and Meltwater roads during calving and up to 2 weeks post calving. Very few calves were observed within 1.2 miles of either road during the calving period and densities appeared to be reduced as far away as 2.4 miles. Traffic convoying on the Meltwater road was not effective at reducing calving displacement to less than 1.2 to 2.4 miles, or reducing the disturbance reactions of caribou within 1,640 feet of the road. Data analyzed by Cameron et al. (2002) suggested that having roads too closely spaced would depress calving activity within the oil field complex. Other studies (Roby 1978; Cameron et al. 1981, 1983, 1992; Pollard and Ballard 1993) and literature reviews (Cronin et al. 1994, 1998) indicate some seasonal avoidance of habitats within 3 miles of existing Prudhoe Bay area facilities by cows and calves during calving and early post-calving periods (May through June).

The WAH and CAH caribou core calving ranges lie outside of the Planning Area, while the TLH caribou calving area is concentrated in the northern section of the Planning Area near Teshekpuk Lake. Under the No Action Alternative, no permanent oil and gas surface facilities would be permitted in the Teshekpuk Lake Surface Protection Area, which is a subset of the Teshekpuk Lake Special Area. Exploratory or delineation wells would not be allowed in this area; however, ice roads, seismic activities, winter overland moves, and other nonpermanent activities could be authorized. Under such conditions, development under the No Action Alternative would not result in the loss of any core calving habitat. On-site development would not be expected to effect caribou movements within the calving range, and no calving activity would be displaced unless access to calving grounds was disrupted.

In some years, 5 to 10 percent of the WAH caribou may winter on the North Slope. Depending upon the location of oil development infrastructure, movement of both TLH and WAH caribou from winter range to calving grounds could be disrupted by oil 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 could be delayed in reaching the calving grounds because of delays in crossing roads or attempts to detour around roads or oil fields. Calving en route to calving grounds could result in reduced calf survival. One issue arising from oil field development is the ability of caribou to move freely through the oil fields to insect-relief habitats. Caribou under extreme insect harassment initially move rapidly to insect-relief habitat. For the TLH caribou, this is often coastal areas from west of Barrow to Smith Bay, outside of the Planning Area, and to the north and east of Teshekpuk Lake, predominately in the Teshekpuk Lake Special Area where permanent development would be prohibited under the No Action Alternative. After reaching these habitats, caribou 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 alter movements of caribou from coastal insect-relief areas to foraging habitat further inland. Impaired movements between insect-relief habitat and inland foraging areas could reduce food intake and slow rates of weight gain (Smith 1996). The probability of producing a calf is directly related to body weight and 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-relief 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 1970s, had become rare. An analysis of the distribution of radio-collared female CAH caribou from 1980 to 1993 suggested that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970s (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 5 feet above the ground. Movement of insect-harassed caribou through the Kuparuk oil field has been examined in several studies (Johnson and Lawhead 1989; Lawhead et al. 1994; Smith et al. 1994). In the Kuparuk oil field where all pipelines are elevated a minimum of 5 feet 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 et al. (1994) monitored caribou movement in relation to roads and increasing development in the Kuparuk Area from 1978 to 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 have been avoiding the core areas of industrial activity.

Development in the TLH caribou insect-relief habitat would be unlikely under the No Action Alternative, since the majority of the insect-relief habitat is covered by the Teshekpuk Lake Surface Protection Area. When mosquito numbers decline and oestrid fly harassment increases in mid-July, the large aggregations of caribou generally disperse into smaller groups of animals seeking insect-relief habitats. These insect-relief habitats include a variety of unvegetated and elevated sites. Coastal areas apparently provide little relief from fly harassment (Ballard et al. 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 more aggregated at this time than during the fall and winter, and may move long distances when insect harassment occurs. At this time, oil field facilities and roads that temporarily delay movement of animals back to foraging habitats may negatively affect caribou movements. In the Planning Area, the majority of insect-relief habitat during the oestrid fly season is located around Teshekpuk Lake, although caribou tend to be more dispersed than they are during the mosquito season. Most oestrid fly relief habitat is located within the Teshekpuk Lake Surface Protection Area, and would not be affected under the No Action Alternative. However, caribou do range further south in search of relief and do enter areas where development is possible.

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 (greater than 15 vehicles per hour). Isolated pipelines or roads had lesser effects on crossing success. Groups did eventually cross the roads and move through the oil field. 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 per hour, or traffic levels of greater than 15 vehicles per 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 (Lampe 1997 *in* USDOI BLM 1997). A decline in the frequency with 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).

A pipeline from an oil field(s) in the northern and central Planning Area would connect to the TAPS through facilities at the Kuparuk oil field, while an oil field in the extreme south of the Planning Area could connect to TAPS by a southern route. Any pipelines 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 a mile of the pipeline. It is expected that disturbance effects on caribou would 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 was completed. Disturbance of important riparian areas would be avoided. Oil field facilities (other than buried pipeline) would not be located within 1 mile of major stream drainages.

The mere physical presence of a pipeline would probably have a minimal effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall prevented some animals from crossing under or over the pipeline. During the winter, caribou movements could be blocked or interrupted along the elevated (5-foot) pipelines by snow drifting under the pipeline (Nukapigak 1997 *in* USDOI BLM 1997). Such an effect should be temporary and localized, however, with the caribou moving across the corridors at locations with shallower snow. Construction of additional pipelines from the Northwest National Petroleum Reserve – Alaska to the Kuparuk area would add to the cumulative effect of development on TLH and CAH caribou. Construction of a pump station in the National Petroleum Reserve – Alaska would result in the loss of up to 40 acres of tundra habitat and the temporary displacement or disturbance of caribou during construction.

Development of an oil field(s) could result in impacts to wintering TLH caribou; WAH caribou are unlikely to be encountered during winter since most winter south of the Brooks Range. Depending on the location of the development, some TLH caribou migration movements could be temporarily disrupted or diverted by air and surface traffic along pipelines and roads within the oil field. Wintering animals could also be temporarily disturbed or avoid the development area. Repeated disturbance of the same animals during the winter could have negative impacts on the energy balance of individual animals.

Development of oil fields would require large amounts of gravel (up to 5 million cubic yards). Gravel is a scarce resource in the National Petroleum Reserve – Alaska, and if local sources of gravel were not available, alternative strategies could 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 major effects on the CAH caribou, and would likely have a minimal impact on the TLH and WAH caribou.

Under the No Action Alternative, some terrestrial mammals could be affected by offshore drilling from an ice island, and subsequent oil development on the coast of the Planning Area in Harrison Bay, in a small area south of Atigaru Point. This area is used by TLH caribou as insect-relief habitat during the mosquito season and during the oestrid fly season. Barging of supplies could also occur in this area but is not expected to have a substantial impact on terrestrial mammals. Noise and disturbance from these activities would be local and are not likely to affect terrestrial mammal populations.

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. Unless an oil field were to be developed in the extreme south of the Planning Area near the Colville River, development would be unlikely to impact moose. A number of studies show that the TAPS has no major effect on moose movements and habitat use near the pipeline (Sopuck and Vernam 1984, 1986; Eide et al. 1986). In one study, 94 percent of 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 feet (Sopuck and Vernam 1984). Under the No Action Alternative, in-field pipelines and a crude oil pipeline (elevated 5 feet) connecting with the TAPS would not be expected to affect moose habitat use and movements regardless of the location of the field(s). Air and surface traffic could also disturb moose, but the number of animals affected would likely be minor, and no impacts to the population would be anticipated; any air or surface traffic disturbance should be of short duration.

If gravel were mined from riverbeds in the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could destroy or degrade 20 to 90 acres of moose habitat.

Muskox

Potential effects of oil and gas development activities on muskox 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 (Garner and Reynolds 1986; Clough et al. 1987). Muskox 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, muskox may be more likely to habituate to these activities because of this year-round exposure. Muskox have been exposed to the TAPS and the Dalton Highway with the expansion of their range west from the Arctic National Wildlife Refuge and the Kavik River. Oil development activities would be unlikely to impact muskox. However, as populations continue to expand west into the Planning Area, they could move into areas of development. Construction of oil pipelines to Prudhoe Bay could result in temporary disturbance of mixed-sex groups of muskox in the Colville River and Fish Creek areas. Repeated disturbance of the same group during the winter, by air traffic, for example could negatively affect the energy balance of individual animals and potentially contribute to winter mortality. Under the No Action Alternative, lease stipulations are in place to minimize impacts to muskox—for example, by avoiding activities close to riparian habitat, prohibiting hunting by employees, limiting ground transportation, and controlling air traffic.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, pump stations, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. In one study, seismic activities within 1.2 miles of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds et al. 1986). The investigators suggest that seismic testing activities within about 600 feet of the den may cause abandonment of the den. A similar effect could occur from construction activities within 600 feet 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 could also disturb 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 North Slope (McLellan and Shackleton 1989). The increase in human presence and resulting encounters with grizzly bears associated with recreation and tourism are temporary in nature. The establishment of permanent settlements (oil fields, mines, etc.), however, usually leads to human-bear encounters on a regular basis and to conflict, particularly if bears learn to associate humans with food (Harding and Nagy 1980, Schallenberger 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, some bears are likely to habituate to the noise and human presence, leading to an increase in encounters. Individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some would 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 sub-adults (Shideler and Hechtel 2000).

The attraction of grizzly bears to garbage or other food odors at oil and gas 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 respond by making an extra effort to get to the food sources that they are conditioned to having.

Under the No Action Alternative, oil exploration and development would likely attract some grizzly bears to oil production facilities, and could result in the loss of some bears due to interactions with humans, including roadkills. The level of impacts to bears would be dependent upon the location of the oil fields. Bears are much less common in the ACP than in the foothills 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 were attracted to development, impacts could increase over time. Shideler and Hechtel (2000) estimated bear densities in the oil field region (Prudhoe Bay and Kuparuk river Unit) to be 1.5 bears per mi^2, more than twice the highest density estimate for the ACP. Because this higher density could not be attributed to anthropogenic food sources, the authors speculated that the oil field region was higher quality habitat than other parts of the ACP.

Gravel mining in riparian corridors along major rivers could result in the disturbance and loss of 20 to 90 acres 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.

Lease Stipulations 24, 29, 39, and 41 restrict industrial activities close to riparian habitat and bear dens, and should reduce impacts.

Wolves

Potential effects on wolves include short-term disturbances from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence associated with oil development. If caribou abundance were negatively affected by oil development, wolf abundance could in turn be affected. Wolves are generally not abundant in the Planning Area, and the highest populations are located in the southern portions of the area. Therefore, oil development in the high potential area would have minimal impact on wolves.

Wolverines

The potential effects of oil development on wolverines 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 could be sensitive to oil exploration and development activities. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake caused the displacement of a wolverine from its den (Brower 1997 *in* USDOI BLM 1997). If caribou abundance were affected by oil development, wolverines could also be affected. Decline in the 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 pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Under the No Action Alternative, some wolverines could be displaced near (within a few miles) oil field facilities. Lease stipulations that control or prohibit development activities near riparian areas in the vicinity of the Pik Dunes and in the Teshekpuk Lake Special Area would help mitigate impacts on wolverines.

Foxes

Oil development activities could 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 et al. 1994). Crawl spaces 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 could 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 were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur. Standard waste management practices and employee training would reduce the likelihood that foxes would be attracted to oil field facilities.

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 could increase the local densities of ground squirrels.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas. However, pads, roads, and airstrip, if left in place, could provide some insect-relief habitat for caribou. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou, and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material’s toxicity and the amount ingested by fox, this could cause mortality, though the numbers of fox killed would likely be very small. Overall, the impacts of abandonment and rehabilitation activities would be measured as impacts to individuals; no adverse impacts to populations are expected.

Effects of Spills

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. The majority of 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 be coated with oil or ingest contaminated vegetation. Adult caribou, moose, and muskox that were to become oiled would not likely 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 reduce thermal insulation, leading to their death (USDOI BLM and MMS 1998). Oiled caribou, moose, and muskox hair would be shed during the summer before the winter fur was 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. Depending upon the timing of oiling, the oiled fur might not be shed until the following summer. No documented caribou deaths have been attributed to spills associated with TAPS. Toxicity studies of crude-oil ingestion in cattle indicate that anorexia (substantial weight loss) and aspiration pneumonia leading to death are possible effects (Rowe et al. 1973). Exposure of livestock (horses and cattle) utilizing grazing lands with oil development has resulted in mortality and morbidity (Edwards 1985). Exposure could involve heavy metals, salt water, caustic chemicals, crude oil, and condensates. In cattle, this exposure has been shown to result in a wide variety of symptoms including effects on the central nervous system, cardio-pulmonary abnormalities, gastrointestinal disorders, inhalation pneumonia, and sudden death. Caribou, moose, and muskox 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 disturb terrestrial mammals; some oiled animals could be captured for treatment, while non-oiled animals could potentially be hazed from the area under agency guidance. The extent of the disturbance would depend upon a variety of factors, including spill size and location, response actions, and season. Aircraft or overland vehicles would temporarily disturb terrestrial mammals present in the vicinity of the spill. Response to disturbance could 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 could last for a few days to a few weeks. Small mammals, such as lemmings and voles, could be killed during clean-up activities. It is not expected that these disturbance impacts would have population level effects on any terrestrial mammals.

If an oil 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 muskox 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 clean-up operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskox away from the spill and limit the likelihood that these animals would graze on the oiled vegetation. In most cases, onshore oil spills would not be expected to affect caribou, moose, and muskox 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 would likely vary depending upon the environment. Over time, any remaining oil would gradually degrade. Although oiling of animals would be unlikely to remain a threat after clean-up efforts, some toxic products could remain for some time. Depending upon the spill environment, a portion of the oil could persist for 5 years (USDOI BLM and MMS 1998).

Oil spills on wet tundra would kill the moss layers and aboveground parts of vascular plants and could potentially kill all of the macroflora at the site (McKendrick and Mitchell 1978). Damage to oil-sensitive mosses could persist for several years if the site were not rehabilitated. The length of time that a spill would persist would be dependent 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. At a dry habitat exposed to the same application, vegetation cover was less than 5 percent after 24 years. For the most part, onshore oil spills would be very localized (less than 1 acre) in their effects and would not be expected to substantially contaminate or alter caribou, moose, and muskox habitat. However, some local contamination of tundra vegetation would likely occur near production wells and processing facilities. Spills occurring within or near streams and lakes could 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 (an extremely unlikely situation under the No Action Alternative), some grizzly bears would be likely to ingest contaminated food, such as oiled birds, seals, or other carrion (USDOI BLM and MMS 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; 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 effects on thermal insulation. The No Action Alternative could result in the loss of a very small number of grizzly bears through ingestion of contaminated prey or carrion.

Small mammals and furbearers could 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 Planning Area. 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 effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be no more than a few acres. Thus, saltwater spills would probably not affect forage availability for caribou, muskox, moose, or other terrestrial mammals in the Planning Area. In cattle, ingestion of saltwater at greater than 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 recovered.

In the event of a natural gas-well blowout or pipeline rupture, there would be a short-term release of gas (less than 1 day) which could extend downwind for about ½ mile 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, muskox, wolves, or grizzly bears being exposed to toxic amounts of gas and condensates would be very minor and would probably only affect a few individuals. Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings could be affected in larger numbers. However, there would be no population level impacts on these species.

Effectiveness of Stipulations

Lease stipulations described in the 1998 Northeast IAP/EIS ROD (USDOI BLM and MMS 1998) would reduce the impacts of development under the No Action Alternative.

Several Lease Stipulations (1 through 17) that specifically address solid and liquid-waste disposal, fuel handling, and spill cleanup should reduce the potential effects of oils and other waste on terrestrial mammals. Lease Stipulation 24(a) addresses overland moves and seismic work and would minimize alteration of terrestrial mammal habitats, while the lease stipulations requiring that aircraft maintain an altitude of 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and an altitude of 2,000 feet AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, should minimize disturbance of caribou.

Lease stipulations addressing oil and gas exploration and development, including facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, as well as ground and air transportation, should minimize interference with caribou movements and the amount of terrestrial mammal habitat altered by gravel pads and other surface disturbances. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be particularly effective at minimizing impacts to terrestrial mammals such as caribou, moose, and muskox.

Conclusion

Terrestrial mammal populations that could be affected by management actions under the No Action Alternative include the TLH, WAH, and CAH caribou. However, impacts to caribou would be greatly limited, since permanent oil and gas surface occupancy would not be permitted in the Teshekpuk Lake Surface Protection Area, which is a subset of the Teshekpuk Lake Special Area. 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 would not be expected to have any effects at the population level. The TLH caribou movements within insect-relief areas could be disrupted by oil development activities, which could impact herd productivity. However, most insect-relief habitat in the Planning Area used by the TLH would be protected by lease stipulations under the No Action Alternative; therefore any impacts to herd productivity would likely be minor. The WAH caribou could also be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could be locally affected by activities associated with oil and gas exploration and development. In general, management actions would not affect terrestrial mammal populations in the Planning Area. There would be some permanent loss of habitat associated with gravel placement, as well as potential avoidance of areas where development occurs. Noise associated with development would cause a temporary disruption of normal behavior patterns, but would be unlikely to cause any long-term impacts to the animals. Bears and foxes could be attracted to developments, although the attractiveness of developments could be limited by proper waste handling.

In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the smaller disturbance area, the potential for impacts to mammals under this alternative would be about 50 percent less for oil and gas exploration activities, and one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) as much for oil production and development activities, as compared to the action alternatives, based on the amount of habitat impacted. If oil and gas activities occurred in areas with an abundance of caribou or other mammals, or in areas with high quality habitat, impacts could be greater than those based strictly on number of acres of habitat impacted.

4.3.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

The principal non-oil and gas activities occurring in the Planning Area would be aircraft traffic (both rotary- and fixed-wing) associated with surveys and wildlife studies; ground activities such as resource inventories, paleontological excavations and research, and recreational camps; overland traffic; and human foot traffic. Overland moves would occur during the winter on stable sea ice or frozen tundra, and could impact small numbers of seals and polar bears. Most of the other non-oil and gas activities would take place in summer and early fall (June-September) and would only impact marine mammals if they occurred along the coast of the Planning Area. Activities occurring near the coast could cause short-term displacement or harassment of hauled-out seals and polar bears.

Overland moves would take place during the winter, and follow routes from Prudhoe Bay or Oliktok Point to Barrow or Nuiqsut. Overland routes would occur over stable sea-ice and over frozen tundra. Vehicle and sled trains could disturb denning ringed seals if the routes occurred over denning habitat in floating fast-ice, and could temporarily displace basking seals near the traffic route. Polar bears could also be displaced a short distance within approximately 1 mile of traffic along the route.

Some polar bears could be attracted to anthropogenic sources of food at camps used for various activities, which could result in some polar bear mortality if bears were killed in defense of human life and property. Such losses, by themselves, would not be expected to impact the population, but could contribute to cumulative effects. Camps would not be expected to impact other marine mammals.

Small fuel spills would likely occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills would most likely involve aviation fuel and other light-fraction hydrocarbons fuels that would evaporate and disperse rapidly, and would be cleaned up immediately whenever possible, as required by lease stipulations. These small spills would not be expected to impact marine mammals in or near the Planning Area.

The effects of non-oil and gas activities on marine mammals in the Planning Area should be localized and short term.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under the No Action Alternative, seismic surveys conducted near the coast could expose a few denning polar bears to noise and associated disturbances. This disturbance could result in the displacement of a few maternal polar bears and their dependent cubs, leading to the abandonment of the den site and possible death of a small number of cubs. However, relatively few polar bears would be affected because of the low number of recorded maternal den sites in and adjacent to the Planning Area. Lease stipulations prohibit seismic surveys within 1 mile of known or suspected polar bear dens. Onshore seismic surveys would not be expected to have any impacts on marine mammal species other than polar bears since no other marine mammals occur onshore during the winter.

Potential noise disturbance to marine mammals could result from support aircraft (there would be several helicopter round trips/day during exploration and development) from Prudhoe Bay or the Alpine field traveling to and from Planning Area exploration and production facilities, and from seismic activities along and near the coast from the Colville River Delta to Harrison Bay. Effects should be localized and short term, and include displacement from preferred resting and feeding locations. Aircraft would be required to be above minimum altitudes, except on takeoff and landing, which would reduce the potential for aircraft disturbance. Overflights by fixed-wing aircraft or helicopters could cause the temporary displacement of seals from their haul outs. The number of seals affected would depend on the number of disturbance incidents and the number of seals hauled out on the ice. Moulton et al. (2003) reported minor responses by seals to fixed-wing surveys flown at 300 feet; only 1.5 percent of the observed seals were reported to dive into their holes in response to the aircraft. Aircraft routes would not likely occur over ringed seal pupping habitat, so no impacts to ringed seal pups are expected.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed, bearded, and spotted seals hauled out on nearshore ice or on beaches. Such disturbance could result in the displacement of seals into the water. Aircraft disturbance to seals hauled out along the coast or on nearshore ice would not be expected to result in the death of any seals, although increases in physiological stress resulting from frequent disturbance could reduce the fitness of individual seals.

Exploratory drilling near the coast during winter (December to mid-April) would potentially disturb, displace, or attract polar bears. Female polar bears denning within 1 mile of the construction activity could be disturbed by vehicle traffic or construction noise. Disturbance of females in maternity dens could result in abandonment of the cubs or premature exposure of cubs (Amstrup 1993). Few dens have been reported in the Planning Area in the last 10 years (Map 3-30), although bears are known to occasionally den in the area. Lease Stipulation 24(a) requires that industrial activities maintain a 1-mile buffer around known or suspected polar bear dens. MacGillivray et al. (2003) measured noise from industrial activities in the air and within artificial polar bear dens at varying distances from the activity. Noise within the dens from vehicle traffic was generally attenuated to background levels when vehicles were approximately 1,600 feet away. Thus, it appears that current lease stipulations would be sufficient to prevent disturbance to polar bears in natal dens.

It is possible, but unlikely, that denning polar bears would be affected by the construction of roads, pads, or pipelines. The number of bears affected would depend on the number of undetected dens located within the 1-mile buffer around construction activity. The severity of the effect would depend on the reaction of individual bears, whether the den was active or abandoned, and the age of the cubs when the disturbance occurred.

Some polar bears could be attracted to oil field camps by food odors and curiosity. Attraction to the area would increase the potential for human-bear interactions, and could result in intentional harassment or death of the bear in defense of human life or property. However, such actions have been rare in the past, and should not be common in the Planning Area. Workers would be required to participate in bear-awareness training programs (Lease Stipulation 63), and Lease Stipulations 76 and 77 have been established that would minimize the potential for polar bear interaction with humans. Consultation between oil field developers and the USFWS should result in the use of nonlethal means of deterrence in most cases. Therefore, the number of bears lost as a result of such encounters is expected to be minor.

Under the No Action Alternative, seals and polar bears could be affected by possible offshore oil exploration and subsequent development on the coast of the Planning Area in Harrison Bay, in a small area south of Atigaru Point. The effects of these activities would be localized and would not be likely to affect marine mammal populations.

Most exploration and development activities would occur onshore, where they would be unlikely to affect individual marine mammals or populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs if they are abandoned or prematurely exposed to adverse weather conditions, by activities within about 1 mile of their dens if these dens were not detected and disturbance avoided as required by lease stipulations.

Effects of Spills

Effects from a Large Spill. If a large spill occurred near the Colville River Delta, some oil could reach the marine environment. Some spotted seals and beluga whales within the Colville River Delta could be exposed to oil if the spill occurred during the open-water season. A spill could affect ringed seals if it occurred during spring break-up. Assuming that the spill occurred during the open-water season, the coastline of many small islands in the Colville River Delta could be oiled. A small number of spotted seals regularly use the Colville River main channel and Nigliq Channel in summer. Johnson et al. (1998, 1999) reported spotted seals in the East Channel of the Colville River, at the mouth of the Kachemach River, and on the southwest end of Anachlik Island. Local residents of Nuiqsut reported that spotted seals regularly use Nigliq Channel, and the Fish Creek and Judy Creek deltas. Spotted seals have been observed as far upstream as Ocean Point, and occur regularly as far as the mouth of the Itkilik River (Reed 1956; Seaman et al. 1981). There are limited records of coastal sightings of beluga whales near the Colville River Delta. Beluga whales are common near shorefast ice in the Colville River Delta region until ice moves offshore in July. Seaman et al. (1981) reported sightings of a few groups, ranging up to 100 beluga whales, near Jones, Pingok, and Thetis islands, north and east of the Colville River Delta, during fall migration. Recently, Nuiqsut hunters reported that beluga whales have been seen in Niglik Channel in the Colville River, and were seen stranded in shallow water in the Fish Creek Delta (Lampe 2003). An oil spill located in the waters or along the islands in the Colville River Delta could result in the loss of some spotted seals and beluga whales. The spotted seal population would be expected to replace lost individuals within a few years. The beluga population would likely replace lost individuals within 1 year.

An oil spill would be unlikely to contaminate benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales because little oil would be expected to reach offshore feeding areas. Thus, a spill in the Colville River Delta would not be likely to have any food-chain effects on marine mammals.

Polar bears are known to travel and den along the Colville River and would be most vulnerable during fall (open water), winter, and spring months. Polar bears may be affected directly through contacting spilled oil or ingesting contaminated prey, or indirectly through loss of habitat or prey species. However, the low probability of a large scale oil spill combined with the likelihood of low numbers of bears occurring in the area suggests that population-level effects would likely be minor, unless spilled oil traveled extensively into the marine environment, or aggregations of bears encountered oil.

Effects from Small Onshore Spills. Small onshore spills would generally not have any effects on marine mammals unless the spills entered and contaminated streams that run into the Colville River Delta, Fish Creek or Judy Creek, or the Kogru River. In this scenario, a small number of spotted seals or beluga whales might be exposed to oil in nearshore habitats and suffer lethal or sublethal effects. A small number of ringed seals and their pups could be contaminated if a spill were to reach the marine environment during early winter. Such contamination could result in the death of a small number of pups. If the spill occurred during the open-water season, a small number of spotted seals could be exposed to oil. A few spotted seals could suffer sublethal or lethal effects. A small number of beluga whales could be exposed to oil in the Colville River Delta and in Fish or Judy creeks. A small number of polar bears could be directly exposed to oil or indirectly exposed through consumption of contaminated seals. The small number of deaths that could occur from small onshore spills is not expected to affect seal, beluga, or polar bear populations in the Beaufort and Chukchi seas. Small onshore spills would be unlikely to affect bearded seals, walruses or gray whales that occur offshore of the Planning Area.

Effectiveness of Stipulations

Lease Stipulations 1 through 17 concern waste prevention, handling, and disposal, and spills. These lease stipulations should be effective in reducing potential marine pollution and its effects on marine mammals in the Colville River Delta where oil exploration and development could occur under the No Action Alternative. Lease stipulations addressing waste prevention, and handling and disposal of food and garbage should also be effective in preventing or minimizing attraction of polar bears to oil field camps by minimizing food odors, although curious bears might still approach camps. Minimizing or preventing polar bear attraction should reduce the potential for negative bear-human interactions and reduce the likelihood of bears being killed in defense of human life and property.

Lease Stipulation 24(a) would require consultation with the USFWS before overland moves or seismic surveys could be conducted within 25 miles of the coast, and would prohibit activities within 1 mile of known polar bear dens. This lease stipulation would be effective in preventing disturbance to some denning polar bears under the No Action Alternative. Lease Stipulation 39 would require setbacks for Fish Creek, Judy Creek, and the Colville River. These lease stipulations should be effective in preventing disturbance to spotted seals, and perhaps beluga whales, that inhabit the waters of the Colville River Delta, Fish Creek, and Judy Creek during the open-water season.

Lease Stipulation 63 would require lessees to implement a program to inform personnel about the importance of not disturbing biological resources, including marine mammals. This lease stipulation should be effective in minimizing direct disturbance to marine mammals from human activities. Lease Stipulation 77 would encourage operators to apply for a letter of authorization from the USFWS to conduct activities in polar bear denning areas. This lease stipulation would be effective in minimizing disturbance to denning polar bears.

Permanent oil and gas surface occupancy and seasonal exploratory or delineation wells would not be permitted in the Teshekpuk Lake Surface Protection Area. This measure would preclude disturbance to marine mammals from onshore oil and gas activities along the coast of the Planning Area from north of the Kogru River to the east side of Smith Bay. Ice roads, seismic activities and winter overland moves could be authorized in the Planning Area, but the lease stipulations described above should prevent these activities from disturbing marine mammals.

Conclusion

Under the No Action Alternative, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would likely be short term and localized and occur within 1 mile of aircraft corridors, survey sites, recreational camps, and overland moves. The effects of oil and gas leasing and development activities would likely cause increases in noise and disturbance, primarily near the Colville River Delta and Inner Harrison Bay areas. Effects would be localized (within 1 mile of aircraft corridors and activities) and short tem (generally < 1 year) and should have minor effects on marine mammals.

A small number of ringed seals, spotted seals, beluga whales and polar bears could be affected by oil spills reaching Fish Creek, Judy Creek, the Kogru River, the Colville River, or drainages that empty into the Colville River. It is expected that the potential losses would be minor, and would not substantially impact marine mammal populations.

The effects of development under the No Action Alternative would likely be short term. Overall, it is not expected that oil exploration and development activities under the No Action Alternative would have a measurable effect on marine mammal populations in or adjacent to the Planning Area. Since nearly all exploration and development activity would occur onshore, impacts to marine mammal resources under the No Action Alternative would be similar to, or slightly less than, those that would occur under the final Preferred Alternative and alternatives B and C.

4.3.10 Threatened and Endangered Species

Management actions in the Planning Area could affect the endangered bowhead whale, which would potentially be present in the Beaufort Sea offshore of the Planning Area, primarily from August through October. In addition, two threatened bird species, spectacled and Steller's eiders, could potentially be affected by management actions in the Planning Area under the No Action Alternative. Most activities that could affect eiders would result from oil and gas exploration and development. Other activities that could affect eiders include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. Spectacled eiders are distributed in low densities throughout much of the Planning Area, with the highest concentrations occurring in wetland habitats north of Teshekpuk Lake (USDOI BLM and MMS 1998; Map 3-33). Steller's eiders occur in much lower densities, with no known areas of concentration within the Planning Area.

4.3.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on the Bowhead Whale

Under the No Action Alternative, bowhead whales would be disturbed by non-oil and gas activities only under exceptional circumstances. Such circumstances could occur when whales migrate near the coast when barge traffic was present, or possibly from air traffic, supply camps, or aerial surveys located along barrier islands or offshore areas. Effects would likely be localized and short term, and would be unlikely to have a high impact on individuals or the population (Richardson and Malme 1993, Richardson and Williams 2002, USDOI BLM and MMS 2003).

Effects on Spectacled and Steller's Eiders

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity, could affect spectacled or Steller's eiders in the Planning Area. During the winter, when most birds are on wintering grounds, these activities would have no direct impact on eiders, although eiders could be indirectly impacted if their habitat is harmed. However, many of these activities would occur during the summer breeding season when eiders are in the Planning Area.

Aerial surveys for wildlife could include fixed-wing surveys for waterfowl and caribou, or helicopter surveys for grizzly bears and caribou. These surveys could cause temporary displacement of some eiders from feeding, nesting, or brood-rearing habitats, but would not be likely to have population level effects.

Aircraft use associated mobilizing and re-supplying summer camps could disturb eiders along continually used flight corridors and near airstrips during take-offs and landings. Helicopter or fixed-wing aircraft could also be used for clean-up activities at abandoned sites in the Planning Area, which could affect eiders. These activities could be intermittent or occur on a regular basis. The potential effects of this type of visual and noise disturbance would range from temporary displacement from preferred habitats to nest abandonment. Cumulative impacts of aircraft disturbance of all types is of concern for spectacled and Steller's eiders.

Various types of disturbances could affect eiders near summer camps. Noise and ground activity could disturb feeding, nesting, or brood-rearing birds, causing temporary or permanent displacement from feeding or nesting areas and potentially affecting the bird's energy budget and success in producing young. Disturbance to eiders from aircraft traffic and camp activities would likely be greatest within approximately 2,300 feet of the camp, and have little or no effect beyond 6,500 feet (Johnson et al. 2003b). Eiders nesting near summer camps could suffer mortality or egg loss from predators attracted to anthropogenic sources of food at camps. However, the lease stipulations under the No Action Alternative would require proper handling of food and waste to eliminate predator attraction to areas of human activity. If possible, summer camps should be located in areas away from habitats used by spectacled and Steller's eiders.

Subsistence hunting would obviously result in the mortality of eiders taken during spring or fall hunts, as well as potential loss of eggs due to collection. Other subsistence hunting and fishing activities could cause disturbances in areas where activities occurred. Summer boat traffic could occur on the Colville, Kogosukruk, Kikiakrorak, and Ikpikpuk rivers for recreational or subsistence activities, or to re-supply camps along these rivers.

4.3.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

Under the No Action Alternative, the coastline north of the Kogru River would be unavailable for oil and gas leasing. Only a small portion of the coast, and a small area in Harrison Bay, south of Atigaru Point, would be available for development. Bowhead whales generally do not enter Harrison Bay during the fall westward migration (Treacy 1988-1997, 2000-2002). No drilling activities would occur in OCS waters under this alternative. Noise-producing activities, including seismic surveys and drilling activities, would take place in winter (early December to mid-April), and onshore. Therefore, it is unlikely that any impacts to bowhead whales would occur from exploration activities under the No Action Alternative.

Noise-producing marine vessel and aircraft traffic would be the most probable source of disturbance to bowhead whales under this alternative. Only under exceptional circumstances (i.e., whales migrating near the coast coincident with the presence of barge traffic to Prudhoe Bay or Kuparuk), is it likely that bowhead whales would be disturbed by vessel activity. Although bowhead whales could encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration through the Beaufort Sea, most of the vessel activity would be in shallow, nearshore waters in Harrison Bay, which is rarely traversed by migrating bowhead whales (Treacy 1988-1997, 2000-2002). The effects of vessel traffic on bowhead whales would likely be localized and short term. Whalers in Barrow perceived that bowhead whales migrated farther from shore in 2003 than in other years, and hypothesized that the deflection resulted from vessel operations at Camp Lonely, within the Northeast National Petroleum Reserve – Alaska (G. Ahmaogak, pers. comm.).

Aircraft flying at altitudes greater than 1,000 feet AGL generally do not affect bowhead whales. Flights supporting oil and gas operations in the Planning Area would be not likely to occur over marine waters beyond the nearshore zone, and should therefore be well outside the bowhead whale migration corridor. The effect of aircraft traffic on bowhead whale behavior would likely be localized and short term.

Spectacled and Steller's Eiders

Exploration. Because seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when eiders are not present in the Planning Area, these activities would have no direct impacts on eiders. Rolligons and track vehicles used during seismic exploration could leave tracks on tundra habitats that would be observable for a number of years. These types of disturbances would likely affect wet areas less than dry areas (Walker 1996), and impacts to eiders would probably be minimal. Indirect impacts associated with ice-road construction and its effect on tundra vegetation would also be unlikely to affect eiders. In some cases, equipment would be stored on ice pads that are specially designed and constructed to last through the summer and into the following winter. The tundra under the footprint of these ice pads would be lost as feeding, nesting, or brood-rearing habitat during the course of that season. Water withdrawal from water source lakes could impact eider nesting or brood-rearing habitat if lake levels were lowered, although lake surveys would be conducted prior to the withdrawal of water to identify potential water sources. Aerial and ground-based surveys for waterfowl prior to water withdrawal would help to identify lakes that may be important as eider habitat. In addition, Lease Stipulation 20 would place restrictions on water withdrawal from lakes 7 feet deep or deeper to protect fish habitat. This lease stipulation could also help to mitigate the potential impacts from water withdrawal on eiders.

Predators attracted to anthropogenic sources of food or shelter could cause increased predation pressure on eiders near facilities. However, Lease Stipulations 2 and 3 would require proper handling of non-hazardous waste to avoid human-caused changes in predator populations. This policy has apparently been successful at the Alpine field, where Johnson et al. (2003b) reported no increase in the numbers of most predator species after development. The one exception was common raven, which became more common and nested at the Alpine field after development.

Development and Production. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, oil-spill clean-up activities, and surveys to monitor eider populations could cause disturbances that would affect threatened eiders in the vicinity of gravel roads and pads. The effects of these types of disturbances, which are discussed for other waterfowl in Section 4.3.8 (Birds), could result in temporary displacement from preferred foraging, nesting, and brood-rearing habitats, decreased nest attendance or nest abandonment, and increased energy expenditures that could affect the physiological condition and rate of survival or reproduction. The potential for the various sources of disturbance to impact eiders would depend on the location of the disturbance, the number of individuals in the area, and the time of year. Under the No Action Alternative, development would not occur in the areas with the highest concentrations of spectacled eiders in the wetland habitats north of Teshekpuk Lake.

Most construction activities, including pipeline installation, gravel mining, and placement for oil field infrastructure (airstrips, and pads, camps, staging areas, and processing facilities), would be conducted during the winter when eiders are not present in the Planning Area. During the summer, eiders could be subject to disturbances associated with vehicular and pedestrian traffic, and noise from equipment on roads or at facilities, including large trucks hauling cranes and other equipment, and road maintenance equipment on access roads and pads. No studies have been conducted to determine how these types of disturbances would affect spectacled or Steller's eiders; however, it is reasonable to assume that effects would be similar to those described for other waterfowl. These types of disturbances have been shown to have greater effects on geese feeding within 160 feet of roads than on geese feeding further away, although some disturbance could occur as far as 685 feet away (Murphy et al. 1988; Murphy and Anderson 1993). Disturbances would occur most often during the pre-nesting period when birds gather to feed in open areas near roads, and during brood-rearing and fall staging when some geese exhibit higher rates of alertness (e.g., "heads up" behavior) in areas near roads than in undisturbed areas. A small percentage of birds could walk, run, or fly to avoid vehicular disturbances (Murphy and Anderson 1993).

Pedestrian traffic could have a greater impact than vehicular traffic on some birds. During a study of the effects of disturbance related to the Lisburne Development in the Prudhoe Bay oil field, Murphy and Anderson (1993) reported that of the more common sources of disturbance, humans on foot elicited the strongest reactions from geese and swans. Johnson et al. (2003b) reported that aircraft and pedestrians elicited higher responses by nesting geese at the Alpine field than other sources of disturbance. Restricting or reducing the level of foot traffic on gravel roads and pads could help to reduce the potential for disturbance to foraging, nesting, or brood-rearing eiders.

<u>Air-Traffic</u>
Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The potential for disturbance to waterfowl from aircraft is well documented (Schweinsburg 1974; Ward and Stehn 1989; Derksen et al. 1992; McKechnie and Gladwin 1993). Johnson et al. (2003b) conducted the most thorough study of aircraft disturbance to waterfowl in the Arctic at the Alpine field in the Colville River Delta. Such disturbances may displace birds from feeding habitats and negatively impact energy budgets. Gollop et al. (1974b) suggested that helicopters may be more disturbing to wildlife than low-flying fixed-wing aircraft, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 feet AGL often caused spectacled eiders to flush, while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. Under the No Action Alternative, permanent oil facilities would be prohibited in the wetland habitats north of Teshekpuk Lake, where the highest concentrations of spectacled eiders occur, and most aircraft overflights in this area would likely be at altitudes sufficiently high to avoid disturbance to eiders. Aircraft disturbance could affect eiders in portions of the Planning Area open to development, although under the No Action Alternative the effects of aircraft disturbance would likely be reduced compared to other alternatives. Potential impacts to eiders could be reduced by selecting aircraft routes that avoid areas of high use or are conducted at elevations high enough to minimize or eliminate responses by eiders (Miller 1994).

The Alpine field avian monitoring program in the Colville River Delta was a multi-year project designed to identify the potential effects of noise and disturbance from aircraft on birds nesting near the airstrip and on large waterbirds during brood-rearing (Johnson et al. 2003b). Other sources of disturbance also included vehicle and pedestrian traffic, and predators. When compared to pre-construction numbers, the overall number of waterfowl nests near the airstrip declined in the area within 3,250 feet of the airstrip after construction began (Johnson et al. 2003b). However, the number of post-development nests increased in the area between 3,250 and 5,000 feet from the airstrip. This decline apparently did not affect yellow-billed loons and tundra swans nesting in the area, which displayed no measurable effects of disturbance. The decline could not be directly linked to disturbance, as other factors, such as lower temperatures and more severe flooding later into the breeding season during construction years, may also have influenced nest densities. During years of heavy construction, white-fronted goose nest sites were apparently displaced to habitats similar to those used prior to construction, but located further from the airstrip. Johnson et al. (2003b) suggested that preferred white-fronted goose nesting habitats in the Alpine field area had not been saturated with nests prior to development, and that suitable nesting habitat was available in areas away from the airstrip. Proximity to the airstrip apparently did not affect nest success; successful white-fronted goose nests were generally closer to the Alpine field airstrip, the flight path, and the nearest gravel than unsuccessful nests, although most comparisons were not statistically significant. Successful waterfowl nests located near aircraft activity were also documented by Johnson (1984), who reported that at least three successful common eider nests were located within 1,000 feet of a helicopter pad on Thetis Island that averaged approximately 12 trips per day. Although there would be the potential for displacement of some eiders nesting near routinely used aircraft landing sites as a result of numerous overflights, landings, and takeoffs, some eiders would likely habituate to routine air traffic.

Low-level helicopter survey flights to monitor pipelines for potential oil spills or leaks could also disturb threatened eiders. Routine flights would be of short duration and limited to a particular area, and would likely cause minimal disturbance. However, temporary displacement from preferred feeding habitats or brood-rearing habitats could affect the energy budgets of some eiders, and incubating eiders could be temporarily displaced from nests.

Watercraft

Several types of watercraft could be used during the summer for transportation of equipment and supplies and for oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting eiders, could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after barges pass though the area. Most of the area adjacent to the coastline would be unavailable to oil and gas leasing under the No Action Alternative, and the potential for barge traffic to displace eiders in offshore habitats would likely be lower than under the final Preferred Alternative and alternatives B and C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The vessels used would likely be small maneuverable crafts, suitable for work in shallow waters. Spill response training activities would have the potential to disturb foraging, nesting, or brood-rearing eiders. Boat activity could cause alert postures, disruption of feeding behavior, and flight in waterfowl, shorebirds, and raptors (Burger 1986, Belanger and Bedard 1989, Steidl and Anthony 2000). Rodgers and Smith (1995) and Rodgers and Schwikert (2001) determined the required setback distances for minimizing the potential for boat disturbance to various bird groups. Suggested buffer zones around areas of activity ranged from 325 feet for shorebirds to 600 feet for wading birds. Establishing buffer zones around known areas of eider activity during oil spill response-training activities, or conducting these activities in areas not frequented by eiders, could help to reduce negative impacts.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of eider habitat. The potential long-term impacts associated with habitat loss could be minimized by locating gravel roads, pads, airstrips, and mine sites away from areas with high concentrations of eiders. Habitat studies and eider surveys conducted in areas proposed for development prior to the establishment of gravel mine sites and construction of roads could identify areas that are important to threatened eiders. Under the No Action Alternative, Lease Stipulations 39 to 41 would provide for setbacks from lakes in the Deep Water Lakes Area south of Teshekpuk Lake within which permanent oil facilities would be prohibited. Although these lease stipulations were designed primarily to protect fish habitat, they could also help to mitigate potential impacts to adjacent eider habitats.

Under the development scenario for the No Action Alternative, the gravel footprint for roads, pads, airstrips, staging areas and gravel extraction sites would range from approximately 130 to 515 acres. Loss of eider habitat would be permanent in the area occupied by the development footprint, and eiders nesting in this area would be displaced to other areas. If spectacled and Steller's eider densities are assumed to be 0.4 and 0.02 birds per mi^2 (640 acres per mi^2) respectively (relatively high estimates based on aerial survey data; Larned et al. 2003; Ritchie and King 2003), up to 0.34 spectacled eiders and 0.02 Steller's eider could be expected to be displaced by the gravel footprint. Under the No Action Alternative, it is likely that less eider habitat would be lost to development than under the final Preferred Alternative or alternatives B and C, because development would not be permitted in the area with the highest concentrations of spectacled eiders in the wetlands north of Teshekpuk Lake. However, under all alternatives, the potential effects of habitat loss would depend on the location of the development, the types of habitat lost, and the level of eider use in the areas to be developed. Without specific information on the locations of potential developments, it is difficult to make comparisons of the effects of habitat loss among alternatives.

In addition to permanent habitat loss, temporary loss of habitat associated with gravel placement could occur on tundra adjacent to gravel structures, where accumulated snow from snow plowing activities or snow drifts would become compacted and cause delayed snowmelt. Delayed snowmelt persisting into the nesting season could preclude eiders from nesting in those areas.

Dust deposition could affect eider habitat by causing early green-up on tundra adjacent to roads and pads, which could attract eiders and other waterfowl early in the season, when other areas were not yet snow free. Traffic levels, air traffic (including helicopters), and wind can all influence the amount of dust that may be deposited adjacent to roads and pads.

Impoundments created by gravel structures could cause temporary or permanent flooding on adjacent tundra. Impoundments could be ephemeral, drying up early during the summer, or they could become permanent water bodies that would persist from year to year (Walker et al. 1987a, b; Walker 1996). Tundra covered by impounded water could result in a loss of nesting habitat for some birds. However, impoundments could also create new feeding and brood-rearing habitat that would be beneficial to waterfowl, including eiders. Noel et al. (1996) reported that the areas occupied by impoundments in the Prudhoe Bay area generally supported higher waterfowl densities than the same areas did prior to development, and that spectacled eiders nested on some impoundments. Warnock and Troy (1992) and Anderson et al. (1992) also reported use of impoundments by spectacled eider in the Prudhoe Bay and Kuparuk oil fields. The effects of impoundments could be minimized or eliminated with engineering plans that provided culverts to allow for adequate cross-drainage at gravel structures. However, culverts blocked by snow or ice could prolong the spring flooding period (Walker 1996).

Mortality. Eider mortality could result from road kills due to collisions with vehicular traffic. Within the TAPS, roadkills were the greatest source of bird mortality, particularly along the Dalton Highway where dust shadows caused early green-up along the road that attracted birds (TAPS 2001). Reduced speed limits along roads, particularly during periods of poor visibility, could help to reduce the potential for eider collisions with vehicles.

Some earlier mortality could also result from collisions with structures such as elevated pipelines, buildings, towers, boats, or bridges. Quakenbush and Snyder-Conn (1993) reported that a female Steller's eider was apparently killed by a collision with an observation tower at Nanvak Bay near Cape Pierce, Alaska. Lovvorn et al. (2003) salvaged three spectacled eiders that collided with a ship during the predawn hours in the Bering Sea. However, visibility is generally good during long summer daylight hours in the Arctic, and collision has apparently been only a minor source of bird mortality associated with the TAPS (TAPS 2001). The biggest risk period would be in the fall during staging with higher potential of poor visibility due to storms.

Some predators, such as ravens, gulls, Arctic fox, and bears, would be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites were present (Eberhardt et al. 1982, 1983a, b; Day 1998; Burgess 2000). Increased levels of predation due to greater numbers of predators could in turn impact nesting and brood-rearing eiders. Major negative impacts have occurred at the Howe Island goose colony in the Sagavanirktok Delta from predation by Arctic fox and grizzly bears (Johnson 2000a), and Arctic fox and glaucous gull are predators of common eider and brant eggs and young on the barrier islands (Noel et al. 2002). Arctic fox predation can also impact tundra nesting shorebirds and passerines (Day 1998, Rodrigues 2002). In recent years, oil field operators have installed predator-proof dumpsters at camps and implemented new refuse handling techniques that have helped to minimize the attraction of predators to areas of human activity (Johnson et al. 2003b).

Effects of Abandonment and Rehabilitation

Bowhead Whale

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. Noise and other disturbances associated with barges to remove materials from the Planning Area could have minor impacts on bowhead whales if whales deflected from normal migration routes.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause impoundments of water that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for eiders. If they were revegetated without removing the gravel, the habitat would not return to its current utility. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what was present in the disturbed area prior to disturbance. If foam-insulating materials were used in pad construction, they could be broken up during removal. Fine particles of foam that were not removed from the environment could be ingested by eiders. Depending upon the material's toxicity and the amount ingested, this could cause mortality, though the numbers of eiders killed would be small.

Effects of Spills

Bowhead Whale

An oil spill would be unlikely to occur in the marine environment, or to reach typical bowhead whale migration habitat from onshore locations at concentrations that would cause some effects. Small spills would be unlikely to reach marine habitats, and thus would have a minor probability of affecting bowhead whales. Short-term exposure to spilled oil would not be likely to have substantial effects on bowhead whales or their prey (St. Aubin et al. 1984; Bratton et al. 1993). Activities associated with spill containment and clean up, if they were to occur outside of the nearshore habitat of Harrison Bay during the westward migration in autumn, could cause a minor diversion of migrating bowhead whales. Such a minor diversion of the southward edge of the migration corridor would have limited impact on individuals or the population. A detailed discussion of the potential effects of oil on whales can be found in the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS* (USDOI MMS 1996c).

Spectacled and Steller's Eiders

Oil spills or leaks onto tundra or marine habitats could negatively impact spectacled or Steller's eiders in numerous ways. Oil could come in contact with and adhere to feathers, causing the feathers to lose their insulating capabilities and resulting in hypothermia (Patten et al. 1991). This effect would be particularly severe for birds that come in contact with water where feather integrity is necessary to maintain water repellency and buoyancy, and could have more severe consequences in marine habitats than in terrestrial habitats. Birds could also suffer toxic effects from ingestion of oil by consumption of food contaminated by an oil spill or from oil ingestion resulting from preening of oiled feathers (Hansen 1981). Oil contacting with bird eggs could cause toxic effects to embryos (Patten and Patten 1979, Stickel and Dieter 1979). Oil could come in contact with eggs directly as a result of a spill, or indirectly from oiled feathers of incubating adults.

Topographical features could confine oil spills and leaks from pipelines located in terrestrial habitats. Spilled oil could also enter a lake or pond and be contained by the banks of these waterbodies. McDonald et al. (2002) cited terrestrial and aquatic spills in the Prudhoe Bay area that covered 24 and 186 acres, respectively. However, during spring flooding, an oil spill could spread to a much larger area, depending on the amount of oil spilled, surface topography, and the extent and duration of flooding. Oil entering a river or stream would have the potential to spread into delta or coastal areas, where impacts to birds could be more severe. Under the No Action Alternative, Lease Stipulation 39 would help to mitigate potential impacts to eiders from an oil spill by providing setbacks of ½ to 3 miles from specified rivers, within which permanent oil facilities would be prohibited. McDonald et al. (2002) conducted an oil spill risk assessment for spectacled eiders in the Prudhoe Bay area, using scenarios constructed to mimic spills that had occurred on lake and tundra habitats in the Prudhoe Bay oil field. Based on the assumptions of these scenarios, a maximum of 0.1 spectacled eiders would be exposed to oil from an aquatic spill covering 185 acres, and 0.02 spectacled eiders would be exposed to oil from a tundra spill covering 24 acres.

In marine habitats, wind and currents would have the potential to spread an oil spill over a larger area than in under most terrestrial habitats; therefore, molting eiders in marine habitats could be particularly susceptible to the negative impacts of an oil spill. Under the No Action Alternative, offshore development is not proposed for the Planning Area; however, a potential spill from an onshore source could spread to offshore areas, or a tanker spill could occur in offshore waters. A spill occurring during the summer breeding season would have a greater impact on threatened eiders than a spill occurring during the winter, when eiders are on wintering grounds. However, lingering effects from a winter spill could impact eiders during the following breeding season if clean-up activities did not adequately remove contaminants from bird habitats, such as open leads that are used by eiders during spring migration. An oil spill spreading into offshore waters of Harrison Bay during the fall molting/staging period would have the potential to affect a greater number of spectacled eiders than a nearshore spill (Fischer et al. 2002). Stehn and Platte (2000) developed an oil spill scenario for the central Beaufort Sea for the proposed Liberty Project based on a spill size of 5,912 bbl. When taking spectacled eider densities in the Beaufort Sea into consideration, the highest mean number of spectacled eiders exposed to oil was two birds. There is some evidence, however, that spectacled eiders can occur in flocks in offshore Beaufort Sea habitats (Fischer et al. 2002). Under such a scenario an offshore spill could impact more birds than predicted by Stehn and Platte (2000).

4.3.10.3 Effectiveness of Stipulations

Under the No Action Alternative, lease stipulations would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, minimizing potential effects to individual bowhead whales or the population, and to eiders (Lease Stipulations 1 through 17). Eiders would benefit from lease stipulations to ensure protection of vegetation used for nesting, cover, and foraging (Lease Stipulations 18 and 24), and aquatic habitats (Lease Stipulations 21, 31, 39, 41, and 46). Eiders would also benefit from lease stipulations designed to reduce or prohibit activities that could disturb the birds, including seismic operations and aircraft activities (Lease Stipulations 24, 53, and 57).

4.3.10.4 Conclusion

Under the No Action Alternative, only if bowhead whales were to migrate near the coastline 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, seismic activities, or recreation. Similarly, oil and gas exploration and development activities are unlikely to effect bowhead whales unless noise and disturbance from barge and low altitude aircraft traffic occurred near the shoreline of the National Petroleum Reserve – Alaska and was coincident with the bowhead migration and the migration occurred unusually close to shore. Bowhead whales may exhibit temporary avoidance behavior from vessel traffic associated with barge traffic or oil spill clean-up activities if they were to occur offshore of Harrison Bay, and during the fall migration. Bowhead whales could also be impacted by a large oil spill, particularly if it occurred coincident with the fall migration. The probability of a large spill occurring is very small. In general, impacts to bowhead whales under the No Action Alternative would not occur or would be minor.

Spectacled and Steller's eiders may be affected by oil and gas leasing and development in the Planning Area. Activities related to oil development and production such as vehicle, aircraft, pedestrian and boat traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities could cause disturbances that affect eiders. Permanent habitat loss would result from gravel placement for roads and pads, and at gravel mine sites. Temporary habitat loss or alteration may occur in areas adjacent to gravel roads due to snow and/or dust deposition, thermokarst, and the formation of impoundments. Eider mortality could result from collisions with vehicular or vessel traffic, or collisions with towers, buildings, pipelines, bridges, or other facilities. An oil spill also could impact eiders on terrestrial or marine habitats.

The expected number of fields and the level of development under the No Action Alternative would be reduced compared to the other alternatives and the potential effects of disturbance, habitat loss and alteration, and mortality to spectacled and Steller's eiders due to development under this alternative would likely be reduced compared to other alternatives.

4.3.11 Cultural Resources

4.3.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Aircraft and watercraft traffic, scientific investigations (e.g., archaeological, paleontological, and geological survey and excavation), summer camps, hazardous and solid waste material removal and remediation, overland moves and recreation associated with non-oil and gas activities would all have effects on cultural resources. Aircraft use would not directly affect cultural resources; however, it could have an indirect effect by making cultural resources more accessible to recreation and other users. Watercraft use is difficult to quantify at this time; however, increased boat traffic would increase the rate of erosion along waterways, which could affect coastal and riverine cultural resources through wakes.

The BLM and other permit holders conduct archaeological, paleontological, and geological research, survey and excavation within the Planning Area. Surveys (pedestrian and aerial), excavation, and collection generally occur during the summer. Survey personnel often encounter cultural resources by chance because they are generally located on or near the surface. While excavation and collection are destructive activities, they are necessary for the recovery of scientific data.

The temporary summer field camps commonly associated with scientific research or resource assessment generally affect small areas for one to several summers. Larger camps would most likely be located at the Inigok airstrip, Point Lonely DEW-Line site, the Ivotuk airstrip, and a camp on the Iligwa River. These sites would use existing gravel pads where available, and low-impact camp practices elsewhere. It is possible that larger camps would affect undocumented cultural resources. However, these camps have been in place for some time, and previous research and surveys should have already identified any cultural resources near these camps. Therefore, temporary 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, would not have an effect on cultural resources.

Prior to or during ground disturbing activities, qualified cultural resources personnel would determine if cultural resources exist on the site and monitor hazardous and solid waste material removal and remediation. Determinations of National Register of Historic Place eligibility would be, and have been, conducted at sites undergoing hazardous and solid waste material removal and remediation to determine whether the sites being cleaned up are themselves archaeologically and historically important (e.g., Point Lonely DEW-Line site, Planning Area exploration camps, pioneer exploration pads, and wells). Cultural resource monitoring and clearance would occur during the discovery, site verification, risk assessment, and site evaluation stages, if ground-disturbing activities were to occur.

The BLM regulates non-oil and gas related overland moves, which only occur during the winter when there is adequate snow depth or ground freezing, or when ice roads are present. It is possible that damage would occur to known or unidentified cultural resources in the Planning Area. The prevalence of shallow and surface level cultural resources in the Planning Area suggests that undocumented cultural resources could be damaged even using the best available practices. Since non-oil and gas-related overland moves are rare in the Planning Area, however, they would have minor impact on cultural resources.

Recreational use of the Planning Area primarily includes summer use by birdwatchers and rafters. Given the importance of waterways to prehistoric and historic peoples for transportation and subsistence, cultural resources are concentrated along these corridors and may be exposed by erosion over time. Therefore, recreational users camping on riverbanks and bars could affect these resources as a result of boating activities, and these users could remove cultural resources ("pot hunting") found along waterways or near camps. Instances of removing cultural resources could also take place along some areas the Colville River.

4.3.11.2 Oil and Gas Exploration and Development Activities

Because gathering of seismic data is permitted only during the winter using low-ground-pressure vehicles (Lease Stipulation 24[f]), it is unlikely that this activity would effect undocumented subsurface cultural resources. However, use of seismic vehicles could result in the damage or destruction of surface cultural resources. In general, permittees can visually detect and subsequently avoid most surface cultural resources, which are usually structures of some type, even when these resources are covered by snow. Snow cover and frozen vegetation would protect other surface cultural resources, such as isolated artifacts, from vehicle crushing. An exception could be human skeletal remains that lie on the ground surface and are not protected from vehicle crushing by snow cover.

It is worth noting that cultural resources are not as widespread as wildlife and vegetation. As a result, oil and gas exploration or development activities would have a minor effect on cultural resources, because permittees could conduct oil and gas activities to avoid the locations of identified cultural resources. However, as modern users tend to use the same areas used by prehistoric and historic Iñupiat, such as high, dry ground along rivers, streams, and lakes, minor damage to resources in these areas could occur.

Effects of Disturbances

Under the No Action Alternative, exploration and development activities in the Planning Area would be conducted on existing leases, outside the areas excluded by withdrawals and lease stipulations listed in the 1998 Northeast IAP/EIS ROD. However, because most of these activities would occur during the winter months, the potential for effects to subsurface cultural resources would be minor.

Disturbances associated with development activities (i.e., the construction of production pads connected by roads, airstrips, staging bases, and pipelines) could affect cultural resources under the No Action Alternative. For example, the Alpine Satellite Development Plan may result in the construction of up to 29 oil exploration and development pads under the full-field development scenario in the eastern portion of the Planning Area, and could affect cultural resources in this area. This type of development would be most likely to affect cultural resources through the excavation of material (e.g., gravel) for the construction of permanent facilities, as the location of terrestrial gravel sources often coincides with the location of cultural resources. Placement of gravel for pads, roads, and airstrips could potentially alter or destroy cultural resources. However, pre-construction clearance and monitoring under Lease Stipulations 64 and 74, as well as under the NHPA, would identify the location and extent of nearby cultural resources. Under this alternative, no permanent roads are allowed in the Planning Area, and only winter ice roads are allowed, so impacts to cultural resources from road building would be minor. The placement of VSMs during pipeline construction could also affect buried cultural resources in the Planning Area, depending on the depth at which the VSMs were set. The excavation and burial of pipelines could also alter or destroy subsurface resources, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities unless the facilities to be abandoned were themselves historic.

Effects of Spills

In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would most likely not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. If the oil is warm enough, however, it could melt through the snow and melt the ground and impact cultural resources buried near the surface of the ground. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur. Oil spills at cultural resource sites, either surface or buried, would make radiocarbon dating of that site problematic or impossible. The spilled oil would seep into charcoal, bone, wood, or other materials used for radiocarbon dating, and contaminate them so that their true dates would no longer be possible to accurately determine.

4.3.11.3 Effectiveness of Stipulations

Under the No Action Alternative, several lease stipulations would minimize the effects of oil exploration and development activities on cultural resources. Lease Stipulation 24 addresses overland transportation and restrictions on ground surface disturbance, and would potentially protect subsurface cultural resources by requiring that operators use low-ground-pressure vehicles and cease operations when the spring melt of snow begins. Lease Stipulation 26 prohibits exploratory drilling within 1,200 feet, and Lease Stipulation 47 prohibits permanent oil and gas facilities (with the exception of pipelines) within 1 mile, of any known, long-term cabin or campsite. Lease Stipulations 39 and 62 provide for setbacks along rivers, streams, lakes, cabins, and the coast, providing additional protection for cultural resources and traditional/cultural land use areas. Lease Stipulation 63 minimizes cultural and resource conflicts through an orientation program for personnel that would include instruction on the importance of not disturbing archaeological resources and sensitivity to community values, customs, and lifestyles. Lease Stipulation 64 calls for an inventory of known traditional land use sites (NSB TLUI sites; see Appendix I) prior to any field activity so that these sites can be avoided and any damage from field activities can be mitigated. Lease Stipulation 67 mandates the avoidance or minimization of damage to vegetation, including the tundra mat, which could protect shallow sites. Lease Stipulation 74 calls for a cultural resources survey prior to any ground disturbing activity.

The BLM requires permittees to complete a cultural resources survey prior to any undertaking (i.e., any ground-disturbing activity, such as the construction of buried pipelines) on federal lands. If surveyors identify cultural resources during the survey, BLM guidelines and policy require that all potential effects to these resources be mitigated to the satisfaction of the land manager.

4.3.11.4 Conclusion

The potential exists for harm to or loss of cultural resources from non-oil and gas activities, and those activities associated with oil and gas exploration and development, but these impacts should be minor. Most impacts would be associated with ground-disturbance activities, but lessees are required to conduct a cultural resource survey prior to implementing any ground-disturbing activity.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). Activities that occur near these areas may have a greater likelihood of impacting cultural resources. In the most general terms, where surveys and inventories have been conducted, cultural sites have usually been found. Since surveys are required before any ground-disturbing activity can take place, the potential impacts to cultural resources from oil and gas exploration and development activities under the No Action Alternative is minor. These impacts would be mitigated by lease stipulations that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources, enforcement of lease stipulations that prohibit collection of artifacts and require training of workers regarding avoidance of effects on cultural resources, and compliance with all federal laws, including the National Historic Preservation Act, requiring surveys for cultural resources in areas where ground-disturbing activities are proposed.

4.3.12 Subsistence

4.3.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Subsistence Species

In most cases, non-oil and gas activities would be of limited duration and magnitude, and effects would be limited to the immediate area of the activity. Aircraft (e.g., helicopters and fixed-wing planes) and watercraft (e.g., airboats, outboards, jet-drive, and non-powered boats) could be used in the Planning Area. Aircraft operating under a BLM permit for non-oil and gas projects would follow the stipulated altitude and activity rules; however, the BLM would have no authority over private aircraft not associated with permitted activities. Watercraft operations would be managed in the same fashion. Non-oil and gas aircraft and watercraft activities would have a localized effect that could cause subsistence species, such as caribou, to avoid the area of activity, or cause the short-term abandonment of habitats by waterfowl.

Scientific research and data collection in a variety of disciplines (e.g., biological, geological, archaeological, and paleontological) could affect subsistence species in the Planning Area. Research and data collection activities could require the establishment of temporary or semi-permanent camps; the use of aircraft, four-wheelers, or boats; and the disturbance of wildlife, vegetation, or soil. Scientific research and data collection could disturb subsistence species, but the effect would be localized and temporary.

Residents of Nuiqsut have noted a decrease in bird populations, which they attribute to foxes (SRBA 2003a, b). Scientists that observe nesting waterfowl could influence predator behavior by attracting predators to the nest. As noted in USDOI BLM (2003a):

> There is evidence that researchers conducting studies on avian nest density and success may inadvertently affect the results by attracting predators to nests and broods (Bart 1977, Götmark 1992). Birds that are flushed from their nests during surveys may be more susceptible to nest predation than undisturbed birds. Ongoing activities by researchers could cause some mortality to eggs and chicks of tundra-nesting birds. Increased aerial survey efforts from agency and industry-sponsored studies to support development within the National Petroleum Reserve – Alaska may cause additional flushing and disturbance of pre-nesting waterfowl.

Recreational uses of the Planning Area include rafting and bird-watching tours conducted primarily on the Colville River by commercial guiding companies. Commercial permit holders would be subject to the lease stipulations outlined the 1998 Northeast IAP/EIS ROD. Non-guided rafting and bird watching tours could take place during the summer, but the frequency, duration, and intensity of this use are difficult to predict. Non-guided recreational users are not legally bound to all of the lease stipulations, but must comply with existing laws and regulations for the area. Recreational uses could disturb the movements and habitat use of subsistence species, causing a short-term, localized effect.

Overland moves would occur only by permit, and would be subject to the lease stipulations in the 1998 Northeast IAP/EIS ROD. These moves would be very rare, and would occur in the winter on frozen tundra, an adequate accumulation of snow pack, or on ice roads. These activities are very rare in the Planning Area, but they could disturb wildlife subsistence species.

Effects on Subsistence Harvest Patterns

Non-oil and gas activities that could affect subsistence harvest patterns would include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. These activities could alter the availability of subsistence species in traditional harvest areas through direct interference with hunts. This direct interference could affect harvest patterns by requiring hunters to travel further because the subsistence resources are more wary than normal following a disturbance or are deflected from traditional harvest areas following the presence of vehicles, vessels, and aircraft. Nuiqsut residents stated in the *Alpine Satellite Development Plan EIS* that aircraft have diverted subsistence resources away from areas where hunters were actively pursuing them, directly interfered with harvests, or caused harvests to fail (USDOI BLM 2004C). Increased travel distances would result in greater expenditures for fuel and equipment as wear and tear on snowmachines, outboards, and four-wheelers could occur. The risk of equipment failure would increase as travel distances and times increased, which could require increased search and rescue efforts by the NSB.

Aircraft activity could have the most widespread effect on subsistence harvests because aircraft could fly during all seasons anywhere in the Planning Area. Caribou, waterfowl, and muskox could be disturbed by aircraft traffic. Under certain conditions (e.g., insect harassment, hard or deep snow cover), aircraft activity could increase stress in these animals.

Watercraft activity could disturb subsistence species near navigable water routes during the open water season. The effect on harvest patterns would be dependent on the frequency of the aircraft and watercraft activities, but would most likely be a temporary and local effect on harvest patterns.

Personnel walking on the tundra could disturb caribou and muskox to a greater degree than other activities (Murphy and Lawhead 2000). Depending on the timing of research and data collection, and its areas of effect and intensity, these activities could cause terrestrial mammals, birds, and fish to move out of areas where subsistence harvesters would anticipate them to be available, thus affecting subsistence patterns for the duration of the activities. Presumably, most scientific research and data collection would take place in the brief summer months, but some research could also occur at other times of the year. The effects of research activities on subsistence harvest patterns would be temporary and localized (e.g., the camp and data collection areas).

Recreational users would likely frequent waterways shared with other users, such as subsistence hunters, potentially resulting in resource conflicts. Effects on subsistence harvest patterns caused by recreational users would be localized and temporary.

Solid and hazardous waste removal and remediation projects would be limited in area and duration and would be subject to NEPA review. Evaluation activities would have little effect on long-term harvest patterns. However, site cleanup and remediation activities could disturb caribou, muskox, and grizzly and polar bears for the duration of these activities. These effects would be localized to the project area and would be limited to the duration of the project; therefore, they would have little effect on long-term subsistence harvest patterns.

The effects of overland moves on subsistence harvest patterns would also be localized and of short duration; however, their effects on harvest patterns would increase as the frequency increased. Overland moves displace or disturb caribou, grizzly bears, polar bears, muskox, wolves, and wolverines. Although surveys for dens would normally be performed prior to overland moves, accidental disturbance of denned grizzly and polar bears in winter, especially post-partum sows, could result in bear mortality. In cases where oil and gas ice roads were used for non-oil and gas activities, increased traffic could result in additional effects on harvest patterns. These effects would last for as long as the ice road was used, and would vary depending on the intensity and frequency of traffic.

4.3.12.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Oil exploration, delineation, development, and production activities would create disturbances affecting the way in which terrestrial mammals and waterfowl behave (USDOI BLM 2003). The *Alpine Satellite Development Plan EIS* defines and discusses disturbance and displacement for biological resources:

> In general, disturbance can be considered impacts that change behavior or cause stress in animals. Displacement refers to movement from one area to another in response to disturbance. It is important to note that disturbance and displacement can vary in intensity and over time…. The level of disturbance would vary among species and be influenced primarily by habitat availability. If there is adequate alternative habitat, displacement may not affect animal health or survival. Displacement during winter, however, when energy budgets are negative, could have an additive effect and contribute to death by starvation (USDOI BLM 2003).

Subsistence Species

Caribou are year-round residents of the Planning Area, and the TLH is not habituated to oil and gas activities. Prior to becoming habituated to development activities, the TLH caribou would likely be wary of and avoid the new infrastructure and associated activities (USDOI BLM 2003). Muskox are not frequently observed in the Planning Area, but would likely avoid activity areas, as would moose using riparian habitats. Other terrestrial mammals (e.g., grizzly and polar bears, wolves, and wolverines) would also avoid oil and gas activity areas, although some animals (e.g., denning grizzly and polar bears) would not be able to avoid these activity areas. In addition, if grizzly bears and polar bears were to associate oil and gas activity areas with food, then they might be attracted to these areas. Oil and gas activity areas would be likely to attract foxes, who associate these areas with denning habitat and food in the form of handouts and trash (Burgess 2000). Foxes have been implicated in causing declines in waterfowl populations in areas where fox populations have increased in response to human activities (Burgess 2000, USDOI BLM 2003). The effects of disturbance from oil and gas activities on terrestrial mammals would be of relatively long duration, but would be local in nature.

Winter oil and gas activities would not affect waterfowl; however, waterfowl could be affected by changes to nesting and molting habitat due to oil and gas activities in the summer. For example, gravel extraction could create new habitat (e.g., dredge ponds) favorable for the survival of waterfowl, as these deep ponds would be inaccessible to predators. However, waterfowl could be negatively affected by vehicle strikes (e.g. aircraft and trucks), accidental collisions with structures, and increases in fox populations associated with oil and gas facilities (USDOI BLM 2003). Overall, disturbance to waterfowl caused by oil and gas activities would be localized and infrequent.

The No Action Alternative would not likely affect marine mammals. However, seals may use the Ikpikpuk and Colville rivers (Nigeluk Channel) seasonally in the summer and the nearshore environment in winter and spring. Aircraft traffic, vehicle traffic on nearshore ice roads, and activities near the rivers could affect spotted, ringed, and bearded seals by increasing their levels of alertness and restricting their access to some habitats.

Fish and fish habitats could be affected by water withdrawals, seismic testing, gravel mines, changes to hydrologic regimes due to infrastructure (e.g., pads, roads, causeways, docks, bridges and culverts), increases in turbidity and salinity, oil and hazardous materials spills, and access to new habitats. These activities have the potential to reduce fish populations, divert fish from their normal locations, kill large numbers of fish, or contaminate fish populations and habitat. Depending on the event or activity, effects could be widespread, last from one season to several years, and result in population level effects on fish.

Subsistence Harvest Patterns

Caribou, moose, and muskox would avoid areas of oil and gas activity and new infrastructure, which would make them more difficult to locate and harvest by hunters. As a result, the expense associated with the harvest of subsistence resources could increase, reducing the amount of traditional foods available to the community. These effects would continue until species were able to habituate to the new environment, which could take several years (e.g., for infrastructure), or might never occur (e.g., for human and vehicle activities; Murphy and Lawhead 2000). Nuiqsut hunters would be the most affected by movement of caribou away from areas of development, while Barrow, Atqasuk, and Anaktuvuk Pass hunters would likely see fewer effects, as development would likely proceed west from the Nuiqsut vicinity. In addition to having to travel greater distances to harvest resources, the disturbance caused to the snow surface by seismic testing, which leaves a trench in the snow, increases the likelihood that equipment would be damaged or subsistence users potentially injured in crossing the trails (ICAS 2004).

Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine field and 27 percent occurred 6 to 15 miles from the Alpine field.

Muskox and moose are rarely seen in the Planning Area, and muskox are not a preferred subsistence food. However, as moose are normally harvested along the Colville River near Umiat, subsistence hunting of this species could be affected by oil and gas activity in the Umiat vicinity. Subsistence users primarily harvest fox and bear when they become nuisances or dangers (SRBA 2003a, b). Wolf and wolverine hunting is a major activity for Nuiqsut, Barrow, and Atqasuk in the Planning Area, and subsistence users have noted that these species have avoided areas where they normally could be found because of oil and gas activity. These species are important for cash and for traditional clothing, as the furs are strong and shed frost. Overall, disturbances from oil and gas activities under the No Action Alternative would have an effect on subsistence harvest patterns by causing subsistence resources to move away from traditionally used areas.

Waterfowl harvests could be affected, as oil and gas activity would cause migratory birds to move outside of their normal migration routes and nesting and molting areas. Although gravel ponds could increase population numbers by increasing the protected habitat available to birds, they could also put waterfowl out of reach of subsistence users. For subsistence users who prefer not to shoot near oil infrastructure, birds using habitats near facilities would effectively be inaccessible. Nuiqsut is the community most likely to be affected by any change in waterfowl numbers or availability; however, hunters would continue to be able to harvest early arriving birds following the Colville River en route to coastal areas. Overall, activity under the No Action Alternative could effect waterfowl subsistence harvest patterns if waterfowl avoid traditional harvest locations.

Seal in nearshore and riverine habitats could be affected by oil and gas activities. However, these animals should still be available to hunters from Nuiqsut. With few exceptions, Barrow and Atqasuk hunters do not travel to the Planning Area to harvest seals or other marine mammals (SRBA 2003a, b).

Fish and their habitats could be disturbed by oil and gas activities. In the past, Iñupiat subsistence users associated fish kills with seismic testing across water bodies and oil and fuel spills (Edwardson 1976). However, these effects have not been cited as recent occurrences since the early 1980s, and likely have been corrected with improved seismic testing and hazardous materials handling and transport methods. Fish provide approximately one-third of Nuiqsut's, 7 to 14 percent of Barrow's, 37 percent of Atqasuk's, and 4 to 8 percent of Anaktuvuk Pass' subsistence harvest by weight (see Section 3.4.2; Subsistence). An interruption in subsistence fishing would cause severe hardship for Nuiqsut and Atqasuk, and would present challenges for Barrow and Anaktuvuk Pass subsistence users. Most fishing occurs near the communities, with Nuiqsut in closest proximity to oil development. Thus, Nuiqsut subsistence harvest patterns for fish are the most likely to be affected by disturbances from oil and gas activities under the No Action Alternative.

Effects of Abandonment and Rehabilitation

During oil facility abandonment and rehabilitation activities, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following these activities, subsistence resources would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

Subsistence Species

The effects of oil spills on subsistence species would depend upon the size of the oil spill and the environment in which the oil spill occurred. Spills contained on pads (small and some large) would likely have few long-lasting or wide-ranging effects on subsistence species. In addition, oil spills (small and large) on the tundra, if they did not escape to a waterway and occurred on snow or frozen tundra, would likely have few long-lasting or wide-ranging effects on subsistence species. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl that were unable to avoid the spill area, but would be unlikely to have population-level effects. Oil spills on wet or non-frozen tundra would have some possibility of seeping into lakes and streams, and very large spills would most likely contaminate a waterway. Oil spills directly into a water body, particularly under conditions that made them difficult to contain, such as breakup or broken ice, could spread widely and be toxic to fish and waterfowl, leading to long-term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could also affect marine mammals, such as seals, and beluga and bowhead whales.

Subsistence Harvest Patterns

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence (Brower 1976, Itta 2001). A large or very large oil spill into nearshore or riverine environments could cause injury or death to bowhead whales, or cause them to move off of their normal course, thereby making them unavailable for subsistence harvest for Nuiqsut, and Barrow, and possibly other communities. In this unlikely event, residents of both whaling and non-whaling communities would lose an important source of subsistence food as well as face issues of contamination, increased cost and effort to replace lost resources, social disruption due to resource damage and inability to participate in whaling, and financial hardship cause by the loss of a major source of subsistence food. Whaling is the center for social and community organization. A spill could interrupt subsistence seal hunting and fishing in riverine, lacustrine, or nearshore environments. The effects of a spill into lakes, rivers, or nearshore waters would extend beyond the margins of the spill itself, and concerns about contamination would last for many years. In Barrow, marine mammals, including seals and whales, supply from 53 to 74 percent of the total subsistence harvest by weight. Marine mammal harvests in Nuiqsut ranged from 8 percent in a poor year to 35 percent in a more successful bowhead whale harvest year. Atqasuk residents harvest seals, and may harvest whales in cooperation with other communities, while Anaktuvuk Pass residents depend on trade for marine mammal products.

An oil spill (of any volume) into a river system or lake could have effects on subsistence fish harvests. Loss of some portion of the subsistence fish harvest would negatively affect Atqasuk, Barrow, and Nuiqsut. Nuiqsut has depended upon fish for 30 to 45 percent of its total subsistence harvest by weight—the larger number when no bowhead whales were harvested. Barrow, Atqasuk, and Anaktuvuk Pass depend on subsistence fish harvests for varying proportions of their diet. A worst-case scenario would result from a spill into lakes, rivers, or nearshore waters, particularly in key areas such as spawning and feeding areas and overwintering habitat. In addition, broken ice conditions pose significant challenges to timely and effective cleanup. Any impact due to an oil spill would compound risks associated with current contamination levels.

Oil spills also have the potential to impact subsistence harvest patterns indirectly, in that subsistence users would decrease harvests of subsistence resources due to contamination concerns. For example, the people of Nuiqsut have a contamination issue with regard to burbot livers, which many residents believe should not be eaten because of high levels of toxic chemicals. According to interviewees, residents have been advised not to eat more than six burbot livers, the amount of one meal according to interviewees (SRBA 2003a, b). Despite scientific evidence to the contrary, numerous residents of Nuiqsut still believe that burbot livers are unsafe, and therefore, refrain from ingesting them.

Subsistence users would likely also allow for a period of time for the resources, especially bowhead whales, to recover following exposure to oil. A large or very large oil spill into nearshore or riverine environments could cause injury or death to bowhead whales, or cause them to move off of their normal course, thereby making them unavailable for subsistence harvest for Nuiqsut and Barrow, and possibly other communities. Such an event could also trigger a reduction in the International Whaling Commission subsistence bowhead whale quota, causing hardship to all subsistence whaling communities in Alaska, Arctic Canada, and Eastern Siberia.

4.3.12.3 Effectiveness of Stipulations

Many of the lease stipulations outlined in the 1998 Northeast IAP/EIS ROD relate to ensuring the continued health of subsistence resources and wildlife (USDOI BLM and MMS 1998). Oil and gas development is subject to continuous improvements in methods, and each new generation of technology improves safety and reliability. Many of the lease stipulations reflect knowledge gained from past mistakes and reflect a desire by the BLM to safeguard wildlife and subsistence resources from harm. The 1998 Northeast IAP/EIS ROD also calls for consultation with affected communities (Lease Stipulation 61), which would help include residents in the processes that could change subsistence harvest activities in those communities.

Effectiveness of Stipulations on Subsistence Species

The lease stipulations in the 1998 Northeast IAP/EIS ROD would protect subsistence species by withdrawing critical habitat for TLH caribou calving and insect relief, as well as habitat for molting geese; establishing buffers around lakes and streams; mandating that exploration and construction activities minimize impacts on subsistence animals; and establishing conflict resolution processes. Areas termed LUEAs would be protected from development. Buffers along rivers, where year-round occupation would be prohibited, would protect fragile riparian habitat (Lease Stipulations 28, 39, and 41). The Teshekpuk Lake Surface Protection Area (Lease Stipulation 31) and the Pik Dunes LUEA (Lease Stipulation 45) would be unavailable for year-round occupation and would be seasonally closed to exploration and drilling. Protections for fish-bearing and deep-water lakes, streams, and nearshore habitats (Lease Stipulations 28, 30, 39, 40, 41, 46, 62, 70, and 78) would protect fish, waterfowl, and marine mammal species using those habitats. Maintaining the suitability of overwintering fish habitat, spawning areas, and feeding habitats are the key goals of lease stipulations addressing water and fish habitat management. Agency jurisdiction over these issues would be dependent on the water body (e.g., USACE on the Colville River Delta, and U.S. Coast Guard on navigable waters).

Protections for denning grizzly and polar bears and strategies for managing human-bear interaction have been designed to minimize effects to these animals (Lease Stipulations 2, 24, 72, 76, and 77). Lease stipulations intended to minimize effects on waterfowl populations include 21, 25, 31, 39, 46, 50 through 55, 57, 62, 71, 72, and 73. Caribou are addressed in Lease Stipulations 25, 29, 33 through 37, 49, 50 through 55, 57, 72, and 73. The main goals of the bear, waterfowl, and caribou lease stipulations are to protect these species while they are vulnerable (e.g., bears denning, caribou calving, and waterfowl nesting and molting). During these times, aircraft and ground activity would be regulated to minimize effects on these species. Raptors would be protected by aircraft harassment under Lease Stipulation 56.

Under lease stipulations outlined in the 1998 Northeast IAP/EIS ROD, development could proceed in areas that have already been leased. These activities would be bound by the lease stipulations of the ROD, with the caveat that procedures for the AO to grant exceptions to the lease stipulations exist (USDOI BLM and MMS 1998).

Granting an exception would require the AO to find that implementation of the lease stipulation would be not technically feasible or economically prohibitive, or that an environmentally preferable alternative was available, and that the alternative proposed by the lessee would fully satisfy the objectives of the lease stipulation.

Effectiveness of Stipulations on Subsistence Harvest Patterns

Lease stipulations to protect subsistence species, as listed above, should aid in keeping those species available to subsistence users by maintaining population numbers. The management goal of other lease stipulations would be to prevent oil and gas activities from causing subsistence resource to move outside of their traditional harvest areas (Lease Stipulations 23, 47, 51, 57, 59, 62, 72, 73, and 78). Additional lease stipulations would minimize conflicts with subsistence users by directing industry to avoid subsistence camps, maintaining subsistence access and cabins, and initiating consultation for conflict avoidance and resolution (Lease Stipulations 23, 26, 47, 59, 60, 61, 63 and 73). Lease Stipulation 71, prohibiting pesticide use, would reduce concerns about contamination for some species. Other lease stipulations could reduce concerns about the effects of development on subsistence resource availability and harvest success (the causeways and docks Lease Stipulation 30), aircraft altitude and activity Lease Stipulations (52 through 57, and 59), and surface activity Lease Stipulations (24, 25, 34, 35, 36, 50, 51, and 73). Subsistence users in Nuiqsut believe that Lease Stipulation 37, which makes 5 feet the minimum pipeline height above ground, would be inadequate to allow caribou passage under most conditions (SRBA 2003a, b).

4.3.12.4 Conclusion

Most impacts associated with oil and gas exploration and development would be localized and would not impact subsistence species. Because less area would be available for leasing, impacts to subsistence resources should be less under the No Action Alternative than the action alternatives. In addition, the lease stipulations discussed above would be protective of subsistence species and would help to resolve conflicts between the oil and gas industry and local residents. It was apparent from public scoping and hearing testimonies, however, that local residents are concerned about the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children. These issues are discussed in more detail in the next section.

4.3.13 Sociocultural Systems

The social and cultural effects of amending the 1998 Northeast IAP/EIS ROD would take place against a background of other continuing social effects caused by both oil development and the ongoing adaptation of Iñupiat residents to changing social, political, technological, and economic factors associated with the rapid introduction of hunter-gatherers to modern technical and industrial society (USDOI BLM and MMS 2003). The primary aspects of the sociocultural systems covered in this analysis include social organization, cultural values, and social health, as described in Section 3.4.3 (Sociocultural Systems).

Effects on social organization and cultural values from increased industrial activities, population, and employment, and from changes in subsistence harvest patterns associated with oil and gas development, could be brought about at both the community and regional level, as Iñupiat cultural values and social organization transcend individual communities. Iñupiat are mobile between communities and often have lived in several communities over their lifetimes. Extensive kinship ties exist between communities, and the value placed on subsistence activities and distribution is widespread throughout the North Slope.

As stated in Nuiqsut Paisanich (Brown 1979), "Today, as in the past, subsistence harvest of wild resources is the central occupation of traditionalist Iñupiat. Most of the people in Nuiqsut and other northern Alaska villages are traditionalists. Despite their acceptance of many elements of Euro-American culture, technology and economy, these people continue to participate in and depend on the subsistence way of life, either as hunters or as sponsors and sharers of the hunt. Subsistence provides such necessities as food and clothing, and it organizes the people's lives seasonally, socially, and ceremonially in the defining patterns of their culture." Subsistence activities are the vehicle through which culture and values are passed on to the next generation. It is also through the subsistence harvest that successful hunters are able engage in the sharing of meat, a tradition that is a significant part of the Iñupiat culture and that is key to the cohesiveness of families and communities.

Sociocultural effects include, but are not limited to, changes in social cohesion, changes in social interaction within and between communities, increases in suicides and violent crimes, high risk behavior and substance abuse, and decreases in cultural transmission between youths and elders (USDOI BLM and MMS 1998, 2003). Iñupiat values include a high regard for subsistence activities and uses that include sharing, transfer of knowledge, satisfaction of eating traditional food, integrity of culturally important places, and autonomy. To the extent that outside influences come into conflict with those activities, they conflict with core Iñupiat values, and produce sociocultural consequences. In this sense, cultural values are a standard against which change can be compared. The impending change could allow greater opportunities for Iñupiat to realize their values and goals, or it could constrain and restrict the realization of these values and goals.

An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of Iñupiat family ties, kinship networks, and a sense of community well-being. In rural Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship. 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 (USDOI BLM and MMS 1998, 2003). Social groups generally are based on kinship and marriage systems, as well as on nonbiological alliance groups formed by characteristics such as age, sex, ethnicity, community, and trade. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization on the North Slope centers on group subsistence activities and on an extensive network that shares subsistence resources. An influx of a new population that caused growth in the community or change in the organization of social groups and networks could affect social organization. Disruption of subsistence harvest task groups would damage the social bonds that hold the community together. In addition, disruption of the subsistence cycle could change the way these groups are organized.

An analysis of cultural values involves examining those values shared by most members of a social group. Effects on cultural values could result from a fundamental cultural change imposed or induced by external forces, such as when an incoming group causes acculturation of the residing group, or when a series of fundamental technological inventions change existing physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly, or suddenly and dramatically (Lantis 1959). For the system of sharing to operate properly, some households must be able to consistently produce a surplus of subsistence goods. For this reason, sharing, and the supply of subsistence foods in the sharing network, could be more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers. Disruption of subsistence harvest patterns would conflict with cultural values, and could trigger an array of negative emotions such as fear, anger, and frustration, as well as a sense of loss and helplessness. Because of the importance of subsistence in sharing networks, threats to subsistence activities are a major cause for anxieties about oil development.

The No Action Alternative would maintain the existing lease stipulations published in the 1998 Northeast IAP/EIS ROD. The area north of Teshekpuk Lake would be closed to year-round surface occupancy and leasing, and would continue to be protected, as would buffers around fish-bearing lakes and streams. The No Action Alternative would be unlikely to cause further sociocultural impacts to the communities described in the affected environment; however, the existing and foreseeable impacts of this alternative should not be minimized or discounted depending on what projects are proposed and undertaken, where operations are to occur, how they are to be conducted, and when they occur. While the existing lease stipulations and regulations were developed with local participation, the lease stipulations and regulations were the result of a rushed compromise among diverse interests, no local authority had the power to veto the options, and the lease stipulations and regulations are too recent to have demonstrated their efficacy, if any, in protecting local resources that contribute to the well-being of local residents. Also, the uncertainty of location, degree, timing, and pace of development results in heightened anxiety among subsistence users of the potentially developed land.

4.3.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Non-oil and gas activities include use of aircraft and watercraft, scientific research and data collection, recreation, overland moves, and solid and hazardous waste removal and remediation. Under The No Action Alternative, these activities should not increase in frequency, would be of short duration, and would occur in limited areas. Research and data collection could result in the diversion or deflection of subsistence resources where helicopter or fixed-winged aircraft were used, which could result in local and temporary disruption to subsistence harvests of these resources. These localized and temporary effects would be unlikely to affect sociocultural patterns in North Slope communities. Archaeological research could increase interest in Iñupiat cultural history; however, some members of the community might oppose archaeological research for religious or cultural reasons. Recreational uses, primarily rafting and bird watching, would generally occur during the summer along rivers such as the Colville and Ikpikpuk, which could create localized and temporary effects (e.g. user conflicts and subsistence resource deflection), that would last only as long as these users were in the area. Overland moves are, in some cases, necessary for supplying communities with bulky goods and fuel, as well as for moving scientific and other camp equipment during the winter using low ground pressure vehicles, and are subject to the restrictions placed on such activities in the lease stipulations (USDOI BLM and MMS 1998). However, non-oil and gas overland moves are uncommon. Effects from these overland moves would be temporary and would be unlikely to affect overall sociocultural patterns.

4.3.13.2 Oil and Gas Exploration and Development Activities

Under the No Action Alternative, areas outside the closed areas and buffer zones or setbacks would be available for year-round occupation, and several lease sales have already been held. The Alpine Satellite Development is currently undergoing permitting and would be the first production facility in the National Petroleum Reserve – Alaska.

Effects of Disturbances

Nuiqsut is the community in closest proximity to oil and gas development activity. Many Nuiqsut residents have stated during scoping testimony that they are being affected by oil and gas development and related activities enveloping the community from the east and excluding them from preferred subsistence harvest areas (Ahtuangaruak 2001). Oil and gas development in the central and southern portion of the Planning Area, as allowed under the 1998 Northeast IAP/EIS ROD, could further surround the community of Nuiqsut and increase the difficulty, expense, and risk of traveling to desired subsistence harvest areas. This development would also divert subsistence users for a distance of 5 to more than 25 miles from facilities. This would decrease the use of traditionally-used lands by reducing access to these lands and lowering the quality of the experience of and connections to the land for Iñupiat users. This disconnection from traditional uses threatens the subsistence way of life that is a major component of Iñupiat culture. Under the Alpine Satellite Development Plan, development allowable under the No Action Alternative would be located in Nuiqsut's primary subsistence use area. Nuiqsut residents observe direct connections between the general well-being of their community and subsistence harvests (Ahtuangaruak 1997). To the extent that oil and gas activities conflict with ongoing subsistence activities, they conflict with Iñupiat cultural values.

Public testimony indicates a relationship between oil and gas development and social stress or well-being (Ahtuangaruak 1997). However, little data exist to support the correlation between oil and gas development and social stress. Examples of studies that are being conducted to explore this relationship include: 1) a limited ethnographic and harvest pattern study of bowhead whaling at Cross Island (Galginaitis 2003), sponsored by MMS as part of a broader effort to monitor effects of British Petroleum's Northstar offshore oil development facility on selected environmental variables; and 2) a MMS sponsored study that will analyze NSB residents' observations and perceptions about effects from past, present, and future oil industry activities and other forces of modernity on their lives and subsistence whale hunting activities (EDAW In Prep). In addition, the NSB has submitted a grant request to the State of Alaska for a study of the cultural, social, and economic impacts to National Petroleum

Reserve – Alaska subsistence communities resulting from current Arctic oil and gas exploration and production. The North Slope Science Initiative, now in the planning stages, could also affect scientific research projects (Argonne National Laboratory 2004).

Under the No Action Alternative, subsistence harvest areas used by Atqasuk and Barrow for wolf and wolverine hunting, caribou harvests, and fishing would be available for year-round occupation and development, including large areas south of the Teshekpuk Lake closed area that are outside the setbacks protecting fish-bearing lakes and streams. In addition, this area contributes to the wilderness character and solitude desired by many North Slope residents. Oil and gas exploration and development could alter subsistence harvests in these areas, thus affecting sociocultural patterns such as transfer of knowledge between elders and youth related to those areas and integrity of culturally important places and the wilderness character of the area. Areas with traditional importance to families, such as camps and cabins used by many residents of Barrow and Atqasuk for caribou and sometimes fish and seals, would be protected by the closed area and stream and lake setbacks. This is consistent with the high value the Iñupiat place on these locations.

Anaktuvuk Pass could be affected by oil and gas activity in the Planning Area under the No Action Alternative, if TLH caribou were diverted or deflected from their normal migration routes by oil and gas activity. As discussed in Section 4.3.12 (Subsistence), such effects have occurred in the recent past. If subsistence foods were not available from Nuiqsut or other communities, it could be necessary for Anaktuvuk Pass hunters to travel outside of traditional harvest areas to harvest subsistence foods, which would increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, there would be an increase in social stress, as hunters would leave the community for longer periods to harvest resources. Indirect effects could include increased competition for subsistence resources with other communities, a change in subsistence emphasis to other resources (e.g., sheep, moose, and fish), decreased self-sufficiency, and changes in relations with other Iñupiat communities.

Under the No Action Alternative, staging for oil and gas activities in the Planning Area would occur primarily from facilities at the Prudhoe Bay/Deadhorse, Kuparuk, and other existing sites, which would reduce disruption to nearby Native communities. A trend toward displacement of community social institutions could lead to a short-term and decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood. Increasing oil and gas activity could increase access to urban communities and cause more interaction with oil-industry workers, resulting in the introduction of new values and ideas as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions would be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining the ability of traditional Iñupiat institutions to maintain social stability and cultural continuity.

As discussed in the 1998 Northeast IAP/EIS, long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under the Planning Area. These changes are already occurring to some degree on the North Slope as a result of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes the teaching of Iñupiat language and culture, the Arctic Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and quite successfully at preventing the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of Iñupiat social institutions. Changes in population and employment are unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and termination activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

Small spills that remained on land and did not spread to fresh water or marine environments would likely have a minor effect on overall sociocultural patterns. Large and very large spills, if contained on land, could disrupt subsistence harvests, as hunters would avoid contaminated resources, and not participate in traditional subsistence activities in contaminated areas. This decrease in participation could increase the cost and effort of harvesting uncontaminated resources.

A large or very large oil spill into a river, lake, or marine environment prior to breakup could contaminate a wide area with crude oil. Oil spills in these environments could affect fish and marine mammals, and many residents would decrease harvests of these contaminated resources. Effects on subsistence and sociocultural responses, similar to those described for the *Exxon Valdez* oil spill, could result from the unlikely, but possible, release of large volumes of crude oil in the Planning Area (Fall et al. 2001). If oil spill contamination concerns or clean-up activities were to result in the suspension of whaling, then Barrow, Nuiqsut, and Atqasuk would be directly affected for the duration of the suspension, as whaling is the basis for most social organization and interaction in those communities. The Iñupiat believe that a large marine oil spill would injure or kill large numbers of whales, especially during the spring migration when whales and oil spills would concentrate in open leads (NRC 2003). In addition, the Iñupiat fear that the International Whaling Commission would reduce or curtail whaling quotas due to the increased threat to bowhead whales following a spill (Napageak 1990, NRC 2003). A reduction in International Whaling Commission bowhead whaling quotas on the North Slope would result in negative subsistence, economic, cultural, and social impacts throughout the region. Whaling is important to the Iñupiat for both subsistence and cultural purposes. Organization of whaling crews and preparations for the hunt reinforce social and cultural bonds, and processing of the whale often involves a large portion of the community. Therefore, disruptions to the bowhead whale hunts would affect social organization and add to social stress. Sharing of the whale is a valuable part of the Iñupiat culture, and a loss of this resource would affect cultural values and Iñupiat well-being. A large or very large oil spill into a riverine, lacustrine, or marine environment prior to breakup could indirectly affect Anaktuvuk Pass due to a decrease in bartered subsistence foods from other North Slope communities.

Other industrial activities associated with oil development that could have an effect on sociocultural systems would be those associated with cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because oil spills would be small, chronic events, and would normally be contained on the drill pad, effects from the spills themselves and potential disruption from clean-up activities are not likely to cause great disturbance to sociocultural systems or the surrounding environment.

4.3.13.3 Effectiveness of Stipulations

Under the No Action Alternative, lease stipulations identified in the 1998 Northeast IAP/EIS ROD would remain in effect. These lease stipulations were the result of 18 months of intensive consultation among the communities near the Planning Area and the local, state, and federal agencies with management interests in National Petroleum Reserve-Alaska lands and waters. The 79 lease stipulations provide protections for subsistence resources, cabins, camps, and river corridors, as well as the system of negotiating conflicts between permittees, leaseholders, and subsistence users. Lease stipulations relevant to sociocultural effects are also described in Section 4.3.12 (Subsistence).

Under the No Action Alternative, Lease Stipulation 39 would prohibit permanent oil and gas facilities, including roads, airstrips, and pipelines, within and adjacent to listed water bodies in order to protect fish and raptor habitat, cultural, and paleontological resources, and subsistence and other resource values (USDOI BLM and MMS 1998). Lease Stipulation 47 would prohibit permanent oil and gas facilities within 1 mile of known long-term cabins or long-term campsites. Lease Stipulations 59 through 62 specifically address subsistence (e.g., management plans, consultation, and access to traditional use areas). Lease Stipulation 63 outlines an orientation program for all personnel involved in exploration or development and production activities. The purpose of this orientation would be to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the Planning Area and increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating. Lease Stipulation 64 would require lessees to conduct an inventory of known traditional land use sites prior to any field activity, develop a plan to avoid these sites and mitigate any potential damage that could result from field activities, and indicate how local subsistence users would be provided access to the site. Lease Stipulation 73 would prohibit hunting and trapping by a lessee's employees, agents, and contractors when these persons are on “work status,” and would prohibit use of lessee facilities, equipment, or transport for personnel access or aid in hunting and trapping. Lease Stipulation 74 would require lessees to conduct a cultural and paleontological resources survey prior to any ground-disturbing activity. If any potential cultural or paleontological resource were found during oil and gas activities, then the lessee or their designated representative would be required to notify the AO and suspend all operations in the immediate area of such discovery until written authorization to proceed was issued by the AO.

The implementation of the 1998 prescriptive lease stipulations has been underway for a relatively short period of time, limiting an empirical assessment of their effectiveness. However, the 1998 lease stipulations were developed through extensive consultation with local communities, and local residents are generally less familiar with the new approach to mitigation measures, relying on performance-based lease stipulations and ROPs rather than prescriptive lease stipulations. As a result, many residents are concerned that the new approach may be less effective. In expressing their concerns, it was stated during scoping for this amendment that unilateral changes to the lease stipulation package would be a violation of trust between communities and the federal agencies managing the National Petroleum Reserve – Alaska (Ahmaogak 2003). The BLM believes performance-based mitigation measures would provide the agency greater flexibility to adapt management decisions to changing and uncertain environmental conditions on the ground.

4.3.13.4 Conclusion

Oil and gas development in the Planning Area could surround the community of Nuiqsut, and increase the difficulty, expense, and risk of traveling to subsistence harvest areas. As a result, the continued use of and access to traditionally used lands could decrease, potentially threatening the subsistence way of life. Nuiqsut residents report in public testimony and scoping direct connections between the general well-being of their community and subsistence harvests (e.g., Ahtuangaruk 1997). To the extent that oil and gas activities conflict with ongoing subsistence activities, they conflict with Iñupiat cultural values.

The lease stipulations listed in the 1998 Northeast IAP/EIS ROD were the result of several years of collaboration between the communities near the Planning Area and the local, state, and federal agencies with management interests in National Petroleum Reserve – Alaska lands and waters. The lease stipulations provide protections for subsistence resources, cabins, camps, and river corridors, as well as the system of negotiating conflicts between permittees, leaseholders and subsistence users, through the Subsistence Advisory Panel. Although these lease stipulations would not eliminate conflicts between Iñupiat cultural values and oil and gas development activities, they would help to reduce these risks and allow Iñupiat cultural values to coexist with development.

The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision. The new approach proposed in the final Preferred Alternative and alternatives B and

C is not well known or understood, and some local residents are concerned that the new approach may not provide equivalent protection. The BLM believes that these mitigation measures would provide the BLM greater flexibility to adapt management decisions to changing and uncertain environmental conditions on the ground. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.3.14 Environmental Justice

Executive Order No. 12898 of February 1994 is "intended to promote nondiscrimination in federal programs substantially affecting human health an the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for participation in, matters relating to human health and the environment."

U.S. Environmental Protection Agency guidelines for evaluating the potential environmental effects of projects require specific identification of minority populations when either: 1) a minority population exceeds 50 percent of the population of the affected area; or 2) a minority population represents a meaningfully greater increment of the affected population than of the population of some other appropriate geographic unit, as a whole.

The North Slope includes two relatively distinct populations: local residents who are predominately indigenous Iñupiat natives, and the oil and gas industry workforces, who rotate on a regular schedule and are temporary worker/residents in the region. As temporary residents, the oil and gas industry workers have minimal participation in the local economy, and their needs for all services are provided by industry. On the other hand, full-time residents of the region form the primary social structure and the local economy.

The North Slope has a fairly homogeneous population of Iñupiat; the percentages in the 2000 Census ranged from 89.1 percent Iñupiat in Nuiqsut to 64.0 percent Iñupiat in Barrow. In 2000, 5,450 (73.8 percent) NSB residents reported they were all or part Alaska Native or American Indian. Although the Census did not differentiate between Eskimo, Aleut, and Indian, it did ask for the individual's "Alaska native or American Indian tribe(s)." Based on tribal data, at least 4,594 (62.2 percent) of the 7,385 NSB residents were Eskimo (see Section 3.4.3; Sociocultural Systems). Based on the census data, the minority population in the NSB is well above the 50 percent threshold specified in the USEPA guidelines, so it is appropriate to consider potential environmental justice issues in evaluating the effects of the Planning Area alternatives.

Personal income is the income received by people from all sources: private sector and government wages, salary disbursements, other labor income, farm and nonfarm self-employment income, rental income, personal dividend income, personal interest income, and transfer payments. Per capita personal income is the annual total personal income of the residents of an area divided by their resident population. Per capita personal income can be a measure of economic well being because the amount of goods and services that people can afford is often directly related to their personal income. Personal income estimates do not attempt to quantify the non-cash contribution of subsistence activities to the economic well-being of NSB residents.

Figure 3-10 shows annual per capita personal income (in 2000 dollars) for residents of the North Slope, compared to that of Alaska residents as a whole, for 1969 through 2000. From 1975 through 1991 and from 1993 through 1996, per capita personal income of North Slope residents exceeded the statewide average, sometimes by as much as 50 percent. Starting in 1984, the real per capita income in the region began to decline and the gap narrowed. Currently, the North Slope average is virtually the same as the average for the state as a whole.

While North Slope residents have often enjoyed higher real personal per capita incomes than the statewide average, the statewide average has been notably less volatile than that of the North Slope. This is to be expected, as regional economies that are not highly diversified tend to be more sensitive to internal and external economic changes.

Based on the per capita income data, the North Slope population would not qualify as a low-income community for environmental justice consideration. However, personal income data alone do not address the question of overall economic well-being. The average cost of living is much higher on the North Slope than in Anchorage, for example, and, as noted above, many North Slope residents benefit from subsistence activities, which also do not figure in the income data. Regardless, it is not necessary to dissect the income/economic well-being issue in greater detail because environmental justice considerations are triggered by the race/ethnicity threshold.

An extensive effort was made to provide all interested parties in the project vicinity with access to public information and opportunities to participate in the review process for this amendment (see Section 3.4.4, Environmental Justice, and Chapter 5, Consultation and Coordination). An informational letter was sent to individuals, organizations, federal, state, and local agencies, and Alaska Native groups describing the proposed planning effort and requesting comments. Similar notices were published in newspapers in the area. Several meetings were held on the North Slope to solicit local community input early in the process. Every effort was made in the public consultation process to ensure that access to information was available to all interested parties in a non-discriminatory manner.

Subsistence activities in the Planning Area are important for providing dietary sustenance to North Slope residents. As a consequence, impacts to subsistence resources and access to those resources have a direct relationship to the analysis of whether the alternatives would have a disproportionate effect on the minority and low-income populations. Subsistence effects are the primary measure of disproportionate effects in the context of this planning effort.

4.3.14.1 Activities Not Associated With Oil and Gas Exploration and Development

As noted throughout this document, and in Section 4.3.12 (Subsistence) in particular, the non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. The effects of these activities on subsistence resources would be to temporarily divert or disturb subsistence species from their normal movement patterns or activities. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. These effects would be minor, temporary, short term, and generally highly localized.

4.3.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under the No Action Alternative, oil and gas activities could have long-term effects on several terrestrial mammal species, although the effects would be localized in nature. Infrequent and localized effects on waterfowl harvested for subsistence could also occur. Onshore oil and gas activities would be expected to have little or no effect on marine mammals, but noise and disturbance associated with offshore barge and vessel traffic could impact bowhead whale migration patterns under the No Action Alternative. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under the No Action Alternative could cause widespread effects on fish, perhaps to the level of affecting populations. All of these effects would be mostly experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users’ avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation were completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

The effects of oil spills on subsistence species would greatly depend upon the size of the oil spill and the environment in which the oil spill occurred. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills directly into a water body, particularly in difficult to contain conditions, such as breakup or broken ice, could spread widely and have long-term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). These effects include acute or chronic toxicity to whales or their prey. Thus, a major oil spill would result in effects that would impact Iñupiat subsistence users more than other human groups.

4.3.14.3 Effectiveness of Stipulations

Many of the lease stipulations outlined in the 1998 Northeast IAP/EIS ROD are designed to ensure the continued health of subsistence resources and wildlife (USDOI BLM and MMS 1998). Oil and gas development is subject to continuous improvements in methods, and each new generation of technology improves safety and reliability. Many of the lease stipulations reflect knowledge gained from past mistakes and reflect a desire by the BLM to safeguard wildlife and subsistence resources from harm. Lease Stipulation 61 calls for consultation with affected communities, which would help include residents in the processes that could change subsistence harvest activities in those communities.

Lease stipulations to protect subsistence species should aid in keeping those species available to subsistence users by maintaining population numbers. The management goal of other lease stipulations would be to prevent oil and gas activities from harming or disturbing subsistence resources.

4.3.14.4 Conclusion

Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads and roads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating in the National Petroleum Reserve - Alaska. While these effects would continue under the No Action Alternative, most effects of disturbance would be localized, short term, and relatively minor. Since the amount of area available for leasing, and the number of seismic operations proposed is less, the effects to subsistence resources should be less under this alternative than the action alternatives. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long-term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut.

4.3.15 Coastal Zone Management

This section discusses the potential effects of management actions in the Planning Area on land use and compatibility with Coastal Zone Management priorities under the No Action Alternative. The following sections summarize the information previously presented in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), which has been amended with some additional data from studies conducted since 1998, particularly for the Northwest IAP/EIS (USDOI BLM and MMS 2003).

Federal lands within the National Petroleum Reserve – Alaska are excluded from the coastal zone; however, all uses and activities on federal lands that occur within the coastal zone or that are expected to affect the coastal area and its resources must be consistent, to the maximum extent practicable, with enforceable standards of the ACMP, including Alaska state standards in 11 AAC 112 and enforceable policies of the NSB Coastal Management Plan (CMP). (11 AAC 112 is the standards section of the amended ACMP developed pursuant to 2003 ACMA revisions; OCRM approval is pending. The NSB CMP is addressed as it is currently in effect, recognizing that there may be adjustments when it is updated in 2005 to comply with the amended ACMP.) The primary goal of the comprehensive plan is to protect the subsistence lifestyle of the NSB's largely Iñupiat population, while also encouraging and managing economic development.

Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. Subsistence uses of coastal resources in the Planning Area have been, and will continue to be, of the highest priority to the NSB Iñupiat, given cultural and historic patterns of existence within the Planning Area. 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 clean-up plans; pipelines; causeways, residential development associated with resource development; air and water quality; and solid-waste disposal.

4.3.15.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, non-oil and gas activities would be subject to all applicable lease stipulations listed in the 1998 Northeast IAP/EIS ROD (USDOI BLM and MMS 1998), as well as any other federal, state, or NSB regulations that pertain to the activities in question. These activities would include aircraft use for point-to-point transport, and wildlife and other aerial surveys; ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves; and guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous and solid waste removal and remediation would continue to occur at abandoned drill sites. Oil spills could occur from fuel storage at construction sites and camps, but the size of such spills would likely be small (a few barrels), resulting in a small area of contamination. Clean-up activities are not likely to greatly disturb subsistence harvest activities or the surrounding environment. As non-oil and gas activities are normal occurrences under existing BLM management practices, it is expected that there would be little net change in the amount of disturbance to the primary uses of the Planning Area, which are related to subsistence resources and harvest patterns of nearby communities.

4.3.15.2 Oil and Gas Exploration and Development Activities

Under the No Action Alternative, several ground-impacting-management actions would be associated with oil and gas development. Most oil exploration activities, seismic surveys, and exploration drilling would occur in winter (early December to mid-April), although exploratory drilling would also be allowed only from current production pads or platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area. Construction materials (and gravel for pads), personnel, and fuel would be transported over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter.

As previously indicated, although all federal lands, including those within the Planning Area, are categorically defined as being outside of the coastal zone, all federal activities and federally-permitted activities must be reviewed for consistency with coastal management programs. Therefore, onshore activities within the Planning Area and some offshore activities identified under the No Action Alternative should be assessed against the Alaska CMP, including the NSB CMP.

While the Planning Area is technically outside the coastal zone, it is within the NSB. The NSB applies its Comprehensive Plan policies and CMP policies to all developments occurring on private, federal, and state lands; however, the NSB's jurisdiction is the subject of litigation. Oil and gas development activities could include portions of road/pipeline corridors, including the offshore portions (such as inlets and bays) within the NSB boundary. Development activities occurring adjacent to the Colville and Ikpikpuk rivers that could affect coastal resources or uses, including activities described in exploration plans and development and production plans, could be subject to the statewide standards and NSB district policies of the ACMP. Policies of the ACMP are examined herein for potential conflicts with effects from oil and gas exploration or development activities. Potential effects are summarized as succinctly as possible. Additional information is contained in the Coastal Zone Management section of the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998).

Effects of Exploration and Development on the Alaska Coastal Management Program

Section 307(c)(3)(B) of the federal Coastal Zone Management Act requires applicants to certify that each activity described in an exploration or development and production plan that affects any land use or water use in the coastal zone complies with, and would be implemented consistent with, the state's coastal program. The state may concur with or object to an applicant's certification. The state reviews exploration and development and production plans to determine whether activities that could affect the coastal zone are consistent with the ACMP.

The following paragraphs discuss ACMP uses and activities standards and resources and habitat standards related to the No Action Alternative and to potential effects identified in other resource sections of the amendment. Policies of the current NSB CMP are assessed in conjunction with the most closely associated statewide standard, recognizing that they may be adjusted in the coming year to comply with the revised ACMP. Generally, activities and uses that do not conform specifically to the standards must "avoid, minimize, or mitigate" adverse effects, which means avoiding "adverse impacts to the maximum extent practicable; where avoidance is not practicable, minimizing adverse impacts to the maximum extent practicable; or if neither avoidance nor minimization is practicable, conducting mitigation to the extent appropriate and practicable" (11 AAC 112.900).

This analysis is not a consistency determination pursuant to the CZMA of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that activities or events would occur exactly as predicted in this amendment. It is unknown at this time which of the alternatives, or any combination thereof, would be selected in the Amended IAP/EIS ROD. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale.

Coastal Development (11 AAC 112.200)

Water dependency is a prime criterion for development along the shoreline. The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine, lakeshore, and river waterfronts. Only activities around Kogru Inlet south of Atigaru Point would require a shoreline location, since almost the entire Beaufort Sea coast within the Planning Area is excluded from leasing under the No Action Alternative. Protective measures would forbid most types of surface use for oil and gas activities, including permanent oil and gas surface occupancy, in sensitive issues areas along most of the coast and near deep-water lakes and major creeks and rivers (see Maps 3-7 and 3-8). Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale.

Lease stipulations in place under the No Action Alternative would further reduce the potential for conflicts with this policy around lakes and rivers. Specifically, lease stipulations related to waste-prevention, handling, and disposal and spills (1 through 17); ice roads and water use (18 through 22); facility design and construction (29 through 48); abandonment (58); and protections for subsistence and traditional use sites (59 through 68); would reduce conflicts, making the No Action Alternative consistent with this standard. Although large equipment could be barged outside the Planning Area to coastal staging areas in the summer and stockpiled until winter, no development activity would conflict with this policy.

Natural Hazard Areas (11 AAC 112.210)

This statewide standard permits coastal districts and state agencies to identify and designate areas in which natural hazards are known to exist that may present a threat to life or property. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Flooding, earthquakes, active faults, tsunamis, landslides, volcanoes, storm surges, ice formations, snow avalanches, erosion, and beach processes in the Planning Area should be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSB Municipal Code [NSBMC] 19.70.050.L.3). Lease stipulations in place under the No Action Alternative would reduce conflicts, making this alternative consistent with this standard.

Coastal Access (11 AAC 112.220)

Districts and state agencies shall ensure that projects maintain and, where appropriate, increase public access to, from, and along coastal water. Lease stipulations in place under the No Action Alternative would reduce conflicts, making the alternative consistent with this standard.

Energy Facilities (11 AAC 112.230)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent practicable, on 16 criteria within the energy facilities standard. Lease stipulations in place under the No Action Alternative would reduce conflicts, making this alternative consistent with this standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained (11 AAC 112.230 (a) [3] and [14]). 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).

Construction associated with energy-related facilities under the No Action Alternative would be required to comply with siting standards that apply to all types of development, which are discussed below under: 1) Habitats; 2) Air, Land, and Water Quality; and 3) Historic, Prehistoric, and Archeological Resources.

Utility Routes and Facilities (11 AAC 112.240) and Transportation Routes and Facilities (11 AAC 112.280)

These statewide standards require that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. Utility routes and facilities along the coast must avoid, minimize, or mitigate alterations in drainage patterns, disruption in wildlife transit, and blockage of existing or traditional access.

The NSB CMP contains several additional policies related to transportation and utilities 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 substantial 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 effects the policy was intended to prevent. Transportation development, including pipelines, which 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). Section 4.3.9 (Mammals) indicates that interference with caribou movements would be temporary and brief under the No Action Alternative; caribou migrations and overall distribution should not be affected. Lease stipulations related to the TLH caribou, including restrictions on overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ice roads and water use, ground transportation, and abandonment in place under the No Action Alternative would further reduce conflicts, making the No Action Alternative consistent with this standard.

Transportation and utility facilities would 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), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent practical. Lease stipulations required under the No Action Alternative would further reduce conflicts, making this alternative consistent with this standard.

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 substantial disturbance to important habitat associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. The discussion of habitats recognizes that alterations to wetland habitat and ponds and lakes would occur and birds could be disturbed during construction. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. Lease stipulations in place under the No Action Alternative would reduce conflicts, making the No Action Alternative consistent with this standard.

Sand and Gravel Extraction (11 AAC 112.260)

Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of pads, roadbeds, berms, causeways, and docks to protect the tundra. The ACMP statewide standards indicate sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits if no practicable noncoastal alternative is available to meet the public need. Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, if gravel is not obtained from inland sites, and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). The amount of extraction required to support oil and gas development under the No Action Alternative, combined with the lease stipulations in place, would reduce conflicts, making this alternative consistent with this standard and the NSB policies.

Subsistence (11 AAC 112.270)

The statewide standard for subsistence indicates a project within a designated subsistence use area must avoid or minimize impacts to subsistence uses of coastal resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under the No Action Alternative, nearly the entire Beaufort Sea coast, except for the area around Kogru Inlet, within the Planning Area would be excluded from leasing, reducing potential disturbance to bowhead whales and other marine mammals. Teshekpuk Lake and the areas north and east of the lake would not be available for leasing. However, access to subsistence resources, and subsistence hunting and resource use could be affected by reductions in subsistence resources and changes in their distribution patterns. These changes could occur as a result of disturbance from seismic surveys; aircraft and vessel traffic; drilling activities; and construction of pipelines, structures, support-bases, pump stations, and roads. Disturbances and oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals. These impacts would not affect subsistence harvests for Barrow, Atqasuk, and Nuiqsut hunters. Subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas, and by protections afforded by lease stipulations identified in Section 4.3.7 (Fish), Section 4.3.8 (Birds) and Section 4.3.9 (Mammals) to protect marine and fish, waterfowl, and terrestrial mammals. Surface, air, and foot traffic near the oil fields would likely increase under the No Action Alternative and displace some caribou, moose, muskox, grizzly bears, wolves, and wolverines, but would not substantially affect North Slope populations. This conclusion is based, on part, on the established policy that roads and pipelines be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects to caribou (described in Section 4.3.9) and subsistence (described in

Section 4.3.12), and the lease stipulations identified in Appendix E, potential conflict with the subsistence policies would be reduced, making the No Action Alternative consistent with this standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies also would be minimized under the No Action Alternative by the exclusion of the Teshekpuk Lake Caribou Habitat LUEA from leasing.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in substantially decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities (offshore dredging, pipeline construction, structure placement and onshore pipelines, and construction of support bases, pump stations, and roads).

The No Action Alternative development scenario projects that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River could substantially affect the subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or making subsistence users perceive them as tainted. However, given that the number and size of oil spills estimated for the No Action Alternative would be small, and chronic spills could normally be contained on the drill pad, it is anticipated that the effects of spills and the potential disruption caused by clean-up activities would have little to no impact on subsistence resources and harvest patterns.

Conflict with these policies would be possible during the exploration, development, and production phases, but is more likely during development and production. Special lease stipulations would be in place under the No Action Alternative (Section 4.3.12; Subsistence) to protect subsistence resources, particularly lease stipulations that would establish procedures and advisory bodies to address subsistence resources, uses, and research for inventorying and monitoring; that would require that lessees not unreasonably restrict access in development areas to subsistence users; and that would prescribe conflict avoidance procedures under which lessees would consult with the NSB, affected communities, and the Subsistence Advisory Panel. Under the No Action Alternative, representatives of federal, state, and NSB agencies with biological expertise would participate on an interagency team that would coordinate research and monitoring projects related to the effectiveness of lease stipulations and surface resource impacts. Lease stipulations would also require lessees to develop an orientation program to increase sensitivity and understanding of local community values, customs, and lifestyles, and to provide guidance on avoiding conflicts with subsistence resources and activities. The lease stipulations would reduce subsistence conflicts, making the No Action Alternative consistent with the statewide standard.

Habitats (11 AAC 112.300)

The statewide standard for habitats contains an overall standard policy, plus policies specific to nine habitat areas: offshore areas; estuaries; wetlands; tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes (including associated floodplains and riparian management areas); and important upland habitat. The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under the No Action Alternative, particularly sensitive habitat areas would be excluded from leasing. The special lease stipulations developed for the No Action Alternative would provide protection for birds, terrestrial mammals, fish, and habitats. Therefore, conflicts with the ACMP standards would be reduced and activities under the No Action Alternative would be consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to avoid, minimize, or mitigate significant adverse impacts to habitat resources. This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents substantial impacts on fish and wildlife and their habitats, 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 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 lease stipulations placed on permits. Special lease stipulations in place under the No Action Alternative would reduce potential conflicts, and the activities would be consistent with the statewide standard.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to "avoid, minimize, or mitigate significant adverse impacts" to natural water flow and drainage patterns, and competing uses such as commercial, recreational, or subsistence uses, to the extent that those uses are determined to be in competition with the proposed use. Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline/road complex, impoundments would benefit some waterfowl by creating additional habitat, but would displace other nesting birds.

It is expected that caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of air overflights (i.e. pipeline inspections), but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would increase under the No Action Alternative, displacing some caribou, moose, muskox, grizzly bears, wolves, and wolverines, though not enough to affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to avoid, minimize, or mitigate significant adverse impacts to natural water flow, active floodplains, and natural vegetation within riparian management areas. Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in Section 11AAC 112.260. The special lease stipulations in place under the No Action Alternative would reduce conflicts, making the No Action Alternative consistent with the statewide standard.

Air, Land, and Water Quality (11 AAC 112.310)

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 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 of greater than 660 gallons (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 feet of a coast, lake, or river shoreline that has the potential to impact water quality (e.g., landfills, 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): 1) there must be a substantial 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 effects the policy was intended to prevent. Under the No Action Alternative, there could be some short-term conflict, pertaining to water quality and potential oil spills, between this policy and activities assumed under this alternative. However, the lease stipulations in place would reduce conflicts, and the No Action Alternative would be consistent with the statewide standard.

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 these emissions comply with all state and federal regulations, which is consistent with the statewide standard. Discharges of drilling muds, cuttings, and drilling fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA Underground Injection Control program. The Alaska Oil and Gas Conservation Commission has primacy for this program for Class II wells in the State of Alaska. Produced waters and drilling wastes fall within the Class II category. Some wastes are disposed of through the annulus of producing wells. This activity is exempt from the Underground Injection Control program; however, the Alaska Oil and Gas Conservation Commission also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

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), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. Any onshore development under the No Action Alternative would be required to meet the statewide standard and the district policy related to solid-waste disposal. Assuming the regulations were implemented properly, including Lease Stipulation 13 related to waste handling and hazardous-material disposal and cleanup, there would be no inherent conflict between the proposed activities and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (11 AAC 112.310, 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 the No Action Alternative in Section 4.3.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Historic, Prehistoric, and Archeological Resources (11 AAC 112.320)

The ACMP 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, including natural processes.

The NSB 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) also requires that development not disturb newly discovered historic or cultural sites prior to archeological investigation. Although the National Petroleum Reserve – Alaska is technically excluded from the coastal area, given the number of existing sites, it is likely that new cultural and paleontological sites would be discovered under the No Action Alternative. However, conflicts with these policies should not occur since lease stipulations in place under the No Action Alternative would require an inventory of traditional use sites prior to conducting any activities, which would reduce conflicts, making the No Action Alternative consistent with the statewide standard.

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 use sites. There is no inherent reason to assume conflict with these policies.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

4.3.15.3 Effectiveness of Stipulations

Lease stipulations referred to under each of the Coastal Zone Policy standards discussed above, and itemized in greater detail in Section 4.3.12 (Subsistence), should be sufficient for the No Action Alternative to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZMA policy conflicts over the life of the No Action Alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but the scale of development and enforcement of applicable lease stipulations should minimize the conflicts and quickly return the development to compliance with policies and standards.

4.3.15.4 Conclusion

Under the No Action Alternative, conflicts could occur with specific statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts with the NSB CMP policy related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats, and during oil-spill cleanup. The lease stipulations in place under the No Action Alternative, however, would reduce conflicts, making the No Action Alternative consistent with ACMP standards.

It is expected that disturbance and oil spills associated with oil and gas activities would cause short-term and localized impacts to the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals, but that subsistence-hunter concerns about access to resources and resource contamination would be minimal under the No Action Alternative. Impacts would be minimized by not leasing in important caribou, waterfowl, and fishing areas and by implementing lease stipulations. Under the guiding assumptions of the No Action Alternative, and with the lease stipulations in place, this alternative should be consistent with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between the No Action Alternative and the policies addressed in this section.

4.3.16 Recreational Resources

4.3.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the No Action Alternative, some impacts to recreation resources would result from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, three to four camps, survey, or collection efforts are anticipated at any one time in the Planning Area. In winter, several overland moves may occur during a single season. Aircraft and watercraft activity, and ongoing solid and hazardous waste removal, would also be observable in the Planning Area.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term impact on the experience of solitude, naturalness, or primitive/unconfined recreation. These short-term impacts would be confined primarily to the activity site viewshed or noiseshed (approximately ½ mile in any direction or 500 acres) and are expected to affect no more than a total of approximately 2,000 acres at a time (500 acres each for four camps). Because all of these identified non-oil and gas activities would be transitory and short term, the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area is probably small. If such activities were encountered, the recreation experience and opportunity for solitude on the North Slope would be diminished somewhat. Depending on the activity, there may be some increased likelihood of an encounter with recreationists because of the propensity to concentrate on major rivers and coastal areas.

A longer-lasting impact would be green trails resulting from overland moves. Green trails are created by vehicles compacting snow and dead vegetative matter 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 an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They usually are difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or broken or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem, but one that can occur in conjunction with green trails. Because overland moves would be relatively constant from year to year and generally follow the same route(s), several hundred to several thousand miles of intermittent green trail in some phase of recovery (attributable to overland moves) could be visible from the air during any one summer season. Though still relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

Although there are no formal designations of wilderness or wild and scenic rivers in the Planning Area, and none are anticipated at this time, none of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude such designations in the future.

4.3.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Although no oil and gas development could occur in about 13 percent of the Planning Area under the No Action Alternative, seismic-survey work could continue throughout the area. This work would occur in winter using all-terrain ground 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, associated noise (e.g., vehicles, aircraft), and activities would result in a short-term impact on the primitive setting of the Planning Area and a loss of solitude and naturalness. These impacts would be confined primarily to the activity site viewshed or noiseshed, or approximately ½ mile in any direction. As many as two seismic operations could take place in a season, temporarily affecting approximately 1,000 acres. The potential effect on recreation opportunities and experience would be minimized by the fact that very little winter recreation takes place in the area.

A longer lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. In some years, no surveys would occur. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route and are visible for about 2 to 5 years. Because of the many variables involved, it is difficult to make a reliable estimate as to the number of miles of green trail that would be visible during any one summer season as a result of seismic operations. Assuming one to two operations per season during the first few years of the lease, the number of miles of intermittent green trails visible from the air during any one summer season from seismic operations likely could peak at several thousand miles if 3-D surveys are conducted. The number of miles of trail visible would decline as this phase of exploration slows. Though relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of from 10 to 38 exploration and delineation wells are anticipated under the No Action Alternative. However, due to the limited number of drilling rigs available, no more than two or three wells would be 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., drilling rigs); noise from generators, vehicles, aircraft, etc.; human presence; and associated activity all would have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences during the winter season. These impacts would be expected to be greatest within a 2-mile radius of the drilling site, which is 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 16,000 to 24,000 acres in any given winter. This would be equivalent to about 0.05 percent of the Planning Area and the potential effect on recreation opportunities and experience would be further minimized by the fact that very little winter recreation takes place in the area.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating 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 would be 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 and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site and half of the sites are vacated, as many as 950 acres (19 vacated sites by 50 acres per site) would be in various states of recovery from these impacts.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

One to five production pads and 20 to 110 miles of pipeline are anticipated under the No Action Alternative. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad site (or an area of about 8,000 acres). Pipelines would be elevated about 5 feet and would also impact recreation values.

There would be little if any associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines are expected to be minimal beyond about ½ mile. This equates to about 640 acres per mile of pipeline. Under this alternative at an average oil price of $25 per bbl, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of up to 110,400 acres (i.e., [8,000 acres/pad x five pads] + [640 acres/mile x 110 miles of pipeline]). This would be equivalent to about 3 percent of the Planning Area. Short-term, routine/daily inspection flights also would impact solitude and naturalness along the length of all pipelines as long as they are in use. The potential effect on recreation opportunities and experience would be greatest for development activities because it would entail year-round activity and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nonetheless, the effects would be expected to be minor because they would impact such a small portion of the Planning Area and because there is such a small amount of recreation use in the area. The actual effects would depend greatly on where development fields were located relative to major watercourses and the Beaufort Sea coast.

Future potential for formal wilderness or wild and scenic river designation would likely be reduced in limited areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, a small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills (65 to 80 percent) 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 solitude, naturalness, or primitive/unconfined recreation opportunities resulting from spills likely would be confined to the same area as described above under Effects of Development.

A large spill that reaches a river, especially the Colville River, and moves rapidly downstream could have disastrous short-term (and possibly long-term) impacts on recreation values. Under the No Action Alternative, outstandingly remarkable river values along the Colville River would not receive any special protection under the Wild and Scenic River Act, although buffer areas are included in applicable lease stipulations for other reasons. As such, management activity near the Colville River (and other major watercourses) would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any substantial impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude wilderness or wild and scenic river designations in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 3 percent of the Planning Area under the No Action Alternative. In addition, there could be portions of the area that were explored unsuccessfully that would experience lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.4 million acres (97 percent) of the Planning Area would likely retain substantial wilderness values. For perspective, the Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The “outstandingly remarkable values” that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with the No Action Alternative, primarily an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near an expected pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river’s outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable lease stipulations would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite “free flowing” nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the “outstandingly remarkable values” noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.3.16.3 Effectiveness of Stipulations

Although the lease stipulations in the 1998 Northeast IAP/EIS ROD do not specifically address recreation activities and there is no current intention to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the standards required for development of the No Action Alternative would serve to protect recreation values in the area. For example, areas excluded from leasing and several lease stipulations address protection of subsistence values and wildlife in the Planning Area. Also, buffer requirements serve to minimize potentially damaging activity in and near creeks, rivers and lakes. Since wildlife viewing, big game hunting, and boating are major factors attracting recreationists to the Planning Area, these lease stipulations associated with the No Action Alternative also serve to protect and preserve recreation values.

4.3.16.4 Conclusion

There would be approximately 2,000 acres in temporary impacts to recreation values from activities other than oil and gas exploration and development. Short-term (temporary) impacts from ongoing oil and gas exploration activities would impact approximately 16,000 to 24,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 950 acres. Seismic operations would result in many hundreds of miles of green trails and noise and other disturbance over approximately 1,000 acres. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities would not accumulate.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunities over an area of approximately 110,400 acres (or 3 percent of the Planning Area) for the life of production fields and pipelines.

4.3.17 Visual Resources

4.3.17.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the No Action Alternative, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality, by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast with the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than adding something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

4.3.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the No Action Alternative, seismic surveys would continue, with one to two operations each year. Seismic work would occur in the winter using cat trains with low-ground-pressure vehicles supported by light aircraft. Seismic crews would be housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps and associated activities would result in short-term impacts on visual resources and the scenic quality of the area by creating a color contrast between the vehicles and trailers and the predominantly white background of the snow-covered landscape. These impacts would be confined primarily to the activity-site viewshed.

Green trails resulting from seismic survey operations would result in a longer-lasting impact to visual resources. Unlike overland moves, seismic operations would not follow the same routes every year, and the number of miles of survey line could vary greatly from year to year. In some years, no surveys would occur. Like green trails caused by overland moves, trails caused by seismic operations would not necessarily develop over the entire survey route, but where present would be visible for about 2 to 5 years. Approximately 250 miles of lines would be surveyed using 2-D seismic surveys, while approximately 5,300 miles of lines could be surveyed during each 3-D seismic survey, potentially resulting in several thousand miles of green trails. Because green trails visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

Approximately 10 to 38 exploration and delineation wells would be drilled under this alternative. It is estimated that the long-term disturbance associated with the new wells would be 100 to 380 acres (a 10-acre footprint per well). Given the limited number of drilling rigs available, however, no more than three drilling rigs would likely be operating at any one time. Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow-covered landscape. Winter drilling requires lighting, which would create a visual contrast against the dark night sky. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails, a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a “ring effect” around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 1,900 acres (38 sites by 50 acres per site) would be in various states of recovery from greening and ring effects under the No Action Alternative. Because greening and ring effects visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would leave behind a marker pipe (also known as a Christmas tree), which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from several hundred feet away.

Effects of Development

Production rigs (up to five with an average height of 208 feet under the No Action Alternative) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also introduce strong contrast to the natural browns landforms and greens of the vegetation. In addition, burn-off flares and general work lighting would contrast against the dark night sky. Drill rigs, because of their height and color, could be seen and dominate the attention of the casual observer if they were located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from pads, roads, airstrips, gravel pits, and CPFs would range from 130 to 515 acres. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

It is anticipated that as many as 110 miles of pipeline, impacting up to 660 acres (5 to 6 acres per mile), would be constructed under the No Action Alternative. There would be no on-the-ground activities associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 5 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, the pipeline would attract the attention of the casual observer if located within the Foreground-Middleground Zone.

Other facilities associated with development would include gravel mine sites, bridges, roads, airstrips, and communications towers. Disturbance associated with gravel mine sites would generally occur below the ground surface, with only stockpiled materials being visible aboveground. While these sites could be large in size or footprint, very little material would remain as stockpile at any one time. If located within the Foreground-Middleground Zone, only bridges, because of their contrast with smooth water bodies, and communications towers, because of vertical height above the horizon, would be likely to attract the attention of a casual observer.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.3.17.3 Effectiveness of Stipulations

Although there are no lease stipulations specific to visual resources, lease stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under the No Action Alternative. In addition, approximately 600,000 acres would be closed to leasing and development, further protecting visual values in the vicinity of Teshekpuk Lake.

4.3.17.4 Conclusion

Under the No Action Alternative, as many as 5,550 miles of seismic lines and 1,900 acres associated with exploratory drilling would be in various states of recovery from greening and ring effects. An additional 380 acres of disturbance would be associated with drilling sites each winter. It is anticipated that up to 110 miles of pipeline would be constructed under this alternative, creating surface disturbance of up to 660 acres. There could also be approximately 130 to 515 acres of disturbance associated with pads, roads, gravel pits, and a CPF. Visual impacts associated with this alternative would be approximately one-third (final Preferred Alternative), one-fourth (Alternative B), and one-fifth (Alternative C) of that for the other alternatives because approximately 600,000 acres would be closed to leasing and development near Teshekpuk Lake, and because there would be less overall exploration and development under the No Action Alternative.

4.3.18 Economy

4.3.18.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the No Action Alternative, there would be recreational employment that would generate approximately 30, 1-week long float trips per year. This is equivalent to one person working for 8 months.

4.3.18.2 Oil and Gas Exploration and Development Activities

Increased revenues and employment are the most important economic effects that would occur under the No Action Alternative. The construction, operation, and servicing of facilities associated with oil and gas activities would result in increased property-tax revenues and new employment.

The number of workers needed to operate the infrastructure would be determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume would be handled by a given level of infrastructure. Once the infrastructure was in place, the number of workers needed to operate it would not depend on the amount of product flowing through it. Effects would include employment generated by seismic surveys during exploration. State property-tax revenues would be proportional to the value of onshore facilities. State royalty income and state severance tax revenues would be proportional to production. It is estimated that peak yearly production would be 13 to 51 million barrels.

Effects on Revenues

Exploration, development, and production activities are estimated to generate increases in property taxes of about 1 to 2 percent each year through the production period, or about $2.8 to $4.8 million. Other local, state, and federal revenues are also anticipated to increase under the No Action Alternative. The estimated range of annual royalty payments to the federal government is between $7 to $54 million; the same amount would accrue to the state and the NSB, combined. In addition, between $13 to $90 million (depending on the price of oil) in average annual state severance taxes could be generated.

Effects on Employment

Direct employment gains from the No Action Alternative would include jobs in petroleum exploration, development, and production, and in related activities. It is anticipated that direct employment would peak in the range of 1,300 to 1,600 jobs during the development phase, and decline to a level in the range of 500 to 825 jobs during production from 2018 to 2028.

It is anticipated that total NSB resident employment would increase in the range of 42 to 44 jobs in the peak of development and level off to 17 to 27 jobs during production after 2017. No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

Effects of Subsistence Disruptions on the NSB Economy

Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents, primarily through the direct loss of subsistence resources.

4.4 Alternative B

Alternative B utilizes performance-based lease stipulations, in addition to leasing restrictions on approximately 213,000 acres, to provide for protection of wildlife and subsistence uses while providing access to oil and gas resources (Map 2-2).

Under Alternative B, performance-based lease stipulations (patterned after those developed for the Northwest portion of the National Petroleum Reserve – Alaska) and ROPs would be used to help mitigate the impacts of energy exploration and development on surface resources. A comparison of these lease stipulations with those developed for the No Action Alternative is provided in Table 2-2. Additional seasonal and spatial lease stipulations would be applied to provide protection of environmentally sensitive areas. These areas, which are described in Section 2.2.1 (Areas with Additional Stipulations) and in the lease stipulations outlined in Section 2.6 (Lease Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes

For the resources discussed in the following section, a single value, or a range of values, are given to describe the amount of area that could be impacted by oil exploration and development. If a range of values is given, it represents the level of oil exploration and development, and associated resource impacts, for oil prices of $20 per bbl and $30 per bbl. The range of values better describes the types of impacts that could occur if oil prices are higher, or lower, than predicted to occur during the life of the amendment. If a single value is given, or a value is enclosed in parentheses after a range of values, it represents the level of oil activity, and associated resource impacts, projected to occur if oil prices average $25 per bbl during the life of the amendment.

4.4.1 Air Quality

4.4.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, the ground-impacting-management activities that would affect air quality would be the same as those under No Action Alternative. Impacts to air quality would result from emissions. Emissions from non-oil and gas activities would be extremely limited and would generally be associated with activities of the small resident population and their habitation and transportation activities. The impacts of these activities would be the same as those under the No Action Alternative.

4.4.1.2 Oil and Gas Exploration and Development Activities

Effects of Routine Emissions

The entire National Petroleum Reserve – Alaska is a PSD Class II Area, which allows a moderate incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA 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 (acid rain) and freshwater bodies, or effects on plants.

Under the State Implementation Plan, the ADEC has jurisdiction for regulating and permitting air quality emissions within the Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including obtaining construction and operating permits. Construction air quality permits include PSD requirements.

Exploration

During the exploration phase, emissions would be produced by: 1) vehicles used to gather seismic and other geological and geophysical data; 2) diesel-powered generating equipment required for drilling exploratory and delineation wells; 3) vehicles and aircraft used in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Criteria pollutants generated would primarily consist of NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10}.

If permanent facilities, such as gravel airstrips, storage pads, and connecting roads were built, fugitive dust emissions would occur. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations.

For all these operations, controls would be applied under the ADEC and USEPA air quality regulations. The main emissions would be NO_x, with lesser amounts of SO_2, CO, and PM_{10}.

Development

During the construction and drilling phases, the primary emission sources would be 1) piston-driven engines or turbines used to provide power for drilling, 2) heavy construction equipment used to install modules and pipelines, and 3) various vehicles and aircraft. The principal development-phase emissions would consist of NO_2 with lesser amounts of SO_2, CO, and PM. Based on assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) are projected as follows for construction: NO_x (17.7), SO_2 (1.3), CO (4.2), and PM_{10} (1.3). Emissions for drilling would be: NO_x (26.7), SO_2 (3.0), CO (5.9), and PM_{10} (1.3). These projections assume that the typical development in the Planning Area would be similar in size to the proposed Alpine Satellite Development and that only one development would be under construction at a time.

Aircraft would bring materials and crews to the development sites. Based on assumptions developed for the Alpine Satellite Development Plan, an estimated 40 to 70 one-way aircraft flights each month would be needed initially to service a CFP and associated satellite fields (USDOI BLM 2004C). The number of flights occurring each month could increase to as many as 340 and 90, at the peak of construction and drilling activities, respectively. A similar number of flights would be expected to service a development in the Planning Area. These flights could generate up to 1.2 tons of CO, 0.14 tons of NO_x, 0.9 tons of VOCs and other hydrocarbons, and 0.03 tons of SO_x annually.

During the production phase, the primary source of emissions would be turbines for power generation and gas compression, and power generation for heating, oil pumping, and water injection. The emissions would consist mainly of NO_2, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOCs) from oil/water separators, 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 VOCs 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 VOCs. However, flaring would burn up any emissions of VOCs, 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 (but never completely absent). Based on the assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) during production are projected as follows: NO_x (1,780), SO_2 (23.2), CO (510), and PM_{10} (17.5; USDOI BLM 2004C). These projections assume that 14 fields would be in production at the same time.

It is estimated that up to 190 flights would occur monthly during the operations phase for Alternative B, based on flight estimates developed for the Alpine Satellite Development Plan. At peak flight activity, 0.7 tons of CO, 0.1 tons NO_x, 0.5 tons of VOCs and other hydrocarbons, and 0.02 tons of SO_x would be generated annually, assuming 14 fields would be in production at the same time.

Construction and production activities can produce fugitive dust emissions. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations in the winter as well as during the summer months. Excessive fugitive dust can adversely affect human health and the environment; fugitive dust concentrations are controlled by state and USEPA air quality standards. Control measures include posting speed limits and watering road surfaces.

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 as equipment and personnel are brought into the area to remove equipment. The effects on air quality, however, would be 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 not include activities that would affect air quality more than previously discussed, these operations would cause limited effects to air quality.

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

Table IV.B.12-1 of the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS* lists estimated uncontrolled pollutant emissions for the peak-exploration, peak-development, and peak-production years from that sale proposal (USDOI MMS 1996c). The EIS also has additional relevant discussion, especially in the last paragraph of Section IV.B.12.(1). Information from the Beaufort Sea Sale 144 Final EIS is relevant for the Planning Area because the Sale 144 EIS analysis included the area immediately offshore of the National Petroleum Reserve – Alaska. The Sale 144 EIS analyzed effects from a scenario that included greater projected oil development than is projected in this amendment. Emissions analyzed for the Beaufort Sea also included some emission sources not applicable to operations on land in the National Petroleum Reserve – Alaska. Emissions from expected Planning Area operations would not include major emission sources not analyzed for the Beaufort Sea. Therefore, effects analyzed and pollutants modeled for the Beaufort Sea Sale 144 EIS are greater than those that would be expected for the Planning Area. Modeling discussed in the Sale 144 EIS showed that the concentration of NO_2 was the highest out of all the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and federal ambient air quality standards.

Air quality analyses were also conducted for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a typical field that might be developed in the Planning Area), 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 because of 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 B should have air emissions that are similar to or less than 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.

Effects of Spills

Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOCs from an offshore facility or pipeline oil spill would likely evaporate almost completely within a few hours after the spill occurred. The authors discussed the rate of evaporation and ambient concentrations of 15 different VOC compounds. The USEPA 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 2 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 high in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land in the National Petroleum Reserve – Alaska, 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 VOCs 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 persist for a shorter time. Also, since a diesel spill would probably be smaller than some potential crude-oil spills, any air quality effects would likely be even lower than for other spills.

Oil or gas blowouts could catch fire. In addition, in-situ burning is a preferred technique for cleanup and disposal of oil spilled into water. This type of burning would be less likely in the 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 over 99 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 emit about 10 percent of the burned crude oil as oily soot (and minor quantities of other pollutants) into the air (USDOI MMS 1996a:Table IV.B.12-4; USDOI BLM and MMS 2003).

Effects of Oil-Spill Clean-up Activities on Air Quality

In-situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily affect air quality, but the effects would be minor (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, CO, SO_2, and NO_x were measured only at background levels and were frequently below detection levels. Ambient levels of VOCs were high within about 325 feet of the fire, but were substantially lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAHs) were found to be low, as it appeared that a major portion of these compounds were 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 that affect plume motion. Thus, accidental emissions likely would have a moderate short-term effect on air quality.

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 micrograms per cubic meter ($\mu g/m^3$) beyond about 3 miles downwind of an in-situ burn. This estimate is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. 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 for bronchitis.

Other air quality effects from clean-up activities would include emissions from vehicles and equipment used in the clean-up effort; these effects are expected to be minor.

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 OCS averaged 3.3 per 1,000 wells drilled from 1956 through 1982, and the blowouts were comprised mostly of gas and water (Fleury 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Statistical information from OCS blowouts is relevant for this amendment because of possible activity in offshore coastal waters from leasing in the National Petroleum Reserve – Alaska. The statistical information for the OCS is recent enough that it may assist readers in becoming aware of how relatively infrequent such blowouts have been in recent years. Please see also Section

4.2.2 (Oil Spills) and Appendix K of this amendment for a detailed discussion of oil spills. Typical emissions from such accidents consist of hydrocarbons (VOCs); only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and PM. Accidental emissions likely would have a minor 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 VOCs. It is estimated that the probability of experiencing one or more blowouts while drilling the wells projected for Alternative B would be minor. 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 VOCs. Since 1974, 60 percent of the blowouts have lasted less than 1 day; and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. In addition, in-situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill contingency plans. For catastrophic oil blowouts, in-situ burning may be the only effective technique for spill control. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by over 99 percent and very slightly increase emissions, relative to quantities in other oil and gas industrial operations, of other pollutants. 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 45 miles off the coast of Africa locally deposited oily residue in a rainfall 30 to 50 miles 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 could occur on the North Slope would not cause noticeable fallout problems. Along the TAPS, 500 bbl of a spill 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 would be the major, though not the only, potential air quality risk. Recent examination of PAHs in crude oil and smoke from burning crude oil indicated that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater 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).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only). Visibility can 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 used the VISCREEN model and found noticeable effects on only a very limited number of days with the most restrictive meteorological conditions. No effects were simulated during average conditions. Those results would be expected to be typical of development projects in the Planning Area.

A substantial increase in ozone concentration would not be likely to result from exploration, development, or production scenarios associated with Alternative B. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the National Petroleum Reserve – Alaska during the summer, temperatures remain relatively low (Brower et al. 1988). Also, activities that would occur as a result of field development would be 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 River Unit areas, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05 to 0.07 parts per million (ppm), which is well within the existing maximum 1-hour-average ozone standard of 0.12 ppm (Table 3-1). 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 USEPA cannot enforce the standard until the legal issues are resolved.) Because the projected ozone precursor emissions from Alternative B are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk River Unit 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 SO_2 concentration as low as 12 µg/m^3 for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 µg/m^3. In addition, the sensitivity of lichens 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, it is assumed that the ambient concentrations at most locations would be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under Alternative B is expected to be minor. For the proposed Liberty development project, BPXA determined that maximum-modeled pollutant concentrations were well below levels that can damage lichens, according to laboratory studies. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants on vascular plants or lichens (Kohut et al. 1994). That research was conducted in areas typical of much of the North Slope area. Monitoring the vascular plant and lichen communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

Native Views on Air Emissions

Leonard Lampe, then Mayor of Nuiqsut, reported 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). 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, Alternative B would be expected to have a moderate effect with respect to these observations.

4.4.1.3 Effectiveness of Stipulations and Required Operating Procedures

None of the lease stipulations or ROPs is particularly applicable to air quality impacts. Mitigation of air quality impacts would result from operators’ use of the best available technology to control discharges.

4.4.1.4 Conclusion

An unlikely large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (VOCs) as a result of evaporation from the spill. The VOC concentrations would be very minor and normally limited to only ½ to 1 mi^2 surrounding the point of emission. Moderate or stronger winds would further reduce the VOC concentrations in the air.

Effects on air quality from emissions would likely only constitute 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 moderate effect on air quality with respect to standards. Because of the atmospheric dispersion of emissions, the other effects of air pollutant concentrations caused by 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. Air emissions associated with exploration and development under Alternative B would be approximately 2 to 3 times the level for the No Action Alternative based on the number of fields likely to be developed under this alternative.

4.4.2 Paleontological Resources

4.4.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, the types of non-oil and gas activities would be the same as those described for the No Action Alternative; however, there would be likely be an increase in the level of aircraft and survey activity associated with environmental studies and monitoring. Despite increased activity, the impact to paleontological resources, which are deeply buried, would still be minor.

4.4.2.2 Oil and Gas Exploration and Development Activities

Under Alternative B, the level of seismic activity is expected to increase beyond that of the No Action Alternative because an additional 387,000 acres would be available for leasing, and these additional acres would be in an area with high oil and gas potential. While the types of impacts to paleontological resources would remain the same, the increased level of seismic activity would increase the potential for impacts to occur. Any impacts associated with the increased seismic activity are expected to be minor.

Paleontological resources are not ubiquitous in the Planning Area as are wildlife and habitat, and their locations are much less predictable. As a result, it is possible that oil and gas exploration or development activities would not impact paleontological resources.

Effects of Disturbances

Under Alternative B, the level of activity in the Planning Area would increase. However, because most of the activity would occur during the winter months, the potential for impacts to paleontological resources is extremely minor. The likelihood of impacting surface paleontological material also is low due to their isolated and rare occurrence.

The drilling of exploration wells and delineation wells would occur during winter, except from current production pads and platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area. Because of the limited availability of drill rigs, it is expected that no more than a few wells would be drilled at one time. Drill pads, camp pads, roads, and airstrips made of ice and snow would be used, but permanent pads, roads, or airstrips could also be constructed; therefore, ground disturbance could occur and buried paleontological material could be impacted. The other substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Were scientifically important paleontological material present at the site of the borehole, these resources could be impacted by the drilling practice. However, the likelihood of such an occurrence is minor.

Surface disturbance from development could impact from 140 to 1,570 (1,120) acres, but there would be limited subsurface impacts associated with these activities. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. Extraction of the terrestrial materials could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining operations on the North Slope. It is anticipated that a pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and/or pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs were set it is possible, though highly unlikely, that paleontological resources would be impacted. Overall, ground disturbance from development would have a minor impact on paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities, as these areas would have been previously disturbed by construction and development activities.

Effects of Spills

Under Alternative B, the effects of spills on paleontological resources would be the same as discussed under the No Action Alternative. If present, surface paleontological material could be impacted; however since the occurrence of paleontological remains is rare, the probability of an impact is minor.

4.4.2.3 Effectiveness of Stipulations and Required Operating Procedures

Required Operation Procedure C-2(a, b, c, e) 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. Additionally, ROPs A-3 and A-4(a, b, c, d) would help to prevent large fuel or crude oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. Within the Planning Area, paleontological resources are most diverse and abundant along the Colville and Ikpikpuk rivers. Lease Stipulation K-1(a, b) would prohibit the construction of permanent oil and gas facilities within and adjacent to waterbodies, which would protect exposed paleontological resources along the banks of the Colville and Ikpikpuk rivers. Lease Stipulation E-13 would protect previously unknown paleontological resources by requiring a paleontological survey prior to any ground-disturbing activity. If paleontological material were discovered, all operations would be suspended until written authorization to proceed is issued by the appropriate authority. These ROPs and lease stipulations would be highly effective in protecting known and previously unknown paleontological resources and preserving their research potential and ensuring that impacts to paleontological resources would be minor.

4.4.2.4 Conclusion

The types of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to what was described for the No Action Alternative. The potential impacts to paleontological resources from oil and gas exploration and development could increase about five-fold from levels associated with the No Action Alternative, based on area of surface disturbance. Impacts could be greater if exploration and development occurred in an area with abundant paleontological resources. However, the ROPs and lease stipulations proposed to protect paleontological resources under this alternative are the same as those proposed for the No Action Alternative, and would be highly effective.

4.4.3 Soil Resources

4.4.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, summer research camps, use of OHVs, recreational camps, paleontological and archaeological excavations, and overland moves could affect soil in the Planning Area under Alternative B.

Under Alternative B, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would be little affected by the increased availability of land for oil and gas leasing. There could be some increase in the use of OHVs in the

Planning Area, if development occurred, because of a greater amount of roads within the area. However, impacts to soil from this increase would likely be minor.

4.4.3.2 Oil and Gas Exploration and Development Activities

During oil and gas exploration and development, various activities could cause impacts to soil in the Planning Area. These activities include seismic activities, construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates.

Effects of Disturbances

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months, although some seismic surveys could occur on Teshekpuk Lake during the summer. Under Alternative B, impacts to soil resulting from seismic exploration, and the amount of area surveyed, would be similar to those for the No Action Alternative, although much of the survey focus would be on lands near Teshekpuk Lake. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. Assuming that 250 miles of seismic surveys were conducted, the area impacted by seismic lines would be approximately 6,060 acres (250 miles long by 200 feet wide), although, not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which would traverse about 30 miles. Trails would also be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, and thus would impact a path 30 feet wide. Given 30 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, approximately 500 acres would be impacted by camp move trails. Thus, the total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 500 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 1,000 to 2,500 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, moderate and high-level disturbances would likely be more frequent with 3-D surveys.

Seismic activities could alter the thermal balance of the soil, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

Exploration

Under Alternative B, impacts to soil from activities associated with oil and gas exploration would be similar to those described for the No Action Alternative. It is anticipated that under Alternative B there would be a greater number of exploration and delineation wells drilled, which would result in greater impacts to soil resulting from the construction of well collars and both multi and single year ice pads (500 feet by 500 feet; 6 acres). Ice road construction might also be greater under Alternative B in terms of total miles constructed (probably up to 50 miles per year).

Under Alternative B, it is assumed 6 to 57 (43) exploration wells and 4 to 42 (32) delineation wells, or a total of 10 to 99 (75) wells, would be drilled from ice pads in the Planning Area. Impacts to soils would occur on 60 to 600 (450) acres over a period of about 25 years.

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the loss of soil productivity in the areas of gravel placement. Under this alternative, 2 to 14 (10) fields would be developed, resulting in a total of 110 to 1,340 (950) acres of soil productivity lost by gravel placement.

Construction of CPFs and associated gravel pads, roads, staging areas, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 2,800 (2,000) acres under Alternative B.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that two to eight (six) gravel mine sites would be necessary, resulting in a total of 30 to 230 (170) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would remove soil and impact soil productivity at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under Alternative B than under the No Action Alternative.

Pipelines

Under Alternative B, impacts from pipeline construction would be similar to those described for the No Action Alternative. The extent of impacts associated with buried pipeline could be greater under Alternative B given the potentially greater number of fields developed. Melting of ice in the soils would result, and the filled area, normally mounded immediately after placement of fill, which would level over time as melt water migrated to lower areas.

Effects of Oil and Gas Development on Permafrost

As discussed under the No Action Alternative, structures must be designed to avoid thawing their own foundations. Roadways and buildings must be elevated on thick gravel berms or pads, or on pilings. Gravel berms for roads can be as high as 6 feet above the tundra surface to ensure that the subgrade remains frozen. These roads have visual impacts on the landscape, and can intercept natural drainage and create ponds that thicken the active layer and initiate thermokarst (Walker 1996). Pipelines generally must be built on VSMs to ensure that the heat from the transmission of warm fluids does not thaw the surrounding permafrost, causing differential settlement. Heated buildings can also thaw the permafrost, leading to thaw settlement, if they are not elevated on pilings or their foundations insulated and refrigerated. On pads with closely spaced wells, extensive refrigeration with passive heat pipes and insulation is required to ensure that the heat from fluids does not melt the permafrost.

Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Under Alternative B, impacts to soils from activities associated with oil spills would be similar to those described for the No Action Alternative.

4.4.3.3 Effectiveness of Stipulations and Required Operating Procedures

Development in the Planning Area would result in impacts to soils. Lease stipulations and ROPs developed to protect soil under Alternative B would provide similar protection to those developed for the No Action Alternative.

Many of the lease stipulations and ROPs under Alternative B would directly or indirectly limit potential impacts to soils in the Planning Area. Required Operating Procedures A-2 through A-7 relate to waste prevention, handling, disposal, and spills. These ROPs would be effective in ensuring that waste materials associated with exploration and development activities were properly disposed of, and helping to prevent impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, which would decrease the likelihood of impacts to soils from spills. Required Operating Procedures C-2, C-3, and C-4 would be highly effective in limiting impacts to soils associated with overland moves and seismic work.

Lease Stipulation D-2 would be highly effective in minimizing surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips, and temporary platforms, unless permanent structures were absolutely required. Required Operating Procedures and Lease Stipulations E-1 through E-5, and E-8, would be highly effective in protecting soils by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, place restrictions on the development of gravel pits and permanent roads, and ensure resource issues were considered when deciding on the location of facilities. Lease Stipulation G-1 would effective in restoring soil use and productivity by providing for removal of all oil and gas facilities at the time of field abandonment, unless the AO determined that it was in the best interest of the public to retain some or all of the facilities. If facilities were retained, the lease stipulation would be effective in minimizing soil erosion and additional soil disturbance. Lease Stipulation K-1 would by highly effective in prohibiting permanent oil and gas facilities near important rivers in the Planning Area, although essential pipeline and road crossings to the main channel would be permitted; deep-water lakes and Teshekpuk Lake would be given similar protection under Lease Stipulations K-2 and K-3. Lease Stipulation K-8 would be effective in protecting the soils of the Pik Dunes. These protections would be similar, to slightly greater, than those provided for the No Action Alternative.

4.4.3.4 Conclusion

Under Alternative B, impacts to soils from activities other than oil and gas development would include minor impacts 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 would vary from 1 year to decades.

Impacts from oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time from impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. Oil and gas development and operation would affect soils by disrupting soils under gravel pads, roads, and airstrips, excavating material sites, constructing of VSMs, and spilling oil and other chemicals. These impacts would be permanent except for those associated with spills, which would be cleaned up immediately, allowing recovery within a few years to several decades.

Short-term impacts would occur on up to 6,600 and 250,000 acres of soil from 2-D and 3-D seismic surveys, respectively, during a 25-year period. Another 30 to 300 (225) acres could be impacted by exploration and delineation wells.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Long-term impacts would occur on an estimated 510 to 4,140 (2,950) acres of soil from field and staging area development, and 30 to 230 (170) acres from gravel extraction activities. These activities could result in long-term impacts to approximately 0.01 to 0.09 (0.06) percent of the Planning Area, or approximately 210 to 3,265 more acres (4-fold increase) than under the No Action Alternative. The overall impact to soil in the Planning Area would be minor. The placement of pipelines underground could disturb an additional 1.5 acres per pipeline mile. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soil associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since it is located in the area having high oil potential.

Lease stipulations and ROPs developed for Alternative B would provide protection similar to that offered by lease stipulations developed for the No Action Alternative.

4.4.4 Water Resources

4.4.4.1 Surface Water and Groundwater Resources

Because more acreage in the Planning Area would be open for leasing under Alternative B than under the No Action Alternative, more surface water could be impacted by oil and gas activities under this alternative. However, most of the lease stipulations that govern water resources under the No Action Alternative would also apply to Alternative B. Setbacks from rivers, streams, and fish-bearing lakes would be in the range of ¼ to 3 miles under Alternative B. The main difference between these alternatives pertaining to water resources is that Alternative B allows for drilling within and near Teshekpuk Lake, whereas the No Action Alternative does not allow for drilling near the lake. This greatly increases the likelihood of exploration or development activities impacting water resources and quality in this lake.

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas exploration and development that could occur in the Planning Area under Alternative B include aircraft use, watercraft use, collection and excavation for scientific research, hunting camps, recreational use of the area, and use of the area by local natives for subsistence. These activities would be expected to occur at the same frequency and intensity as under the No Action Alternative. All of these activities have the potential to impact water resources. However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Oil and Gas Exploration and Development Activities

Under Alternative B, exploratory and developmental drilling would be allowed on and near Teshekpuk Lake, subject to the setbacks listed in Lease Stipulation K-3 (see Section 2.6.3.2; Lease Stipulations that Apply to Biologically Sensitive Areas). Although this lease stipulation is generally protective of the water quality in

Teshekpuk Lake, drilling on and near the lake greatly increases the risk for an oil spill in this lake. Therefore, Alternative B is less protective of water resources than the No Action Alternative, particularly for Teshekpuk Lake.

Effects of Disturbances

Thermokarst. Out of all the oil and gas activities that would occur in the Planning Area under Alternative B, seismic surveys would have the greatest potential for causing thermokarst because they involve vehicles that cross the tundra during winter months. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). Limiting seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Because more seismic line mileage would be expected under Alternative B than under the No Action Alternative, the total area of potential thermokarst impact would be expected to be greater under Alternative B. Important lease stipulations for thermokarst would include the restriction on bulldozing of trails, the requirement that snow and frost cover be of sufficient depth to protect the tundra before overland activities could commence, and the lease stipulation that trails could not be used repeatedly, to avoid formation of ruts. These lease stipulations, along with the low impact of modern seismic equipment, should minimize thermokarst erosion of the tundra.

Ice Road and Pad Construction. Under Alternative B, the potential impacts of ice roads on water resources would be greater than under the No Action Alternative because more of the Planning Area would be open for leasing, and more ice pad and road construction would be likely to occur. Ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Ice Road/Pad Water Use. Under Alternative B, water from lakes could be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake would depend on the depth of the lake and the depth of unfrozen water in the lake. As under the No Action Alternative, water withdrawal from fish-bearing lakes would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet in depth if known to be fish-bearing or connected to a fish-bearing stream. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream, or they only have ninespine stickleback or Alaska blackfish. Water from streams would not be used for ice roads or ice pads.

Drilling Water Use. Drilling requires water for making drill mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camp that accompany drill rigs. For example, a 10,000-foot drill test would require about 850,000 gallons of water for drilling and about 100 gallons/day per person (50 to 60 persons per camp) for the drill camp (USDOI BLM 1998b). Under Alternative B, water use would be about twice that of the No Action Alternative. Under Alternative B, water withdrawal from lakes for drilling water would be governed by the same lease stipulations as those for ice roads and pads. Therefore, it is expected that impacts to surface water resources would be minor because of lease stipulations governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Because more of the Planning Area would be open to leasing under Alternative B, more lakes could potentially by impacted be water withdrawal during the winter months than under the No Action Alternative. Lease Stipulations K-1 (Rivers Area) and K-2 (Deep Water Lakes) would be protective of water resources in streams and fish-bearing lakes, but given the greater number of lakes, Alternative B could potentially have more impact on lakes, especially non-fish bearing lakes, than the No Action Alternative.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased. Snow removal and compaction by oil and gas operations would be prohibited over fish-bearing water bodies.

Under Alternative B, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative would be protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities. However, lakes without fish could be subject to impacts due to snow compaction if this activity were authorized by the AO.

Because a greater number of lakes could be affected by winter activities, including snow compaction, under Alternative B, impacts to lakes could be greater under this alternative than under the No Action Alternative.

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 in areas with low flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al. 1987a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structures are needed to minimize drainage problems during the spring snowmelt.

Under Alternative B, drainages would be protected by ROPs and lease stipulations. These ROPs and lease stipulations require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be minor under this alternative as a result of these lease stipulations.

Because a greater portion of the Planning Area would be open to oil and gas leasing under Alternative B, there could potentially be more disruption of drainages than under the No Action Alternative. However, if the lease stipulations and ROPs listed for this alternative are followed, this potential increase in impacts should be minor.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low water and keeping culverts free of snow and ice (Walker et al. 1987a, b).

Lease stipulations and ROPs developed for Alternative B to mitigate for disturbances to drainages, streams, and rivers by exploration and production activities would be similar to those developed for the No Action Alternative. These lease stipulations and ROPs regulate bridges, culverts, winter crossings, removal of ice bridges, and any temporary facilities constructed near rivers. They also include setbacks for specified rivers. These ROPs and lease stipulations should be effective in minimizing impacts to stream channels.

Because more of the Planning Area would be open to oil and gas leasing under Alternative B, there would potentially be more channel erosion and sedimentation under this alternative than under the No Action Alternative. If the lease stipulations and ROPs developed for this alternative were followed, this potential increased impact to stream channels should be minor.

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics and lake shoreline flow patterns, erosion and sedimentation, ice damming, and aufeis formation (NRC 2003). Locating gravel pits at a safe distance from streams and lakes should minimize these impacts.

Under Alternative B, gravel mining sites would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO. Gravel mining sites would also to be kept to a minimum in the Planning Area, and, where possible, be designed so that fish and wildlife could use them after mining was completed. These measures would protect streams, rivers, and lakes and keep impacts to floodplains to a minimum.

Because more of the Planning Area would be open to oil and gas leasing under Alternative B, there would potentially be more gravel removal under this alternative than under the No Action Alternative. Lease stipulations and ROPs developed for Alternative B would be effective in reducing impacts to streams and lakes.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments, diversions, and sedimentation changes in streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope. Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

The lease stipulations and ROPs developed for Alternative B require that pipelines be designed to minimize leaks and that operators have spill prevention and clean-up plans and equipment in place. These measures are designed to reduce impacts to water resources from pipeline leaks. Leaks would generally be small. Therefore, impacts to water resources from pipeline leaks should be minor under Alternative B.

Effects of Spills

The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded or flooded tundra during the summer months can reach temperatures of about 64° F (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Under-Ice Oil Spills. Oil spills under an ice cap have the added problem of the oil binding to the ice. Studies by Glaeser and Vance (1971), NORCOR Engineering and Research (1975), and Comfort et al (1983) have shown that the oil rises to the under-ice surface and spreads laterally, accumulating in under-ice cavities. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice.

Lease stipulations and ROPs developed for Alternative B restrict exploration drilling and production drilling near and within water bodies in the Planning Area. These lease stipulations require a setback of 500 feet or more from any fish-bearing, and 100 feet or more from any non-fish-bearing water body to protect these water bodies from possible oil spills. The AO has final decision authority on the location of drilling platforms. Lakes that are non-fish bearing are not regulated with setbacks; however setbacks from all major streams and rivers are required. These measures are considered to be protective of streams, rivers, and fish-bearing lakes.

The lease stipulations and ROPs for oil and gas drilling, especially the setbacks from streams and lakes, are similar to those for the No Action Alternative. Therefore, the Alternative B should provide protection similar to that of the No Action Alternative when potential oil spills are considered. However, because more of the Planning Area would be open to oil and gas leasing under the Alternative B, a greater area of the Planning Area could be subject to oil spills from drilling operations. If protective measures were followed, impacts to water resources from oil spills should be minor under all alternatives.

4.4.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

The only types of non-oil and gas activities in the Planning Area that could affect freshwater quality would be ongoing subsistence and recreational activities, primarily along rivers and lakes in the ACP, and use of lakes by floatplanes and watercraft. These activities have been ongoing for sometime, and impacts to freshwater quality appear to have been negligible. Impacts under Alternative B would be expected to be similar to those that would occur under the No Action Alternative.

Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative B, exploration activities that could affect water quality within the Planning Area include seismic survey activities, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Spills of crude oil or produced waters would be attributed predominantly to development activities.

Damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al. 1987a, b). Thermokarst erosion and associated effects on water quality could occur in high impact areas if damage to the vegetative mat was persistent. Recovery of a vegetative mat damaged during seismic activities, which would be necessary to improve water quality impacts, could take from a few years to decades.

While the NRC (2003) and others have indicated that short-term impacts, such as compaction of the vegetative mat, water diversions from seismic vehicle tracks, and ponding can be estimated at about 1 percent of the acreage impacted by seismic lines per season, use of newer low-ground-pressure equipment would reduce impacts substantially, to a total of about 66 acres for each 2-D survey, and 495 acres for each 3-D survey, under Alternative B. If it is assumed that 1 percent of the persistent high damage area would result in thermokarst erosion, then up to 26 acres (assumes 250 miles of 2-D seismic surveys and five 3-D seismic surveys) could be affected long term during a 25-year period.

As discussed for the No Action Alternative, use of water for ice-road construction could affect water quality through a change in water chemistry in lakes from which water was drawn; through restrictions on water circulation in shallow lakes that would impact the oxygen content of the water; through changes in water chemistry along the roadbed during and after meltout; and through modification of the local hydrology along the ice road. As discussed under the No Action Alternative, studies in other areas of the North Slope have shown that withdrawal of water from lakes for ice roads and ice pads has not affected water quality.

The preferred means of disposing of drilling wastes, including muds and cuttings, would be reinjection into wells, which would not cause impacts to surface water quality. Mud pits and surface discharge of exploration drilling muds and cuttings would be prohibited. Under this scenario, there likely would be no impact from drilling fluids used in exploration.

Effects of Development

Construction of gravel pads, within-field roads, an airstrip, and staging areas would impact approximately 110 to 1,340 (950) acres for the 2 to 14 (10) fields that could occur under Alternative B. The preferred sources for gravel would be 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). 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 affected by this dredging activity (Walker 1994). Borrow pits created by gravel mining could impound or divert water from an area of 30 to 230 (170) acres under Alternative B. Because gravel is a scarce commodity, construction technology could be refined to lessen gravel use and associated impacts, although such alternatives are not assumed in this analysis.

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by thermal effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity/suspended-sediment concentrations, as discussed under the No Action Alternative. 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, it is anticipated that gravel construction would result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or about 400 to 2,800 (2,000) acres for the development assumptions made under this alternative.

If buried oil pipelines resulted from development under Alternative B, they could range up to several hundred miles in length and affect 165 to 330 acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction was complete, impacts from elevated pipelines should be minimal. If underground pipelines were also constructed, potential impacts during construction could double, also through temporary impoundments, diversions, and sedimentation during construction. Buried lines could also result in thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines were done during winter, these impacts would be greatly reduced.

Effects of Abandonment and Rehabilitation

Removal of structures and facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer-term and higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Dissolved-oxygen concentrations in tundra waters could be affected by oil spilled in the summer. 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 would be negligible.

The primary effect of a small spill on tundra water quality, however, would be direct toxicity rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill, as shown in a National Petroleum Reserve – Alaska experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years (Miller et al. 1978; Barsdate et al. 1980; Hobbie 1982).

As noted in the 1998 Northeast IAP/EIS (USDOI BLM and MMS 1998), an oil spill reaching Teshekpuk Lake would likely have 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 percent of the lake surface) could be considered an effect on water quality. This effect would persist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected if an oil spill were to reach any of the lakes in the Planning Area.

Applicable ambient-water-quality standards for surface water and groundwater 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 surface waters, about 15-fold greater than background concentrations, provides the easiest 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 less than 1,000 bbl can be considered minor. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area 100,000 acres or larger. Concentrations above the 1.5-ppm acute criterion could occur over 10,000 acres or more during the first several days of such a spill.

Under Alternative B, more of the Planning Area would be open to exploration and development. Thus, potential impacts to surface water quality would likely be greater than under the No Action Alternative. Because Alternative B allows drilling on and near Teshekpuk Lake, the potential for an oil spill and contamination of the lake is also considered to be greater under this alternative than under the No Action Alternative.

4.4.4.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative B, the lease stipulations and ROPs listed in Section 2.6.3 (Alternative B and Alternative C Lease Stipulations and ROPs) would be effective in protecting of water resources because they would require setbacks from rivers and fish-bearing lakes for oil and gas activities, place limits on the withdrawal of water from fish-bearing lakes, and regulate the construction of gravel roads, ice roads and pads, and pipelines. Also, oil spill prevention and response procedures would be required, as would oil spill clean-up procedures. Refueling would be regulated and thereby kept away from rivers and lakes, particularly fish-bearing lakes. The required snowpack would be present on the tundra before seismic equipment would be allowed to make overland moves during winter. Drilling would not be allowed in streams, rivers, or fish-bearing lakes. The "K" lease stipulations for Alternative B would be somewhat more protective of water resources than the lease stipulations for the No Action Alternative, because they would provide more specific setback requirements for streams, rivers, and lakes.

Several lease stipulations and ROPs would protect water quality under Alternative B. Required Operating Procedures A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and clean-up plans. Required Operating Procedure B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. Required Operating Procedures C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. Lease Stipulation D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there was no feasible or prudent alternative. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there was no feasible or prudent alternative. Lease Stipulation G-1 could require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Lease Stipulation K-1 would protect aquatic, floodplain, and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Lease Stipulation K-2 would protect aquatic and riparian areas adjacent to deepwater lakes, but would allow exceptions if there were no feasible or prudent alternatives.

4.4.4.4 Conclusion

Under Alternative B, the impacts of activities other than oil and gas exploration and development would likely be similar to those under the No Action Alternative, and few, if any, impacts would occur. The greatest impacts on the water resources in the Planning Area would be from gravel roads, pads, and structures, and would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), and blockages of natural channels and floodways, which would disrupt drainage patterns.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. The potential long-term impacts to water quality from seismic operations would occur on approximately 26 acres. Long-term impacts from development of gravel roads, pads, staging areas, and pits could impact 540 to 4,370 (3,120) acres, a nearly 4-fold increase over impacts associated with the No Action Alternative. Both aboveground oil pipelines (not including infield lines) and buried pipelines could result in short-term impacts. After construction was complete, impacts from elevated pipelines should be minimal. Buried pipelines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase, and result in about 1.5 acres of long-term impacts per pipeline mile. If all work on gravel roads, pads, and pipelines were done during winter, impacts could be reduced. While any surface-disturbing activity could affect water resources, the lease stipulations and ROPs under Alternative B would be effective in protecting most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools.

4.4.5 Vegetation

4.4.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, impacts to vegetation associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area, and at the same frequency and intensity as under the No Action Alternative, despite the increased availability of land for oil and gas leasing. There could be some increased use of OHVs in the Planning Area due to an increase in the amount of roads associated with development occurred. However, additional impacts to vegetation from this increase would likely be small.

4.4.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Various activities associated with oil and gas exploration, development, and production could impact vegetation in the Planning Area. These activities include seismic operations, exploration drilling, gravel road, pad, and airstrip construction, pipeline construction, and construction of ice roads and ice pads.

Exploration

Under Alternative B, impacts to vegetation from activities associated with oil and gas exploration would be similar to those that occur under the No Action Alternative, except that the frequency and total number of seismic surveys would differ somewhat. It is anticipated that under Alternative B there would be a greater number of exploration and delineation wells drilled, which would increase the impacts of well collar construction and the impacts of both multi-year and single-year ice pads.

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months. Seismic exploration would cause impacts to vegetation similar to those described previously for overland moves. A 2-D survey area varies in size, but for this analysis a 600-mi^2 (384,000-acre) area was used. The maximum area impacted by seismic lines would be approximately 6,060 acres (250 miles x 200 feet wide), although not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which would traverse about the same distance as line miles surveyed (Emers and Jorgenson 1997). Additional trails would be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and typically involves a camp train with two or three strings of trailers. All trailer strings could use the same trail, but the resulting damage to vegetation would be more severe and longer lasting if separate trails were used by each trailer study. For this analysis it was assumed that 2.5 individual camp string trains would use different trails to minimize disturbance, thus impacting a path 30 feet wide. Given 30 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, approximately 500 acres would be impacted by camp move trails. Thus, the total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be less than those covered by 2-D surveys since a single move would occur down the center of the surveyed area. Camp move trails would impact about 495 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 990 to 2,475 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines.

The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 200 acres (assuming 250 miles of 2-D and five 3-D camp move trails over a 25-year period).

Ice road construction could also increase in terms of total miles constructed, but the 50-mile estimate used for the No Action Alternative would probably be an upper end for the number of ice road miles within the Planning Area per year.

During the life of the planning process, it is assumed that six to 57 (43) exploration wells and four to 42 (32) delineation wells or a total of 10 to 99 (75) wells would be drilled from ice pads in the Planning Area, under the No Action Alternative. Assuming that half the pads would be multi-year ice pads, the loss of vegetation could occur on 30 to 300 (225) acres spread among five to 50 different sites over a period of about 25 years.

The construction of well collars during exploration requires the digging of that a hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of thermal regime in the surrounding soil may also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.06 to 0.6 acres of vegetation being destroyed under the No Action Alternative, assuming construction of 10 to 99 well collars.

Development

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the destruction of vegetation in the areas of gravel placement. Under this alternative, two to 14 (10) fields would be developed, resulting in 110 to 1,340 (950) acres of vegetation destroyed by gravel placement.

The increased facilities construction and use under Alternative B would result in a larger area impacted by dust than under the No Action Alternative. Assuming that each field developed would have an average of 5 miles of some combination of roads, pads, and airstrips, with a potential for a 10-mile perimeter, dust would impact 36 acres of vegetation per field. Assuming two to 14 (10) fields would be developed, dust could impact 72 to 504 (360) acres of vegetation.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 2,800 (2,000) acres under Alternative B.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that one to seven (five) gravel production sites would be necessary, resulting in a total of 30 to 230 (170) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would destroy vegetation at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under Alternative B than under the No Action Alternative.

Pipelines. Under Alternative B, impacts from pipeline construction would be similar to those described for the No Action Alternative. The total area disturbed by each VSM would be about 14 square feet. About 6 percent of this area would be vegetation destroyed and replaced by the VSM, and the remaining portion would be potentially altered in terms of community type or species composition. Overall, 0.03 acres of vegetation would be disturbed per pipeline mile, or up to 3 to 6 (6) acres.

Impacts associated with buried pipeline could be greater under Alternative B than the No Action Alternative, given the potential increase in the number of fields developed. With an increase in the number of fields developed, the likelihood of river crossings that would require segments of buried pipe would increase.

Air Pollution. The potential for impacts to vegetation from air pollution would be slightly greater under Alternative B, given the potential for additional oil and gas fields and processing facilities, as compared to the No Action Alternative. However, it is unlikely that there would be substantial impacts to vegetation from pollutants in the Planning Area under either alternative.

Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, water impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place, would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrips could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth, although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, and complete restoration to preexisting conditions is improbable.

Effects of Spills

The greater amount of leasing, development, and production of oil that would occur under Alternative B, relative to the No Action Alternative, would result in a greater number of small spills of crude and refined oil in the Planning Area. The chance of a large oil spill occurring would also be greater under Alternative B; however, it would still be a very rare event.

Most oil spills cover less than 500 square feet (<0.01 acres), although a pressured aerial mist may cover substantially more area (Ott 1997). The average spill would cover 0.1 acre; about 17 to 173 (130) acres would be impacted during the lifetime of development in the Planning Area under Alternative B, and about 4 times the amount that would be impacted under the No Action alternative. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery (Jorgenson 1997).

4.4.5.3 Effectiveness of Stipulations and Required Operating Procedures

Many of the lease stipulations and ROPs associated with Alternative B would directly or indirectly limit potential impacts to vegetation in the Planning Area. Required Operating Procedures A-1 through A-7 relate to waste prevention, handling, disposal, spills, and public safety. They ensure that waste materials associated with exploration and development activities would be properly disposed of and would effectively minimize impacts to vegetation from spills and mishandling of materials. They would also provide for rapid cleanup of spills, decreasing the likelihood of impacts to vegetation. Required Operating Procedures C-2 and C-3 would minimize impacts to vegetation associated with overland moves and seismic work.

Lease Stipulation D-1 would effectively protect riparian habitat by preventing exploratory drilling in rivers, streams, and active floodplains. Lease Stipulation D-2 would effectively minimize surface impacts from exploratory drilling by limiting activities to temporary structures such as ice pads, ice roads, ice airstrips and temporary platforms unless permanent structures were absolutely required. Required Operating Procedures and Stipulations E-1 through E-6, E-8, and E-12 would effectively minimize impacts to vegetation by providing facility design and construction regulations that would limit the footprint of developments, provide protection from oil spills, provide setbacks that protect riparian and other high value habitats, and insure that habitat and resource issues were considered in the placement of facilities. Lease Stipulation G-1 would provide for the removal of all oil and gas facilities at the time of field abandonment unless the AO determined that facilities should be left in place. Required Operating Procedure I-1 would help be effective in minimizing resource conflicts by providing appropriate orientation programs and training for facilities workers. Lease Stipulation J-1 would be effective in protecting threatened and endangered species within the Planning Area. All of the "K" lease stipulations would also be effective by providing some protection for vegetation by providing for setbacks along the coast, rivers, lakes, and other high value habitat areas.

Development would result in impacts to vegetation and plant communities. The ROPs and lease stipulations associated with Alternative B are similar to those of the No Action Alternative and would provide extensive protections to limit impacts, and would be effective in minimizing destruction of vegetation and alteration of plant communities.

4.4.5.4 Conclusion

Under Alternative B, impacts to vegetation from activities other than oil and gas development would include minor impacts 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 would vary from 1 to several years.

Impacts associated with oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. The effects of oil and gas development and operation would include destruction of vegetation during construction of gravel pads, roads, and airstrips, excavation of material sites, construction of VSMs, and from spills of oil and other chemicals. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. These impacts would be permanent except for those associated with spills, which would be cleaned up immediately, allowing recovery within a few years to several decades.

Impacts to vegetation from oil and gas exploration would occur from seismic work and construction of well collars during exploratory drilling and the construction of ice roads and ice pads. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 190 acres (assuming six camp move trails over a 25-year period). Effects of well collar construction would also be permanent, but would impact less than an acre of vegetation.

The effects of oil development and operation would include destruction of vegetation during construction of gravel pads, roads, airstrips, and staging areas; from excavation of material sites; and construction of VSMs. Plant communities could also be altered by dust deposition, salinity of gravel fill used in construction, snow drifts, and blockage of or change to natural drainage patterns. These impacts would be long term and would impact 610 to 4,875 (3,480) acres, or 0.01 to 0.1 percent of the Planning Area. This would be four times the amount of vegetation being impacted as compared to the No Action Alternative.

It is assumed that impacts to vegetation types or communities would occur in proportion to their occurrence within the Planning Area. However, increased development in the area around Teshekpuk Lake, which would be allowed under Alternative B, could disproportionately impact wetland vegetation classes. A higher percentage of wet vegetation communities occur in areas in the northern portion of the Planning Area. This area is also considered to have the highest potential for oil reserves, which would increase the likelihood that these areas would be developed under Alternative B.

Under Alternative B, development would be unlikely to substantially harm plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under Alternative B as part of the 213,000 acres unavailable for leasing under this alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir’s fleabane, Drummond’s bluebell, and Hartz’s bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.4.6 Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared an impact analyses on those areas within Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Land removed from leasing and surface activity under Alternative B in the Goose Molting Area to the north of Teshekpuk Lake would prevent development in areas that are predominately wetlands. The Goose Molting Area, in particular, contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.4.6.1 Soil Resources

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. Impacts from winter exploration and well drilling would be expected to be minor. Development could cause loss or disturbance of 540 to 4,370 (3,120) acres of soil. The duration of these impacts would be permanent. Assuming that 95 percent of the area impacted is wetlands, approximately 510 to 4,150 (2,965) acres of wetland soils would be impacted. The duration of these impacts would be permanent and would impact approximately 4 times the amount of area impacted as compared to the No Action Alternative. Oil spills would be cleaned up immediately, causing minimal disturbance to soil. Impacts from development activities to soil would be minor. Little impact to soil 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 soil would be minor (with seismic) to moderate (with development).

4.4.6.2 Water Resources

Water Resources

Seismic impacts should be minimal. Construction of gravel roads, pads, and structures associated with oil and gas development would cause impacts to water resources in the Planning Area. The potential long-term impacts from exploration and delineation would be water removal during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 24 acres of wetlands. Long-term impacts from development of gravel roads, pads, staging areas, and pits could impact up to 510 to 4,150 (2,965) acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water. Gravel construction of pads, within-field roads, staging areas, pits, and field airstrips would cover about 135 to 1,495 (1,065) acres of wetlands for the two to 14 (10) fields proposed. Gravel construction can result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long-term (decade-or-more) effects from development of gravel roads, pads, and pits could occur on 550 to 4,020 (2,880) acres of wetlands, or nearly 4 times the number of acres that would be impacted under the No Action Alternative. Oil spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and cause lakes and cause ponds or small lakes to remain toxic to sensitive species for several years.

4.4.6.3 Vegetation

Impacts from activities other than oil exploration and development would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor.

Impacts from oil exploration would include vegetation disturbance on approximately 6,980 to 47,500 acres of wetlands for each 2-D and 3-D seismic survey, respectively. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 190 acres of long-term impacts to wetland vegetation per seismic survey, 20 percent greater than for the No Action Alternative.

Ice road construction would have impacts on up to 205 acres, and ice pads on 29 to 285 (190) acres, of wetland vegetation per year. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines, staging bases, and the excavation of material sites, would cause the destruction of vegetation on approximately 135 to 1,495 (1,065) acres of wetlands, and the alteration in plant species composition on an additional 450 to 3,140 (2,245) acres of wetlands, affecting a total of 585 to 4,635 (3,310) acres of wetlands, or 4 times the number of acres impacted under the No Action Alternative. 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 and near roads (McKendrick 2000).

Lease stipulations and ROPs would be effective in limiting the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Approximately 30 to 220 acres of wetland vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Northeast National

Petroleum Reserve – Alaska under Alternative B, and the most likely sources of gravel occur in the floodplains of rivers in the Planning Area.

4.4.6.4 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations identified above for soil, water, and vegetation resources would apply to wetlands. These lease stipulations would be effective in minimizing impacts to wetlands from waste discharges and spills, and from direct and indirect surface impacts associated with non-oil and gas and oil and gas activities. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.4.6.5 Conclusion

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Approximately 213,000 acres within this area, however, would be unavailable for leasing.

Impacts from oil exploration would include disturbance on up to 6,980 (2-D) and 47,500 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 180 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about 200 acres annually, and ice pad construction would impact about 425 acres of wetlands during the life of the project.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines, staging bases, and the excavation of material sites, would cause the destruction of vegetation on approximately 135 to 1,495 (1,065) acres of wetlands, and the alteration in plant species composition on an additional 450 to 3,140 (2,245) acres of wetlands, affecting a total of 585 to 4,635 (3,310) acres of wetlands, or 4 times the number of acres impacted under the No Action Alternative. 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). Long-term direct and indirect impacts to wetland vegetation would occur on approximately 0.01 to 0.1 percent of the Planning Area.

4.4.7 Fish

4.4.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that non-oil and gas ground activities occurring under Alternative B would be similar to those occurring under the No Action Alternative. Any impacts to fish or fish habitat resulting from these activities should be minor and have no measurable effects on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Potential threats to overwintering fish from seismic surveys in the Planning Area would primarily stem from 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools, and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas. Overall, any affects to overwintering fish caused by winter seismic surveys would be localized and would not be likely to have any measurable effect on fish populations within the Planning Area.

Under Alternative B, seismic exploration using Vibroseis in the winter and airgun arrays in the summer would be allowed on Teshekpuk Lake. Impacts under this alternative would be identical to those described for the No Action Alternative.

Under Alternative B, ROP C-2(a) would correspond to Lease Stipulation 24(i, j) of the No Action Alternative, allowing winter ground operations to begin only after the seasonal frost and snow cover are at sufficient depths to protect the tundra, and forcing these operations to cease with the beginning of the spring melt. The exact start and end dates for winter operations would be determined by the AO. While these lease stipulations were designed to protect underlying tundra and vegetation, they would also offer some protection to fish overwintering in pools.

Under Alternative B, ROP C-2(b) would be identical to Lease Stipulation 24(f) of the No Action Alternative by stating that all winter activities must be conducted with low-ground-pressure vehicles. Required Operating Procedure C-4 would be identical to Lease Stipulation 24(e) of the No Action Alternative, requiring that winter stream crossings be located in shallow riffle areas when possible to avoid additional freeze-down of deepwater pools harboring overwintering fish and invertebrates used by fish.

Overall, the general level of protection provided to freshwater, anadromous, and amphidromous fish and fish habitat by ROPs and lease stipulations would be effective and similar for both alternatives. The level of seismic activity would be slightly greater in Alternative B than under the No Action Alternative, but it is expected that any impacts would still be localized. Therefore, it is not expected that seismic activities occurring under Alternative B would have a measurable effect on fish populations within and adjacent to the Planning Area.

Effects from Water Demand. Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989a). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Moving waters may deter the thickening of ice, thereby providing overwintering habitat at shallower depths; areas within the Colville River Delta may adequately overwinter fish at depths of 5 feet. Because of the importance of overwintering area to Arctic fish, lease stipulations under all alternatives specifically regulate the winter withdrawal of water from lakes, rivers, and streams.

The principal difference between Alternative B and the No Action Alternative is that under the No Action Alternative, winter water withdrawal from fish-bearing lakes less than 7 feet in depth would be prohibited, whereas under Alternative B, withdrawal from fish-bearing lakes (except where ninespine stickleback and/or Alaska blackfish are the only species present) between 5 and 7 feet in depth would be prohibited, but there would be no restrictions on withdrawing water from lakes less than 5 feet in depth. Since winter ice reaches a thickness of about 6 feet and kills any fish overwintering in confined water bodies less than 5 feet in depth anyway, the additional prohibition offered by the No Action Alternative would be of no additional biological benefit.

The only aspect of Alternative B that could decrease protection to freshwater fish, relative to the No Action Alternative, is the 5- to 7-foot provision that is species-specific for ninespine stickleback and Alaska blackfish. The eastern portion of the Planning Area and Colville River represent the eastern limit of the Alaska blackfish range in northern Alaska, and the presence of this species is occasional throughout the Planning Area (see Section 3.3.4.2; Fish Species). Although loss of fish from an overwintering site could occur, this loss would be isolated and unlikely to have an effect on the population. Conversely, ninespine stickleback are very abundant throughout the Planning Area and the loss of a few fish from a single overwintering site would have a minor effect the population.

Under Alternative B, greater levels of water withdrawal would be expected, in conjunction with increased exploration and development activities, relative to the No Action Alternative. However, careful adherence to lease stipulations and ROPs should effectively protect fish. Although Alternative B would offer slightly less protection to ninespine stickleback and Alaska blackfish than the No Action Alternative, the net affect to these species would be minor. Therefore, winter water withdrawal would not be expected to have a measurable effect on fish populations in and adjacent to the Planning Area.

Effects from Exploratory Drilling. Drilling operations require large amounts of water for blending into drilling muds, and also produce large amounts of rock cuttings. If an exploratory well were to be abandoned, drilling muds and cuttings would be re-injected into the bore hole. If the well were to go into production, muds and cutting would be removed to an approved disposal site at Prudhoe Bay. Any chemical leaching into surrounding waters by cuttings temporarily being stored at the drill site could affect nearby fish habitat.

Under Alternative B, Lease Stipulation D-1 would correspond to Lease Stipulation 28 of the No Action Alternative. Both prohibit exploratory drilling in rivers and streams, as determined by the highest high-water mark, and in fish-bearing lakes unless the lessee demonstrates, on site-specific basis, that biological impacts would be minor or there is no other feasible alternative. The number of exploratory wells would be greater under Alternative B than under the No Action Alternative, but the prohibition of drilling in rivers and streams should provide fish with adequate protection. In general, it is not expected that exploratory drilling would have a measurable effect on fish populations in and adjacent to the Planning Area under Alternative B.

Effects from Gravel Extraction. In general, gravel extraction within the Planning Area would not be likely to have a substantially harmful effect on fish overwintering and spawning grounds, since those habitats represent only a small (less than 5 percent) portion of the Planning Area. However, if gravel mining activities were conducted in these sensitive areas, the localized impacts could be substantial, possibly resulting in spawning failure and high mortalities of overwintering fish. Other detrimental affects that could occur during the open-water summer season include the blocking and rerouting of stream channels; and increased silt concentrations resulting in reduced primary production, loss of invertebrate prey species, and disruption of feeding patterns for sight-dependent feeders (USDOI BLM 1989).

Under Alternative B, ROP E-8 would correspond to Lease Stipulation 40 of the No Action Alternative. Both are intended to effectively minimize the effects of gravel mining on fish by limiting gravel mine sites within the active floodplain of any river, stream, or lake unless the action enhances fish habitat. The protection provided to fish and fish habitat under Alternative B would be equivalent to that provided under the No Action Alternative. Gravel removal under either alternative is not expected to have a measurable effect on fish populations in and adjacent to the Planning Area, and gravel removal under both alternatives could have a positive effect by creating new overwintering areas.

Effects from Pad, Road, and Pipeline Construction. Improper placement and construction of drill pads, roadways, pipelines, bridges, and culverts could affect fish and fish habitat by eliminating, diverting, or otherwise impeding flow from small tributaries that connect rivers, streams, and lakes. Altering water flow characteristics could interfere with fish migrations to and from overwintering, spawning, and feeding grounds. Obstructions to fish movement are most common when culverts or low water crossings are not properly sized to allow for the passage of fish during these critical migration periods (Elliott 1982). Movement can be obstructed during periods of either high or low stream flow. Obstruction to stream and river flow and fish migrations may also occur if ice bridges are still in place once spring breakup begins.

Under Alternative B, Lease Stipulation E-2 would correspond to Lease Stipulation 41 of the No Action Alternative. Under the No Action Alternative, however, construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines would be prohibited within 500 feet of any active floodplain unless otherwise permitted by the AO (special habitat zones identified in Lease Stipulation 39 have their own designated restrictions), while under Alternative B construction would be prohibited within 500 feet of fish-bearing and 100 feet of non-fish-bearing water bodies (special habitat zones identified in the “K” lease stipulations have their own designated restrictions). Since the only difference between the two alternatives is the size of the buffer zone around water bodies that do not contain fish, both alternatives would afford similar protection to fish and fish habitat.

Under Alternative B, ROP C-3 would be identical to Lease Stipulation 24(d) of the No Action Alternative, which requires that ice bridges be removed or breached before spring breakup to maintain natural flow characteristics of the region. In addition, ROP E-6 would be identical to Lease Stipulation 42 of the No Action Alternative, which states that bridges, rather than culverts, be used for road crossings on all major rivers, and that any culverts necessary on smaller streams be large enough to avoid restricting fish passage or affecting natural stream flow.

Under Alternative B, ROP E-12 would correspond to Lease Stipulation 46 of the No Action Alternative. Both require extensive ecological mapping of proposed development sites in order to access and minimize impacts to sensitive wildlife and fish habitats.

Under Alternative B, any increase in the number of pads, roads, and pipelines constructed, relative to the No Action Alternative, would depend on the amount of recoverable oil and gas reserves that would eventually be brought into production. Rigorous adherence to pre-development environmental assessment, structure siting, and construction codes should adequately protect fish. For this reason, as well as those outlined in Section 4.3.7 (Fish) for the No Action Alternative, construction and placement of drill pads, roadways, pipelines, bridges, and culverts would have only a minor effect on freshwater, anadromous, or amphidromous fish populations in and adjacent to the Planning Area.

Effects from Causeways. The construction of solid gravel causeways along the coast has long been a sensitive fisheries issue (USACE 1980, 1984). These structures, which can extend several miles out to sea, are used for offshore drilling, year-round seawater extraction, and as docking facilities for sea-born supply. Their solid construction enables them to withstand the immense pressures of shifting coastal ice in late winter and spring. They also have the potential to physically block fish moving along the shore and/or alter coastal circulation and mixing patterns such that hydrographic conditions becomes inhospitable for anadromous and amphidromous fishes.

Under Alternative B, Lease Stipulation E-3 would be virtually identical to Lease Stipulation 30 of the No Action Alternative. Both prohibit the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas, and artificial gravel islands and bottom-founded structures in active stream channels, unless otherwise approved by the AO on a site-specific basis. Any approved structures must be designed, sited, and constructed in a way to prevent substantial changes in nearshore hydrography, and must maintain free passage of marine, anadromous, and amphidromous fishes. Active monitoring at these structures could also be required. Given these restrictions, the future construction of a causeway or dock would have only a minor effect on anadromous, and amphidromous fish populations under Alternative B, regardless of any increase in exploration and development activities.

Effects from Waterflooding. As under the No Action Alternative, oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area under Alternative B. These facilities, which have been operational for years, and have been shown to have only a minor effect on fish migrating or foraging in the intake area. If seawater intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. Therefore, under Alternative B, waterflooding would not be expected to have a measurable effect on anadromous and amphidromous fish, regardless of any increase in exploration and development activities.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

Oil spills have been observed to have a range of effects on fish (Malins 1977; Hamilton et al. 1979; Starr et al. 1981). 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 sub-lethal 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 [LC_{50}]) for fish generally are on the order of 1 to 10 ppm. Concentrations measured under the slicks of oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations of oil 1.6 to 3.3 feet beneath a slick from the Tsesis spill (Kineman et al. 1980) ranged from 50 to 60 parts-per-billion (ppb). Extensive sampling following the Exxon Valdez oil spill (about 260,000 bbl in size) also found hydrocarbon levels that were well below those known to be toxic or to cause sub-lethal 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.

Most of the ROPs and lease stipulations associated with Alternative B that are designed to prevent or otherwise deal with oil spills in the Planning Area are the same as the lease stipulations listed for the No Action Alternative. Under Alternative B, these include ROPs A-2(d), A-3, A-4, A-6, A-7(a), and E-4. Under Alternative B, ROP A-5 would correspond to Lease Stipulations 15 and 16 of the No Action Alternative. Whereas Lease Stipulation 16 prohibits refueling within 500 feet of any water body or in any active flood plain (fueling of boats, float planes, and ski planes permitted), ROP A-5 prohibits refueling within 500 feet of fish-bearing and 100 feet of non-fish-bearing waterbodies (fueling of boats, float panes, and ski planes permitted). Small caches of boat or plane fuel are permitted in the restricted areas under both alternatives. The buffer zone can be reduced from 500 to 100 feet if it can be demonstrated that those bodies do not contain fish. Both alternatives would afford effective protection to surrounding fish and fish habitat. Lease Stipulation 15 of the No Action Alternative prohibits the storage of fuel on any active floodplain, whereas that decision is left up to the AO under Alternative B. With proper safety features, the protection to fish and their habitat would be effective under both alternatives.

Under Alternative B, the number of spills would increase proportionately with increased exploration and development. Given the small volume of oil typically involved in spills, as well as the safety requirements for operations in the oil field and stringent clean-up protocols, oil spills associated with Alternative B would likely have only a minor effect on freshwater, anadromous, or amphidromous fish populations in or adjacent to the Planning Area.

Effectiveness of Stipulations and Required Operating Procedures

As noted above, numerous performance-based lease stipulations and ROPs are proposed under Alternative B to protect fish and their habitats. As discussed, these lease stipulations and ROPs afford similar protection to fish as lease stipulations developed for the No Action Alternative.

Conclusion

The potential impacts to freshwater, anadromous, and amphidromous fish from oil exploration and development activities within the Planning Area under Alternative B include minor impacts to sensitive overwintering habitats from winter seismic activities; loss of overwintering habitat from water withdrawals; degradation or blockage of water bodies used as fish migratory corridors or feeding grounds resulting from the construction and placement of pipelines, pads, ice and gravel roadways, airstrips, and causeways; loss or degradation of habitat from gravel extraction; crude and refined-oil spills; and loss or degradation of habitat from gravel structure erosion.

Activities proposed under Alternative B should have only minor effects on fish and their habitats. By opening up additional lands near Teshekpuk Lake to leasing, fish in this lake and other deep-water lakes and streams would have a greater potential to be impacted by spills and habitat degradation, resulting in greater risks to fish under this alternative than the No Action Alternative. Performance-based ROPs and lease stipulations developed for this alternative, however, would ensure the exploration and development activities are designed to effectively minimize impacts to fish habitats and that procedures are in place to clean up most spills before they can harm fish or their habitats. The threat of localized impacts affecting fish stocks would increase if they occurred in sensitive habitats.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the larger disturbance area and potential for more oil and gas exploration and development activities, the potential for impacts to fish under this alternative would be about two times greater for oil and gas exploration activities, and four times greater for oil development activities, as compared to the No Action Alternative.

4.4.7.2 Marine Fish

Activities Not Associated With Oil and Gas Exploration and Development

Most non-oil and gas ground activities would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas activities occurring under Alternative B would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys would be conducted within the Planning Area during the winter months, from early December to mid-May, and possibly during the summer on Teshekpuk Lake. Because marine fish and their habitat lie outside the Planning Area in winter and Teshekpuk Lake in summer, seismic activities associated with Alternative B would not be expected to have a measurable effect on marine fish populations.

Effects from Water Demand. Water used in the building of drill pads, roads, and airstrips would likely be withdrawn from freshwater sources near the site of construction. These activities would have no effect on marine fish and their habitat. Water withdrawal for the purposes of waterflooding, which would have implications for the marine system, is discussed separately below under the “Effects from Waterflooding” subheading.

Effects from Exploratory Drilling. Most exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, most exploratory activities associated with Alternative B would not be expected to have a measurable effect on marine fish populations. Exploratory drilling could also be conducted from current production pads or platforms within a lake body during summer in the TLCH Area, but impacts to marine fish would be minor.

Effects from Gravel Extraction. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minuscule segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Gravel extraction would not benefit fish populations by creating overwintering habitat, as it might for freshwater fish, since all marine fish overwinter at sea.

Under Alternative B, ROP E-8 would correspond to Lease Stipulation 40 of the No Action Alternative. Both are intended to effectively minimize the effects of gravel mining on fish by limiting gravel mine sites within the active floodplain of any river, stream, or lake unless the AO determined that there was no other alternative or that the site would ultimately enhance fish habitat.

Effects from Pad, Road, and Pipeline Construction. Pad, road, and pipeline construction would largely be limited to freshwater habitat regions of the Planning Area, and would not establish a footprint in marine or coastal habitats. Under Alternative B, Lease Stipulation K-6 requires that all permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines established to support exploration and development activities, be located at least ¾ mile inland from the coastline to the extent practicable. The use of previously occupied coastal sites such as Camp Lonely and DEW-Line sites, or sites within ¾ mile of the coastline if an exception is granted by the AO, is possible. Future exceptions could be the construction of docking facilities along the coast, although, for the near future, sea borne re-supply would likely involve the already operational docking facilities at West Dock. A similar level of protection for the coastline would not be provided under the No Action Alternative.

Required Operating Procedure E-12 requires extensive ecological mapping of proposed development sites in order to access and minimize impacts to sensitive wildlife and fish habitats. All coastal construction would be approached with environmental caution. This lease stipulation is similar to Lease Stipulation 46 for the No Action Alternative.

Effects from Causeways. The construction of solid gravel causeways along the coast is less of an issue for marine fish than it is for anadromous and amphidromous fish. The major migration for two of the most dominant species, fourhorn sculpin and Arctic flounder, is onshore soon after ice breakup. Once in coastal waters, these sedentary species do not undergo the extensive alongshore migrations up and down the coast that are characteristic of Arctic cisco and the amphidromous species. Potential blockage to alongshore movement is less critical.

Under Alternative B, Lease Stipulation E-3 would provide restrictions on the use, design, and monitoring of causeways that might be constructed along the coast in the future, much like under Lease Stipulation 30 of the No Action Alternative.

Effects from Waterflooding. Under Alternative B, waterflooding would not be expected to have a measurable effect on marine fish.

Effects of Spills

Hydrocarbon spills can impact marine fishes of any life history 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 could be impacted.

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field, there is a minor likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically important or measurable impact to marine fishes.

Lease Stipulation K-6 requires that all permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, be located at least ¾ mile inland from the coastline, to the extent practicable. Because oil spills in the Planning Area would likely be small, and given the stringent and effective oil-spill-response safety requirements for operations on the oil field as identified in ROPs A-2(d), A-3, A-4, A-5, A-6, A-7(a), and E-4, and the setback restrictions of Lease Stipulation K-6, a major oil spill in the marine environment would be unlikely.

The primary difference in the regulations of the No Action Alternative and Alternative B is the way in which wastewater discharges may be disposed of in the marine environment. Under Alternative B, ROP A-7(a) allows for the disposal of these waters in the marine environment at the discretion of the AO, based on a case-by-case review of environmental factors and consistency with NPDES regulations. In comparison, Lease Stipulation 5(d) of the No Action Alternative allows for a case-by-case approval for discharge into marine waters greater than 33 feet deep, but expressly forbids discharge into marine water shallower than 33 feet. Given that the AO would undertake a rigorous environmental review and take the necessary precautionary measures to ensure the biological and environmental integrity of marine waters, marine fish should be equally protected under Alternative B and No Action Alternative.

Although the number of spills that would occur under Alternative B is estimated to be four times greater than the number of spills predicted to occur under the No Action Alternative, spills would be dispersed throughout the mainland Planning Area. Therefore, spills would not be expected to have a measurable effect on marine fish populations under either alternative.

Effectiveness of Stipulations and Required Operating Procedures

As noted above, prescriptive- and performance-based lease stipulations proposed under the No Action Alternative and Alternative B offer similar protections to fish and their habitats. Lease Stipulation K-6 developed for Alternative B, however, specifically prohibits permanent oil and gas development within ¾ mile inland from the coastline, unless the AO grants an exception; similar protection is not provided under the No Action Alternative. Thus, greater protection is afforded marine fish under Alternative B than the No Action Alternative.

Conclusion

In general, marine fish of the Beaufort Sea are insulated from many potential environmental impacts associated with oil and gas development in the Planning Area. Most of the coastal tidal area of the Planning Area is shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with winter seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters and would not be impacted by summer seismic surveys in Teshekpuk Lake or exploratory drilling in lakes in the TLCH Area. The bulk of the marine fish population would not be directly subject to the effects of river gravel extraction, pad, road, and pipeline construction, sedimentation from gravel erosion, and the potential blockage of migratory corridors.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil and gas development in the Planning Area (the occurrence of which is unlikely) would have a substantial impact on these species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and the stringent oil-spill-response safety requirements for operations on the oil field, such an event is unlikely.

Overall, it is not expected that oil exploration and development activities under Alternative B would have a measurable effect on marine fish populations in or adjacent to the Planning Area. Implementation of Lease Stipulation K-6 would afford marine fish protection under Alternative B that would not be provided under the No Action Alternative. Impacts to marine fish resources under Alternative B would be similar to, or slightly greater than, those that could occur under the No Action Alternative.

4.4.7.3 Essential Fish Habitat

Although there are no federally-managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. Freshwater EFH for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Salmon EFH in the fresh waters of Alaska includes virtually all coastal streams south of about 70° North latitude (USDOI BLM and MMS 2003). Marine EFH includes all estuaries, tidewater, and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone.

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites have been identified for these species. Although both species are taken in the Colville River and Itkillik River fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities jeopardize the fish species upon which the fisheries depend. It is not expected that non-oil and gas activities would have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

The Iñupiat community of Nuiqsut operates subsistence fisheries in the Colville River Delta year-round, with most fishing effort occurring in summer and fall. Summer fishing is concentrated in the Nigliq Channel in the western Colville River Delta, in the Colville River just upstream of Nuiqsut in the Tiragruag area, and in Fish Creek. The primary target is broad whitefish, but Dolly Varden, humpback whitefish, pink salmon, and chum salmon are also taken incidentally. The major fishery is the Colville River under-ice gill net fishery that occurs during autumn. Fishing effort is concentrated in the upper Nigliq Channel near Nuiqsut, the lower Nigliq Channel near Woods Camp, and the Nigliq Delta. Arctic cisco is the principal species targeted, accounting for nearly 70 percent of the total annual harvest. Other targeted species include least cisco, broad whitefish, and humpback whitefish.

To minimize impacts to subsistence fisheries within and adjacent to the Planning Area, certain rivers within the Planning Area that are considered particularly important to Native subsistence fisheries would be designated as off limits to many development activities under Alternative B. These rivers are designated under Lease Stipulation K-1, which is the same as Lease Stipulation 39 of the No Action Alternative, except that the Tingmiaksiqvik River is not afforded protection under Lease Stipulation 39. Under Lease Stipulation K-1, permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, would not be allowed near several rivers. Essential pipeline and road crossings could be approved by the AO on a case-by-case basis. In addition, protection is afforded fish residing in deep-water lakes (Lease Stipulation K-2) and, to a lesser extent, Teshekpuk Lake (Lease Stipulation K-3) under Alternative B. Similar protection is provided to deep-water lakes in Lease Stipulation 39(g) for the No Action Alternative. Under the No Action Alternative, however, no oil and gas leasing would be allowed in the 600,000 acres that includes Teshekpuk Lake, while Lease Stipulation K-3 allows for oil and gas facilities in the lake at distances greater than ¾ mile from shore, and on land at distances greater than ¼ mile from shore. Activities would only be permitted if they could adequately: 1) minimize impacts to, and not unreasonably conflict with, traditional subsistence use; 2) minimize impacts of vehicular traffic (air, land, and water) to traditional subsistence uses; 3) site facilities so as to not pose a hazard to navigation by the public using traditional high-use subsistence-related travel routes; 4) demonstrate adequate year-round oil spill response capability; and 5) minimize impacts related to oil spill response activities.

In addition to the setbacks described above, ROPs H-1 and H-2 outline requirements for consultation among lessees, subsistence communities, the NSB, and the Subsistence Advisory Panel to discuss technical aspects of proposed developments; potential conflicts that might arise from any proposed exploration, development, or production operations; and monitoring studies that might accompany any activities. These lease stipulations correspond to Lease Stipulation 61 under the No Action Alternative, which also mandates a consultation process among lessees, regulatory and resource agencies, subsistence users, and the AO. The "H" ROPs also incorporate provisions of Lease Stipulation 59 of the No Action Alternative, which requires the lessee to develop and implement a plan to monitor the effects of oil and gas activities on subsistence, and Lease Stipulation 60, which requires that lessees not unreasonably restrict access by subsistence users in oil field development areas.

The primary difference between Alternative B and the No Action Alternative is that under the No Action Alternative, the consultation process would apply to specific geographic setbacks around the Ikpikpuk River, Miguakiak River, Fish Creek, Judy Creek, and Colville River (Lease Stipulation 62). The consultation process is more generic under Alternative B and would cover any development deemed as a potential threat to subsistence by the AO in consultation with federal, state, and NSB regulatory and resource agencies, the Subsistence Advisory Panel, and subsistence users.

Together, the lease stipulations and ROPs that serve as the guidelines for oil industry development within the Planning Area, the development setbacks that have been established for special subsistence habitat under the "K" lease stipulations, and the inclusive consultation processes as set forth in the "H" ROPs should be sufficient to protect subsistence fisheries over the long term. Therefore, Alternative B is not expected to have a measurable effect on subsistence fisheries within and adjacent to the Planning Area. The degree of protection to subsistence fisheries should be similar to that provided under the No Action Alternative for all areas, except water bodies located within the 600,000-acre no-lease area under the No Action Alternative.

Effectiveness of Stipulations and Required Operating Procedures

Protections provided by the performance-based lease stipulations under Alternative B would be effective and similar to prescriptive-based lease stipulations developed for the No Action Alternative. The Tingmiaksiqvik River is afforded protection under Alternative B, but not under the No Action Alternative. Oil and gas development would be allowed in Teshekpuk Lake under Alternative B; this area would be closed to leasing under the No Action Alternative.

Conclusion

In general, impacts to fish subsistence species from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish subsistence species from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Because of the larger disturbance area and projected increase in oil and gas exploration and development activities, the potential for impacts to fish subsistence species under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

It is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under Alternative B. Lease stipulations afford similar levels of protection for both alternatives.

4.4.8 Birds

This section discusses the potential effects to bird species, which are not threatened or endangered, that could result from management action in the Planning Area under Alternative B. A discussion of effects to threatened and endangered bird species is given in Section 4.4.10 (Threatened and Endangered Species). Activities that could affect birds in the Planning Area include oil and gas exploration and development, subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could result in: 1) temporary or permanent habitat loss; 2) various types of disturbance that could result in displacement from foraging, nesting or brood-rearing habitats; 3) increased predation pressure from predators attracted to areas of human activity; and 4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills.

4.4.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, activities not related to oil and gas exploration and development that could affect birds in the Planning Area would be the same as those described under the No Action Alternative: private or commercial air traffic; aerial surveys to inventory wildlife or other resources; summer research camps; hazardous material or debris removal; subsistence hunting and fishing; and recreational camps and boating activity. The potential for disturbance, displacement, or mortality from non-oil and gas related activities, would likely be similar under the No Action Alternative and Alternative B. Lease stipulations to protect waterfowl, shorebirds, raptors, and other birds and their habitats would help to mitigate the potential effects of non-oil and gas activities on birds under Alternative B.

4.4.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when birds are mostly absent from the Planning Area. Under Alternative B, the types of effects of winter exploration activities on the bird species present that would be in the Planning Area during the winter would be the same as those discussed under the No Action Alternative. Although impacts associated with winter exploration would likely be minor under either alternative, there could be a slightly greater effect to birds under Alternative B because of the greater area would be available for exploration than under the No Action Alternative. The direct effects of exploration would likely include the temporary displacement of a small number of birds from preferred feeding or roosting areas.

During winter exploration activities, indirect impacts to birds could result from the construction of ice-roads and ice-pads and the associated water withdrawal. The types of effects that could result from ice-road and ice-pad construction under Alternative B would be the same as those described under the No Action Alternative, and would primarily involve the temporary alteration of tundra habitats. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, which could affect nesting or brood-rearing loons and waterfowl. Rolligons and track vehicles used during winter exploration could also temporarily affect tundra vegetation, resulting in minor impacts to tundra-nesting birds. A larger area would be available to oil and gas exploration activities under Alternative B, as compared to the No Action Alternative. Therefore, the potential impacts to birds resulting from exploratory activities would also likely be slightly greater under Alternative B. Primarily, there would likely be additional effects to birds in the areas surrounding the portion of the Goose Molting Area that would be open to leasing under Alternative B, but not under the No Action Alternative. However, Lease Stipulation K-4 would mitigate some potential impacts in the Goose Molting Area by prohibiting water extraction and other oil and gas activities that could affect goose feeding habitat along lakeshore margins.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to bird nesting near the lakeshore, only birds using open water habitats in the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting support activities after the completion of the nesting and brood-rearing periods would eliminate the potential for nest abandonment and loss of productivity.

Predators, such as glaucous gulls, ravens, and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under Alternative B, the potential effects of increased predation would be mitigated by ROPs A-2 and E-9, and the overall effects to birds would likely be similar under the No Action Alternative and Alternative B. Although the No Action Alternative would not have a provision similar to ROP E-9, which requires the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes, this lease stipulation may not be particularly relevant to the temporary storage of exploratory drilling and seismic equipment.

Oil and Gas Development

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic; routine maintenance activities; heavy equipment use; and oil-spill clean-up activities could cause disturbances that would affect tundra-nesting birds. Under Alternative B, these types of disturbances to birds would be the same as those discussed under the No Action Alternative. These disturbances could result in temporary displacement from preferred foraging, nesting, and/or brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition, rate of survival, and productivity of birds. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the bird species and the number of individuals in the area, and the time of year. The greatest potential for impacts from disturbance would most likely occur in habitats with high bird concentrations, such as the Teshekpuk Lake Goose Molting Area, or if species with low or declining populations, such as buff-breasted sandpiper or yellow-billed loon, were disturbed.

The potential for disturbance to birds from activities on roads and pads would likely be greater under Alternative B, as compared to the No Action Alternative, because there are areas that support high bird concentrations in portions of the Goose Molting Area that would be available for oil and gas leasing under Alternative B, but not under the No Action Alternative. The reduction in the amount of habitat protected under Alternative B, as compared to the No Action Alternative, would likely increase the risk of disturbance to internationally significant populations of molting geese, particularly brant that use the Goose Molting Area. The reduction in protection under Alternative B could also affect white-fronted and Canada geese. Disturbance that resulted in a reduction in the breeding success of geese and other waterfowl could also impact the success of subsistence and sport hunters in Alaska, the lower 48 states, Canada, Russia, and Mexico. Disturbance effects could also impact shorebirds if development occurred in areas of high shorebird concentration located north of Teshekpuk Lake. Lease Stipulation K-4, however, would help to mitigate potential disturbance to birds in the Goose Molting Area, by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; and protect the goose molting lakes from disturbance from oil and gas activities by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. Lease Stipulation K-4 would permit the construction of facilities, such as platforms, on lakes within ¾ mile of the lake shore, which could increase disturbance to molting geese if platforms were constructed on lakes used by molting geese. Lease Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This lease stipulation could also help to reduce the potential impacts to waterfowl and their habitats in coastal areas.

Under Alternative B, there could be disturbance to birds in a 5 to 6 mile wide band south and west of Teshekpuk Lake that would be open to surface activity under Alternative B, but closed under the No Action Alternative. Lease Stipulation K-5, designed to protect the Teshekpuk Lake Caribou Habitat Area, would help to mitigate potential disturbance effects to birds by placing limits on various types of oil and gas exploration and development activities that could occur on roads and pads from May 20 through August 20.

Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the perimeter of any fish-bearing lake in the Deep Water Lakes Area south of Teshekpuk Lake. Under Alternative B, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish-bearing lakes in the Deep Water Lakes Area could result in disturbance to yellow-billed loons and waterfowl near the facilities and access roads. However, other bird groups could also be disturbed if facilities were located outside the ¼-mile buffer. The extent of effects to birds from activities on roads and pads would depend on the species and numbers of individuals occurring in areas adjacent to the development. Although Lease Stipulation K-2 has been designed primarily to provide mitigation for deepwater fish habitat, it would also be likely to provide protection for birds using habitats near these lakes.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of disturbance effects to waterfowl and other bird groups from aircraft would be the same under Alternative B as those discussed under the No Action Alternative, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some birds could habituate to aircraft activity and either remain in habitats located near aircraft activities, or move to nearby habitats. This may not be the case for brant, as they apparently do not acclimate well to aircraft traffic (Derksen et al. 1992). Aircraft disturbance to brant may cause behavioral and physiological responses that could increase energy expenditures and reduce foraging time, which could increase the duration of the flightless period and susceptibility to predation. Birds could be displaced from optimal to sub-optimal habitats, causing birds to spend more time foraging to meet nutrient needs (Derksen et al. 1992).

Compared to the No Action Alternative, it is likely that there would be a greater amount of disturbance to birds from aircraft activity under Alternative B, as a greater amount of area would be available for oil and gas leasing in the Goose Molting Area, and from facilities in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity would be prohibited under the No Action Alternative). Under the full development scenario for Alternative B, the projected number of flights per day may range from 50 to 90 depending on the phase of development. These numbers are based on the number of flights that occurred during the Alpine field development (USDOI BLM 2004C). The effects of aircraft disturbance would likely have moderate effects on waterfowl and shorebirds. Under Alternative B, Lease Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic, would be restricted. These lease stipulations would help to mitigate for potential aircraft disturbance, should oil and gas facilities be located within the Teshekpuk Lake Special Areas. However, if CPFs were located within the Teshekpuk Lake Special Areas, the level of aircraft disturbance would likely increase along flight corridors between oil production facilities and airfields and at airstrips located at these CPFs.

If a CPF were located within the ¼-mile buffer around lakes under Alternative B, there would likely be a greater amount of disturbance to waterfowl in the Deep Water Lakes Area than under the No Action Alternative. The degree of effects to birds would depend on the number of birds present and which species of birds were using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this lease stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to birds.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting and staging waterfowl, could occur in offshore waters of the Planning Area from mid-July through October. These impacts would likely be minor. Displaced waterfowl would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact waterfowl. There would be a greater likelihood for disturbance to waterfowl under Alternative B than under the No Action Alternative, because much of the area adjacent to the coast would be open for leasing under Alternative B, but unavailable for oil and gas development under the No Action Alternative. Therefore, development could occur in portions of the Teshekpuk Lake Special Area where waterfowl could be disturbed by barge traffic required for transportation of equipment and supplies during oil field construction and operation.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer. Disturbance from watercraft activity along rivers could affect birds such as ruddy turnstones, semipalmated plovers, and Baird’s sandpipers that use gravel bars. The results of disturbance may include failure to nest or nest abandonment (Rodgers and Smith 1995). Under Alternative B, these activities would be more likely to disturb waterfowl than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of high bird use within the Teshekpuk Lake Special Area. Wildlife resource surveys would be conducted prior to development to identify suitable areas and timing for spill response training.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. As much as 1,340 acres of tundra could be covered by gravel placement under Alternative B and up to 230 acres could be impacted by gravel mining. During the construction of oil field roads and pads, tundra covered by gravel, as well as tundra associated with gravel mine sites, would be lost as nesting, brood-rearing, and foraging habitat for birds. The potential effects of habitat loss under any alternative would likely have moderate impacts to tundra-nesting birds and would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. Permanent habitat loss under Alternative B could potentially have greater impact on tundra-nesting birds than under the No Action Alternative because of the increased amount of habitat loss under Alternative B and because some areas of high bird use that are closed to development under the No Action Alternative would be open to leasing under Alternative B. Birds that use drier habitats may be more affected by habitat loss than those that use wet habitats because less dry habitat is available in the National Petroleum Reserve – Alaska. Loss of dry habitat could be especially important for buff-breasted sandpiper, which is a species of concern with low population numbers that uses dry habitats. In addition, under Alternative B, there would be an increased potential for birds to be affected by a functional loss of habitat in areas near roads and pads if development-related disturbances precluded birds from utilizing these habitats.

Temporary Habitat Loss. In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. Water withdrawal from lakes during ice-road construction could temporarily affect birds in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative B, the types of effects to birds resulting from temporary habitat loss would be the same as those discussed under the No Action Alternative. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by bird populations. Temporary habitat loss under Alternative B could potentially have greater impact on tundra-nesting birds than under the No Action Alternative because some areas of high bird use that are closed to development under the No Action Alternative would be open to leasing under Alternative B.

Mortality

Bird mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment is discussed under the No Action Alternative. The potential impacts to bird populations as a result of collisions in areas of oil and gas development would likely be minor. Without knowing specific locations of potential developments, it is difficult to compare potential impacts among alternatives. However, there would be an increased risk of bird collision with offshore barge and vessel traffic under Alternative B (as compared to the No Action Alternative), because facilities could be constructed in portions of the Teshekpuk Lake Special Area that are unavailable for leasing under the No Action Alternative. Under Alternative B, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of bird collisions with oil field infrastructure could still be greater under Alternative B, because the potential benefits of illumination of facilities may not be adequate to mitigate for the presence of facilities within or near areas of high bird use.

Some predators, such as ravens, gulls, Arctic fox, and bears could be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites were present. The potential impacts of increased numbers of predators on birds are discussed under the No Action Alternative. Increased predation pressure could have moderate impacts on tundra-nesting birds. Under Alternative B, the types of effects to bird populations would be the same as those discussed under the No Action Alternative. Under Alternative B, there may be the potential for greater bird mortality due to predation than under the No Action Alternative if predators were attracted to development in areas of high bird use that are closed to leasing under the No Action Alternative. Although both alternatives have ROPs or lease stipulations in place to eliminate attraction of predators to anthropogenic sources of food, Alternative B would require the lessee to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. Still, it may be difficult to totally exclude ravens from nesting on oil field structures. There would be no equivalent lease stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads could also cause the complete loss of nesting habitat for a season, or cause compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as, those caused by traffic during construction and production. If pads, roads, and airstrips were not revegetated, their value to birds would be lessened. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that existing in the area at the time of disturbance could be created and used by birds, though the precise mix of habitat types would likely not be the same as what originally occurred. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material’s toxicity and the amount ingested, ingestion of foam could cause sickness or mortality, though the numbers of birds harmed or killed would be very small.

Effects of Spills

Oil spills would have similar types of effects to tundra-nesting birds under the No Action Alternative and Alternative B. However, there would be an increased risk of an offshore spill occurring under Alternative B, because there would be increased barge traffic. Offshore spills would have the potential to spread through the action of wind and currents, and could affect molting waterfowl along the coastline or in Harrison and Smith bays, as well as shorebirds feeding in littoral habitats in the Colville River Delta.

If development were to occur under Alternative B in areas of the Teshekpuk Lake Special Area that are unavailable to leasing under the No Action Alternative, a pipeline leak or other spill on terrestrial habitats could affect greater numbers of waterfowl under Alternative B than under the No Action Alternative because of the high concentration of nesting and molting waterfowl found in this area. Under Alternative B, Lease Stipulations K-1, K-3, K-4, and K-

6 would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast, within which permanent oil and gas facilities would be prohibited to help to mitigate potential effects of an oil spill on terrestrial habitats. Although Lease Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it could also help protect loon and waterfowl associated with lakes in the Deep Water Lakes Area.

Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe. Waterfowl along the shoreline or in marine habitats and shorebirds in the littoral areas of the Colville River Delta could be impacted during the fall molting and staging period. Under Alternative B, the potential that an oil spill would enter a major river or stream would be minimized by Lease Stipulation K-1. This lease stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines would not necessarily be prohibited in some of these areas. The No Action Alternative has lease stipulations with similar levels of protection.

4.4.8.3 Effectiveness of Stipulations and Required Operating Procedures

The primary reason for making 213,000 acres unavailable to leasing under Alternative B is to protect important habitat for caribou and molting geese, and medium to high-density concentrations of white-fronted goose which are found on 85 percent of this area (Map 3-14). However, other bird species would also benefit from protection of this area. For example, medium to high-density concentrations of pintails and shorebirds are found on 86 and 84 percent of this area, respectively (Maps 3-16 and 3-19). Approximately half the area contains medium to high densities of tundra swans and Pacific loons (Maps 3-10 and 3-13).

Numerous lease stipulations and ROPs were developed to protect birds and their habitat within the Planning Area. These include the “A” ROPs, which would be effective in ensuring that solid, liquid, and hazardous wastes did not impact birds or their habitats, and in reducing the potential for garbage to attract animals that may prey upon birds to exploration and development sites. The “B” ROPs would be effective in ensuring that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while the “C” ROPs govern seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP “F.” Several of the “K” lease stipulations would be effective in protecting birds and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area. Lease Stipulation K-4 provides for a number of effective measures designed to reduce the effects of development on molting geese by establishing setbacks from lake shorelines within which construction of permanent oil and gas facilities would not be permitted, regulating water extraction from lakes, and minimizing or eliminating disturbance from aircraft during critical periods. However, this lease stipulation also allows construction of facilities, such as platforms on lakes, if these structures are located more than ¾ mile from the shoreline. Activities at offshore platforms could increase disturbance to molting geese.

4.4.8.4 Conclusion

Under Alternative B, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be similar to those described under the No Action Alternative. The potential for these disturbances to impact birds would be greater under Alternative B because a greater percentage of the Planning Area would be available for leasing, including portions of the area of high bird use in the Teshekpuk Lake Special Area. A greater overall level of development would likely occur under Alternative B. The potential for habitat loss and alteration to affect tundra-nesting birds would be greater under Alternative B, as compared to the No Action Alternative, as the amount of tundra habitat that would be lost to gravel infrastructure would be greater, and there would be a higher potential for infrastructure to be located in areas of high bird use in the Teshekpuk Lake Special Area. The potential for bird mortality resulting from collisions with vehicles or infrastructure and marine vessel traffic would be greater under Alternative B because the amount of infrastructure and barge traffic would be greater. The potential for an oil spill to impact tundra-nesting birds would also be greater under Alternative B, as compared to the No Action

Alternative, given the increased amount of infrastructure and development activity. Lease stipulations and ROPs established under Alternative B would help to mitigate potential impacts to tundra-nesting birds.

In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive. However, once exploration and development/production ceased in an area, bird populations could recover from the effects of disturbance, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, and the potential for more oil and gas exploration and development activities, impacts to birds under this alternative would be about twice as great for oil and gas exploration activities, and 4 times as great for oil development activities, as compared to the No Action Alternative based on the amount of area disturbed. Potential impacts may be greater for brant than for other species due to their apparent inability to habituate to some types of disturbance (Derksen et al. 1992), their decreasing population size, and the potential for as much as 30 percent of the Pacific flyway population to use the Teshekpuk Lake molting area. Impacts could be even greater if oil and gas activities occurred in areas with high bird concentrations, with high quality habitat, or used by species of concern.

4.4.9 Mammals

4.4.9.1 Terrestrial Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Impacts to mammals from no-oil and gas activities would be similar to those discussed 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 likely be brief, lasting for a few minutes to an 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. Impacts from recreation and overland moves would be the same as under the No Action Alternative. Current management practices and lease stipulations addressing land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

Oil and Gas Exploration and Development Activities

Under Alternative B, oil and gas leasing and exploration would be allowed in the Planning Area, with the exception of the 213,000-acre area northeast of Teshekpuk Lake. In addition, lease stipulations would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, could potentially be greater under Alternative B than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and the overall scale of development would likely be greater under Alternative B.

Effects of Disturbances

Seismic. Impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative but would be greater in frequency and extent, given the greater number of 3-D seismic surveys and the larger area open to surveys. A larger 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. It is expected that the reactions of caribou and other terrestrial mammals to disturbance would be brief, although large numbers of wintering TLH caribou could be encountered, depending on the location. Some caribou and other large mammals would likely be displaced from the general area of the seismic work. Some terrestrial mammals would avoid seismic camps, while others, such as foxes, could be attracted to the camps by food odors. The potential for disturbance to hibernating bears would be greater under Alternative B because of the increased level of seismic activity occurring in the Planning Area. However, bears are present at low density. Muskox and moose would most likely be present in their greatest numbers in the southern portion of the Planning Area, so impacts would be similar as presented under the No Action Alternative, although the greater number of surveys would likely result in greater impacts. A greater number of lemmings and voles could be killed or disturbed by surface vehicles.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Under Alternative B, it is projected that the number of exploration wells and delineation wells drilled would be an intermediate number between the No Action Alternative and Alternative C. Impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative, but somewhat greater in extent and frequency, as more exploration would occur, particularly in the area to the northwest, south, and east of Teshekpuk Lake, which would be excluded from leasing under the No Action Alternative. Exploratory drilling would be conducted during the winter, when wildlife is largely absent, although wintering TLH caribou could be present in large numbers if more exploration activity occurred in the southern portion of the Planning Area. Exploratory drilling could also occur from pads and platforms in lakes in the TLCH Area during summer, potentially disturbing mammals found near this activity. Moose, muskox, and grizzly bears would experience a greater level of impacts than under the No Action Alternative.

The implementation of lease stipulations and ROPs should ensure minimal impacts to terrestrial mammals. These lease stipulations and ROPs would include provisions to avoid known grizzly bear dens by ½ mile, methods to avoid attracting wildlife to food and garbage, provisions to protect stream banks from damage during overland moves, provisions to minimize the effect of low-lying aircraft on wildlife (particularly over caribou winter ranges), and provisions to minimize the disturbance and hindrance of caribou in the TLCH Area.

Oil and Gas Development. Approximately 95 percent of the Planning Area would be made available for leasing under Alternative B. Leasing would be allowed throughout the Planning Area, with the exception of the 213,000-acre region northeast of Teshekpuk Lake.

The primary effects of oil and gas development on terrestrial mammals would be similar to those outlined under the No Action Alternative, and would result 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 habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of calving areas and interference in the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas. These impacts would likely be greater under Alternative B than under the No Action Alternative, given the larger development scenario that would affect approximately 235 to 3,480 additional acres of habitat (includes acres that could be indirectly lost due to alteration of plant species composition). Functional loss of habitat would be greater than the number of acres indicated, which is the actual development footprint. Wolfe (2000) suggested that when caribou in the CAH avoided areas within 2.5 miles of roads and pipelines, the functional habitat loss increased from 2 percent (the immediate footprint of roads and gravel pads) to 29 percent.

Construction of permanent roads within the Planning Area would increase access to the area and could increase public and subsistence hunting of terrestrial mammals. Caribou would be most impacted by increased access for hunting, but other species (moose in particular) may also be impacted depending on the location of permanent roads. The overall number of animals taken would be unlikely to increase dramatically since most hunting would be for subsistence, but roads could focus hunts in particular portions of the Planning Area. Hunting pressure and harvests have increased for many wildlife species near the TAPS since its construction, but have not produced adverse population effects (TAPSO 2001). It is unlikely that the more remote roads associated with oil and gas development in the Planning Area would have as great an effect on wildlife populations as occurred along the TAPS corridor.

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. If a field were developed in the area surrounding Teshekpuk Lake (excluding the portion unavailable to leasing), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH caribou for calving, insect relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH caribou, impacts to caribou could be greater under Alternative B than under the No Action Alternative. Overall, the level of impact would be dependent on the specific location of any oil field—a field in the central or southern portion of the Planning Area would not impact the TLH caribou calving grounds, although such a development could still affect migratory movements of TLH and WAH caribou as well as activities on their wintering ground.

Development in the TLH caribou calving grounds could displace some calving animals within 2½ miles of roads. Movements of some cows and calves across roads would also likely be reduced, and cow caribou might avoid crossing the roads during the calving season. Some TLH caribou movements during the insect-relief season (late June-August 15) would likely be affected by pipelines and road traffic. The critical part of the movement to the coastal insect-relief area is through the narrow corridor between Teshekpuk Lake and the Kogru River. This area would be open to leasing under Alternative B. Caribou must pass through these corridors to get to and from insect-relief areas. The area to the east of Teshekpuk Lake is a particular problem because nearly all of the parturient cows pass through this area either shortly before or after calving (Carroll Pers. comm.). Any development that occurs on the limited amount of habitat that is used by caribou migrating through this corridor would likely affect caribou movements. Development in the corridors could result from oil finds in the area of the corridors or from a pipeline that would come from petroleum fields north of the lake. Under Alternative B, the region northeast of Teshekpuk Lake would be excluded from leasing. However, pipelines could be allowed in the excluded area as a result of technological limitations, economics, logistics, or other factors. The result would be an increased potential for oil and gas development activities to affect caribou use of this corridor. Additionally, the area that would be excluded from leasing does not extend to the coast, except near Cape Halkett, suggesting that there could be some development along the coastline. While a set-back from the coast is stipulated (Lease Stipulation K-6), development in the coastal area would likely impact caribou use of insect-relief areas near the coast.

Traffic associated with hauling gravel from outside of the Planning Area could result in local disturbance and displacement of caribou within about 1 mile of the operations. A pipeline linking oil fields in the Planning Area with facilities at the Alpine and Kuparuk oil fields would result in the disturbance and displacement of some caribou during winter construction, due to vehicle traffic along ice roads and air traffic. It is expected that these disturbances would be short term and occur within about 1 mile of the pipeline corridor.

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 3-27). Unless an oil field were to be developed in the southern portion of the Planning Area, development would be unlikely to impact moose. Under Alternative B, impacts to moose would be similar to those discussed under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario under Alternative B.

If gravel were mined from the southern portion of the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could potentially destroy or degrade up to 30 to 230 acres of moose habitat if gravel borrow operations occur in the southern portion of the Planning Area.

Muskox

Muskox occur in low densities in the Planning Area, although they may be present year-round. 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. Under Alternative B, impacts would be similar to those under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario. Impacts would be greatest if development were to occur in the southern portion of the Planning Area.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, pump stations, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. Under Alternative B, impacts to grizzly bears would be similar to those that would occur under the No Action Alternative, although the extent and duration of impacts could be greater because of the larger overall development scenario, depending on the location of the field development. Grizzly bears are present at low densities in the northern portion of the Planning Area, but could be attracted to some activities. It is likely that the greatest number of bears would be encountered during development activities in the southern portion of the Planning Area, since the greatest amount of suitable habitat is located in this area.

Wolves

Under Alternative B, oil and gas development would have a minimal impact on wolves, similar to the No Action Alternative. Potential effects to wolves would 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 associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be affected. However, wolves are not abundant in the Planning Area.

Wolverines

The potential effects of oil and gas development on wolverines 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 could be sensitive to oil exploration and development activities and abandon habitat areas near oil development. If caribou abundance was affected by oil development, wolverines could be affected in turn. Alteration of riparian habitats through gravel excavation or pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Wolverines are present at low density in the Planning Area and sightings have been infrequent. Documented sightings and harvest locations suggest that wolverines could be encountered along rivers and in the vicinity of Teshekpuk Lake. Under Alternative B, some wolverines could be displaced near (within a few miles) oil field facilities. Impacts under this alternative are likely to be similar to or slightly greater than those that would occur under the No Action Alternative, given the larger overall development scenario.

Foxes

Under Alternative B, impacts to Arctic foxes would be similar to those discussed under the No Action Alternative, although they could be greater in duration and extent. Oil and gas development activities could affect Arctic foxes by increasing the availability of food and shelter. An increase in the fox population associated with oil development could 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 were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur.

Other Mammals

Small rodents and their predators would be affected locally (i.e., through 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 could increase local densities of ground squirrels. Under Alternative B, impacts to small mammals would be similar to slightly greater than those that would occur under the No Action Alternative, given the larger overall scale of the development scenario.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas. Pads, roads, and the airstrip could provide some insect-relief habitat for caribou, if left in place. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou, and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material's toxicity and the amount ingested by fox, this could cause mortality, though the numbers of fox killed would likely be very small.

Effects of Spills

The impacts of oil spills on terrestrial mammals are described under the No Action Alternative (Section 4.3.9; Mammals). Compared to the No Action Alternative, the risk of oil spills would be greater, but still small, under Alternative B, given the greater extent of development. Activities occurring in the vicinity of Teshekpuk Lake could increase the likelihood that a spill would reach the lake under Alternative B. The majority of impacts to terrestrial mammals would result from disturbance associated with spill clean-up activities rather than direct oiling.

Effectiveness of Stipulations and Required Operating Procedures

Numerous lease stipulations and ROPs were developed to protect mammals. These include the "A" ROPs, which have been developed to reduce the potential for direct mortality due to oiling, ingestion of toxic materials, or contamination of habitat, prey species, and forage species, and to reduce the attractiveness of industrial sites to predators that could result in elevated predator populations. Increased numbers of predators such as foxes may put personnel at risk, which could result in predator removal.

Lease Stipulation D-1 would prohibit exploratory drilling in lakes, streams, lakebeds, and active floodplains unless impacts to wildlife were minimal, while Lease Stipulation D-2 would be effective in minimizing surface impacts from exploratory drilling by limiting exploratory drilling to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee were to demonstrate that construction of permanent facilities was environmentally preferable.

Required Operating Procedure E-1 would be effective in protecting wildlife resources by requiring that all roads be designed, constructed, maintained, and operated to create minimal environmental impacts, while ROP E-7 would require that pipelines and roads be designed to facilitate caribou passage by elevating all aboveground pipelines at least 7 feet above the ground, burying pipelines, or providing ramps to facilitate caribou movements. In addition, ROP E-7(c) would require that a minimum distance of 500 feet separate pipelines and roads, when feasible. If fully implemented, these ROPs would be effective in reducing (but not eliminating) the 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.

Required Operating Procedure F-1 would minimize the effects of low-flying aircraft on terrestrial mammals by requiring an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges, limiting the number of takeoffs and landings in support of operations, and requiring aircraft altitudes of at least 2,000 feet AGL (except for takeoffs and landings) over the TLCH Area from May 20 through August 20. Assuming that aircraft operators were aware of the potential effects of aircraft on wildlife and took the appropriate actions to minimize those effects, disturbance impacts to terrestrial mammals could be effectively reduced.

Lease Stipulations K-5 and K-6 would require that the operator minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions of the TLCH Area and the Coastal Area that are essential for all season use, including calving and rearing, insect relief, and migration. These lease stipulations would require studies of caribou movement, would restrict exploratory drilling, would protect major land corridors, would require field design that takes caribou movements into account, and would require various ground and air traffic controls.

Conclusion

Under Alternative B, oil and gas leasing and exploration would be allowed anywhere in the Planning Area, with the exception of the 213,000-acre area northeast of Teshekpuk Lake. In addition, lease stipulations and ROPs would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, would be greater under Alternative B than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and that the overall scale of development would likely be greater under Alternative B.

Among the terrestrial mammal populations that could be affected by management actions under Alternative B are the TLH, WAH, and CAH caribou. Caribou could be exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction. The TLH caribou movements within calving, insect-relief, and wintering areas could be disrupted by oil development activities. Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities into caribou range. If a field were developed in the area surrounding Teshekpuk Lake (excluding the portion unavailable to leasing), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH for calving, insect relief, migration, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

Studies done over the last decade have indicated that TLH caribou show high fidelity to the calving area near Teshekpuk Lake and that caribou that calve in the traditional calving area have much higher calving success than caribou found outside the area. Collared caribou that are found within the currently protected areas (as identified in 1998 ROD) during calving season have much higher calving success than caribou found outside the areas. In surveys conducted since 1990, 147 out of 163 (90 percent) TLH caribou that calved successfully calved within these protected areas. Of the 178 caribou that were found within the protected areas, 83 percent calved successfully. Of the 59 cows that were found outside the protected areas during calving season, 25 percent calved successfully (Carroll 2003).

If the TLH is displaced from its calving area, as the CAH has been, or if caribou are impeded from reaching the calving area, recent surveys indicate that calving success would most likely be reduced. While there have been no experiments conducted with the TLH to determine whether oil development in the calving area would displace caribou or affect the productivity of the herd, caribou behavior during 1997 and 2001 suggest oil development in the TCH calving area could impact caribou. During 1996-97, most of the herd migrated much farther south than usual and many cows arrived late to the calving area. Only 8 of 21 collared caribou were found in the calving area during calving time and 6 of these calved successfully. Of the other 13 collared cows, only one calved successfully for an overall successful calving percentage of 33 percent. In 2001, heavy snow and a late snow melt-off slowed the migration and only 16 (44 percent) of 36 collared cows calved successfully. Calving success for collared cows that did make it back to the calving area in 2001 was much better (88 percent) than cows that did not make it back (10 percent). This suggests that if oil development takes place in such a way that it displaces caribou from the calving area or interferes with their ability to get to the calving area, it could have an effect on productivity and population numbers (Carroll 2003).

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH, impacts to caribou could be greater under Alternative B than under the No Action Alternative. The WAH caribou could be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could be locally affected by activities associated with oil and gas exploration and development. Impacts to mammals would be similar to those discussed 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, and a greater amount of habitat would potentially be permanently lost.

It is expected that impacts to terrestrial mammals in the vicinity of Teshekpuk Lake would be greater under Alternative B than under the No Action Alternative, particularly with respect to caribou calving and insect-relief habitat. Overall, impacts throughout the Planning Area would be greater under Alternative B, given the greater overall scale of the planned development. In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

The approximately 213,000 acres that would be unavailable to leasing are important to caribou migrating between calving and insect-relief areas and the wintering grounds. In addition, lease stipulations and ROPs have been developed to further protect caribou found near Teshekpuk Lake and using coastal environs.

4.4.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, the effects to marine mammals from non-oil and gas activities would be similar to those discussed under the No Action Alternative. Overland moves could disturb a small number of polar bears within approximately 1 mile of the vehicle train, and could potentially result in den abandonment and death of cubs. Additionally, a few ringed seals could be disturbed if overland moves occurred over floating, shore-fast ice.

Recreational camps could attract a small number of polar bears, increasing the potential for negative human-bear interactions. Defense of human life and property could result in the death of a small number of bears. Small fuel spills could occur under Alternative B. However, these small spills would not be expected to negatively impact marine mammal populations in or near the Planning Area. Under Alternative B, it is expected that the effects of non-oil and gas activities on marine mammals would be localized and short term.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under Alternative B, a small number of polar bears could be affected by seismic exploration occurring along the coast, although ROP C-1 would prohibit seismic activities within 1 mile of known or suspected polar bear dens or seal birthing lairs. The greater level of seismic exploration under Alternative B, as compared to the No Action Alternative, would slightly increase the likelihood that polar bears would be disturbed by these activities.

It is expected that aircraft traffic could potentially disturb marine mammals under Alternative B. The effects of aircraft disturbance would be similar to those discussed under the No Action Alternative, but could be greater in extent, given the greater number of pads and production facilities expected under Alternative B. Aircraft would generally fly at 1,050 feet AGL, minimizing the potential for disturbance to seals.

Under Alternative B, increased levels of exploratory drilling and development near the coast would increase the likelihood of displacing or attracting polar bears or causing den abandonment compared to the No Action Alternative. Female polar bears denning within approximately 1 mile of construction activity could be disturbed by vehicle traffic and construction noise, which could result in the abandonment of the den and the potential death of cubs. Polar bears could be attracted to drill sites by food odors and curiosity, increasing the potential for negative human-bear interactions, and the possible death of bears in defense of human life and property. As under the No Action Alternative, consultation between oil field developers and the USFWS would result in the use of nonlethal means of deterrence in most cases. The effects of exploration activities, including disturbance and potential spills, would depend on the scale and duration of the activity and could affect some marine mammals. However, numbers of marine mammals in the Planning Area are likely to be low, and high effects to marine mammal populations would not be expected.

Under Alternative B, ROPs and lease stipulations (as described under “Effectiveness of Stipulations and Required Operating Procedures” below) would prohibit the construction of permanent structures within ¾ of a mile of the coast, although exploration could occur in the area. The effects of exploration activities, including disturbance and spills, would be localized and would be unlikely to affect marine mammal populations. Individual polar bears could be affected by exploration activities. Seismic surveys in close proximity to polar bear dens could cause abandonment of maternity dens by polar bears; however, numbers of dens affected would likely be minor. Mitigation measures (e.g., use of a habitat classification system to identify den habitat, pre-activity Forward Looking Infrared Radar reconnaissance flights, use of scent-trained dogs to locate/validate dens, and a 1 mile den buffer), implemented through site-specific letters of authorization, would minimize the potential for disturbance.

Under the development scenario for Alternative B, the projected levels of development and related activities could be incrementally higher than under the No Action Alternative, given the larger area that would be available for leasing. Under Alternative B, higher levels of development would result in a greater potential for disturbance to marine mammals from increased aircraft, overland, and barge traffic used to transport supplies and modules for development. Materials and equipment likely would be moved to staging areas in the Planning Area using trucks over ice roads in the winter months. In this scenario, increased barge traffic during the summer could result in local and short-term displacement of whales and seals, and local and short-term changes in marine mammal behavior, as barges and sealifts passed the coastline. It is not expected that local and short-term changes in distribution or behavior would reach levels that could result in substantial impacts to individual marine mammals or populations, although the fitness of some individuals could be impacted if disturbance were to become chronic.

Under Alternative B, the effects of oil and gas leasing and development activities on marine mammals should be localized and short term, with minor impact on populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or introduced to the inclement weather prematurely, by activities within about a mile of their dens if these dens were not detected and avoided as required by ROP C-1.

Effects of Spills

Effects from a Large Spill. Under Alternative B, a large spill occurring near the Colville River could result in some oil reaching the marine environment. Some spotted seals and beluga whales could be exposed to oil, as under the No Action Alternative.

Little or no contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected to occur, because little oil would be likely to reach offshore feeding areas. Thus, as under the No Action Alternative, a spill in the Colville River Delta would not likely to have any negative food-chain effects on marine mammals.

Under Alternative B, polar bears could be vulnerable to a spill in the Colville River Delta during winter or during spring break-up. As under the No Action Alternative, the number of polar bears affected would likely be small and high effects to the polar bear population would not be expected.

Under Alternative B, as under the No Action Alternative, it is expected that few marine mammals would be affected by a large spill in the Planning Area.

Effects from Small Onshore Spills. As under the No Action Alternative, small onshore spills would not be expected to have effects on marine mammals unless the spills were to occur near and contaminate streams that enter the Colville River Delta, Fish Creek, Judy Creek, or the Kogru River. Spills reaching these waterways could impact a small number of ringed seals, spotted seals, or beluga whales. A small number of polar bears could also be affected, as under the No Action Alternative. Small onshore spills would not be likely to affect bearded seals, walruses, or gray whales occurring offshore of the Planning Area. In general, the effects of small onshore spills to marine mammals under Alternative B are expected to be localized and minor, with no or minor impact on species populations.

Effectiveness of Stipulations and Required Operating Procedures

Under Alternative B, performance-based lease stipulations and ROPs designed to mitigate impacts of oil and gas development on other resources would be implemented.

Required Operating Procedures that address waste prevention, handling, disposal, spills, and public safety would be effective in minimizing impacts to marine mammals from development in the Planning Area. These include ROP A-1, which would minimize the potential for food waste to attract polar bears, and A-7(b), which would prohibit the discharge of produced fluids into the marine environment, where currents and water depths, in combination with other conditions, would be inadequate to prevent impacts to known biologically sensitive areas.

Required Operating Procedure C-1 would be effective in protecting polar bear and other marine mammal (ringed seal) denning and birthing locations. Specifically, ROP C-1(b) would prohibit the cross-country use of heavy equipment and seismic activities within 1 mile of known or observed polar bear dens or seal birthing lairs. This ROP would also require operators to consult with the USFWS or NOAA Fisheries Service before initiating activities in coastal habitat between October 30 and April 15.

Lease Stipulation K-1(a) would require a 1-mile setback from the Colville River within the Planning Area. However, the Planning Area excludes conveyed Native lands along the lower reaches of the Colville River. Spotted seals and beluga whales use the Colville River Delta, but would not be effectively protected by Lease Stipulation K-1a, since the setback would not include the delta area.

Lease Stipulation K-1(e) would prohibit permanent oil and gas surface facilities within 3 miles of Fish Creek. Nuiqsut residents report that beluga whales are occasionally seen stranded in Fish Creek. A 3-mile setback would be highly effective in minimizing the potential for oil and gas leasing and development activities to negatively impact beluga whales in Fish Creek.

Lease Stipulation K-6 would prohibit the placement of permanent facilities within ¾ mile of the coast, except where technological limitations, economics, logistics, or other factors necessitated a structure. Under these circumstances, the use of a previously occupied site (Camp Lonely, Husky/USGS drill sites, and DEW-Line sites) would be considered. The elimination of new permanent facilities within ¾ mile of the coast should be effective in reducing the potential for disturbance to seals (spotted, ringed, and bearded) hauled out on beaches in summer, or hauled out on the ice during winter and spring. Lease Stipulation K-6 would also reduce the potential for disturbance to cetaceans that occur in nearshore habitats (gray whales and beluga whales) along the coast of the Planning Area. This lease stipulation would also be effective in reducing the potential for disturbance (displacement or attraction) of polar bears along the coast, reducing the likelihood that bears would be shot in defense of human life and property.

Conclusion

Under Alternative B, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would be short term and localized, occurring within 1 mile of aircraft corridors, survey activities, recreational camps, and overland moves.

Oil and gas leasing and development activities under Alternative B would likely cause a greater level of noise and disturbance, primarily near the Colville River Delta and inner Harrison Bay area than under the No Action Alternative. Effects should be localized (within 1 mile of aircraft corridors and activities) and short term (generally less than 1 year). Lease Stipulation K-6 would minimize the potential for development to impact ringed seals, spotted seals, beluga whales, and polar bears in a small area in Harrison Bay south of Atigaru Point, where activities could occur under the No Action Alternative. While exploration could occur in this area under Alternative B, the effects of seismic exploration would be limited to short-term, localized disturbance to denning or hauled out ringed seals, denning polar bears within approximately 1 mile of the activity, and displacement or attraction of non-denning polar bears.

A small number of ringed seals, spotted seals, beluga whales, and polar bears could be affected by oil spills entering the Kogru River, Colville River, or drainages that empty into the Colville River, Fish Creek, or Judy Creek. It is expected that any losses would be small.

The effects of development under Alternative B are expected to be somewhat greater than those under the No Action Alternative due to the greater amount of exploration and development projected to occur under this alternative. However, these effects would be short term, with few impacts on marine mammal populations. Since nearly all exploration and development activity would occur onshore under all alternatives, impacts to marine mammal resources under Alternative B would be similar to, or slightly greater than, those that could occur under the No Action Alternative.

4.4.10 Threatened and Endangered Species

This section discusses the potential effects to bowhead whale, and spectacled and Steller's eiders, which could result from management action in the Planning Area under Alternative B. Whales would be most affected by disturbance and oil spills. Most, but not all, activities that could potentially affect eiders in the Planning Area would be associated with oil and gas exploration and development. Other activities that could occur in the Planning Area include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. A more detailed analysis of effects to spectacled and Steller's eiders from Alternative B is provided in Appendix D (Endangered and Threatened Species Consultation and Biological Assessment).

4.4.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Bowhead Whale

Under Alternative B, effects to bowhead whale from non-oil and gas activities would be similar to those that would occur under the No Action Alternative, and would occur only when bowhead whales migrated exceptionally close to shore. Impacts from non-oil and gas activities would have no or minor impacts on individual bowhead whales or bowhead whale populations.

Effects on Spectacled and Steller's Eiders

Non-oil and gas activities that could affect spectacled and Steller's eiders under Alternative B would be the same as those listed under the No Action Alternative—private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. Under Alternative B, a larger area is available for permanent oil and gas development than under the No Action Alternative. However, the potential for non-oil and gas activities to disturb, displace, or cause mortality to eiders would likely be similar under the two alternatives. Lease stipulations and ROPs would effectively mitigate some of the potential effects of non-oil and gas activities on these threatened eider species.

4.4.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

The effects of oil and gas activities on bowhead whale would be greater under Alternative B than under the No Action Alternative, given the greater area that is available for development. It is not expected that vessel activity in Harrison Bay and other areas off the coast of the Planning Area would be greater under Alternative B than under the No Action Alternative, except for somewhat heavier barge traffic along the coast transporting equipment and supplies for development within the Planning Area. Effects to bowhead whales would only be expected if bowhead whales were to migrate exceptionally close to shore, coincident with barge traffic. Effects would be limited to short-term shifts of the southern edge of the migration corridor. It is not expected that such a shift would have much impact on individual bowhead whales or the population.

Spectacled and Steller's Eiders

Exploration. Because seismic surveys to collect geological data and exploration drilling activities would likely occur during the winter months when eiders are not present in the Planning Area, these activities would not directly affect eiders. Indirect impacts to eiders could potentially result from construction of ice-roads and ice-pads, and the associated water withdrawal. Under Alternative B, the potential effects of ice-road and ice-pad construction would be similar to those described under the No Action Alternative, and would involve the temporary alteration of tundra vegetation. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, potentially affecting nesting or brood-rearing eiders. Rolligons and tracked vehicles used during winter exploration could also temporarily affect tundra vegetation; however, the wet areas occupied by eiders might be less susceptible to vehicle damage than drier habitats. Since a larger area would be available to oil and gas exploration activities under Alternative B than under the No Action Alternative, the associated impacts to eiders could also potentially be slightly greater under Alternative B. Exploration activities would primarily affect the areas surrounding the portion of the Goose Molting Area closed to leasing under Alternative B. However, Lease Stipulation K-4 would effectively mitigate some potential impacts to eiders in the Goose Molting Area by prohibiting water extraction and other oil and gas-related activities that could affect feeding habitat along lakeshore margins.

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under Alternative B, the potential for increased predation of eiders by predators attracted to development would be effectively reduced by ROPs A-2 and E-9, and the overall effects would likely be similar under alternatives A and B. Although the No Action Alternative would not have a provision similar to ROP E-9, which would require the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes, this lease stipulation may not be relevant to the temporary storage of exploratory drilling and seismic equipment.

Development and Production - Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, use of heavy equipment, oil-spill clean-up activities, and aerial surveys to inventory wildlife or other resources, could cause disturbances that would affect eiders. Under Alternative B, the types of disturbances to eiders would be the same as those discussed under the No Action Alternative. These disturbances could result in temporary displacement from preferred foraging, nesting, or brood-rearing habitats, decreased nest attendance or nest abandonment, and increased energy expenditures that could affect physiological condition and rate of survival or reproduction. The likelihood for impacts to eiders would depend on the location of the disturbance, the number of eiders in the area, and the time of year.

The potential for disturbance to threatened eiders from activities on roads and pads would likely be greater under Alternative B, as compared to the No Action Alternative, because areas that support high spectacled eider concentrations occur in portions of the Goose Molting Area that would be available for oil and gas leasing under Alternative B, but not under the No Action Alternative. However, Lease Stipulation K-4 would help to effectively reduce potential disturbance to eiders in the Goose Molting Area by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities, provide for the protection of shoreline habitats adjacent to these lakes, and protect the goose molting lakes from oil and gas-related disturbances by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Lease Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which permanent oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This lease stipulation could also help to reduce the potential impacts to eiders in nesting, molting, or brood-rearing habitats in coastal areas.

Under Alternative B, as compared to the No Action Alternative, there would be a greater level of disturbance to eiders in a 5 to 6 mile wide band south and west of Teshekpuk Lake that would be open to surface activity under Alternative B, but closed under the No Action Alternative. Lease Stipulation K-5, designed to protect the Teshekpuk Lake Caribou Habitat Area, would also be effective in reducing disturbance effects to eiders by creating setbacks within which permanent oil and gas facilities would be prohibited, and by placing limits on various types of activities on roads and pads between May 20 and August 20.

Under Alternative B, there could also be a greater level of disturbance to eiders in the Deep Water Lakes Area south of Teshekpuk Lake, than under the No Action Alternative. Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the any fish-bearing lake. Under Alternative B, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish bearing lakes in the Deep Water Lakes Area could result in disturbance to eiders near the facilities and access roads. Although Lease Stipulation K-2 has been designed primarily to provide mitigation for deep-water fish habitat, it could also provide protection for eiders using habitats near these lakes.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of effects to eiders from aircraft would be the same under Alternative B as those that would occur under the No Action Alternative, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some eiders could either remain in habitats located near aircraft activities or move to nearby habitats.

Compared to the No Action Alternative, it is unlikely that there would be a greater amount of disturbance to eiders from aircraft activity under Alternative B, as a larger area would be available for oil and gas leasing in the Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity was prohibited under the No Action Alternative). Under Alternative B, Lease Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic, would be restricted. These lease stipulations would help to reduce potential aircraft disturbance to eiders, should oil and gas facilities be located within portions of the Teshekpuk Lake Special Area. However, if CPFs were located within the Teshekpuk Lake Special Area, the level of aircraft disturbance would likely increase along flight corridors and near airstrips located at these CPFs.

If a CPF were located within the ¼-mile buffer around lakes under Alternative B, there would likely be a greater amount of aircraft disturbance to eiders in the Deep Water Lakes Area. The degree of effects would depend on the number of eiders using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this lease stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to birds.

Watercraft. Several types of watercraft could be used during the summer to transport of equipment and supplies and to conduct oil spill response training drills. Summer barge traffic with the potential to temporarily displace molting eiders could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting eiders. There would be a greater likelihood for disturbance to molting eiders under Alternative B than under the No Action Alternative because much of the area adjacent to the coast would be open for leasing under Alternative B but unavailable for oil and gas development under the No Action Alternative. Therefore, it would be more likely that development would occur in portions of the Goose Molting Area, and that barge traffic would be required near this area for transportation of equipment and supplies during oil field construction and operation.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Under Alternative B, these activities would be more likely to disturb eiders than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of spectacled eider concentrations within the Goose Molting Area. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training to minimize potential disturbance to eiders would be identified.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in loss of eider habitat. During construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for eiders. Under the development scenario for Alternative B, the amount of habitat lost could range from 615 to 4,875 acres (includes acres that could be indirectly lost due to alteration of plant species composition). The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed.

In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect eiders in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative B, the types of effects to eiders resulting from temporary habitat loss would be the same as those discussed under the No Action Alternative. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by eiders. Lease stipulations and ROPs would help to mitigate potential effects of habitat loss to eiders.

Mortality. Eider mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment has been discussed under the No Action Alternative. Compared to the No Action Alternative, there would be an increased risk that eiders would collide with offshore barge and vessel traffic under Alternative B, because facilities could be constructed in portions of the wetlands north of Teshekpuk Lake that would be unavailable for leasing under the No Action Alternative. Given that the highest concentrations of spectacled eiders in the Planning Area occur in this area, the siting of facilities within this area would likely result in increased eider mortality due to collisions with oil field structures or equipment, relative to the No Action Alternative. Under Alternative B, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of eider collisions with oil field infrastructure could still be greater under Alternative B because the potential benefits of illumination of facilities might not be adequate to mitigate for the presence of facilities within or near areas of high eider concentrations.

Some predators, such as ravens, gulls, Arctic fox, and bears may be attracted to areas of human activity where they find anthropogenic sources of food and denning or nesting sites. The potential impacts of increased levels of predation on eiders resulting from increased numbers of predators that may be attracted to developed areas are discussed under the No Action Alternative. The potential types of effects of increased predation to eiders under Alternative B would be the same as those discussed under the No Action Alternative. Although both the No Action Alternative and Alternative B have lease stipulations in place to eliminate attraction of predators to anthropogenic sources of food, under Alternative B the lessee would be required to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. There is no equivalent lease stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

Bowhead Whales

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. The use of barges to remove materials from the Planning Area could also have localized impacts on bowhead whales if they were encountered during migration.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause impoundments of water that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, they would remain lost habitat for eiders. If they were revegetated without removing the gravel, the habitat would not return to its current utility. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what was in the area prior to disturbance. If foam insulating materials were used in pad construction, they could be broken up during removal. Fine particles of foam that were not removed from the environment could be ingested by eiders. Depending on the material's toxicity and the amount ingested, this could cause mortality, though the number of eiders killed would be small.

Effects of Spills

Bowhead Whale

There would be a greater potential for oil spills under Alternative B than under the No Action Alternative, given the larger area available for development and higher levels of development activity that would occur under Alternative B. However, it would still be unlikely that spilled oil would reach bowhead whale migration habitat. The southward edge of the migration corridor could be deflected northward due to any vessel activity associated with containment and clean-up activities occurring during the fall migration. However, impacts to individual bowhead whales or the whale population would be minor, except in the case of a very large spill coincident with the fall migration, which is very unlikely.

Spectacled and Steller's Eiders

Oil spills would have similar types of effects to threatened eiders under the No Action Alternative and Alternative B. However, there would be an increased risk of an offshore spill occurring under Alternative B because there would be more barge traffic. In addition, a pipeline leak or other spill in the Teshekpuk Lake Special Area could affect eiders under Alternative B; this area would be closed to leasing under the No Action Alternative. Under Alternative B, Lease Stipulations K-1, K-2, K-3, K-4, and K-6 would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast, within which permanent oil and gas facilities would be prohibited, to help reduce potential effects of an oil spill on eider habitats.

Oil entering rivers or streams could potentially spread into delta or coastal areas, where impacts to eiders could be more severe. Under Alternative B, Lease Stipulation K-1 would help to reduce the likelihood that an oil spill would enter a major river or stream. This lease stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines could be permitted in some of these areas. The No Action Alternative has similar lease stipulations, except that the Tingmiaksiqvik River is protected under Alternative B, but not under the No Action Alternative.

4.4.10.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, thereby minimizing the potential for effects to bowhead whales. These measures would also protect habitat and help to minimize disturbance to bowhead whales and eiders from oil and gas exploration and development activities. These measures should be equally, or more effective than the measures developed for the No Action Alternative.

The final Preferred Alternative incorporates many of the "K" Lease stipulations and establishes buffers around important goose molting lakes in the 213,000 acre portion of the Goose Molting Area that was unavailable to oil and gas leasing under Alternative B. In addition, the final Preferred Alternative establishes buffers around goose molting lakes located outside of the area protected under Alternative B. These buffers are established to protect important habitat for caribou and molting geese, and medium to high-density concentrations of white-fronted goose which are found on 85 percent of this area (Map 3-14). Other bird species, including threatened eiders, would also benefit from protection of this area. The highest density of spectacled eiders in the Planning Area occurs north of Teshekpuk Lake in the Goose Molting Area.

Numerous lease stipulations and ROPs were developed to protect birds and their habitat within the Planning Area. These include the "A" ROPs, which would be effective in ensuring that solid, liquid, and hazardous wastes did not impact birds or their habitats, and in reducing the potential for garbage to attract animals that may prey upon birds to exploration and development sites. The "B" ROPs would be effective in ensuring that water withdrawals do not impact lakes, or lake habitats, used by molting geese or threatened eiders, while the "C" ROPs govern seismic ground operations during spring and summer to prevent seismic activity-related disturbance to eiders during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP “F.” Several of the “K” lease stipulations would be effective in protecting eiders and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area.

4.4.10.4 Conclusion

Under Alternative B, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be the same as those that would occur under the No Action Alternative. The potential for these disturbances to impact spectacled and Steller’s eiders would be greater under Alternative B because a greater percentage of the Planning Area would be available for leasing, including portions of high eider use areas in the Teshekpuk Lake Special Area.

The potential for habitat loss and alteration to affect eiders would be greater under Alternative B than under the No Action Alternative, as the amount of tundra habitat that would be lost due to development would be greater, and there would be a greater potential for infrastructure to be located in areas of high eider use in the Teshekpuk Lake Special Area. The potential for eider mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic would also be greater under this alternative than the No Action Alternative. In general, impacts to eiders from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to eiders from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, the potential for more oil and gas exploration and development activities, impacts to eiders under this alternative would be about twice as great for oil and gas exploration activities, and two to four times as great for oil development activities, as compared to the No Action Alternative.

4.4.11 Cultural Resources

4.4.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Aircraft and watercraft traffic, scientific investigations (e.g., archaeological and paleontological surveys and excavation), summer camps, hazardous and solid waste material removal and remediation, overland moves, and recreation could cause effects to cultural resources. The effects of these non-oil and gas activities on cultural resources under Alternative B would be the same as those occurring under the No Action Alternative, except that the amount of area affected would be greater (approximately 387,000 acres) under Alternative B. There would be no difference in recreational use between the No Action Alternative and Alternative B. However, a greater amount of scientific work would occur in the Planning Area under Alternative B, and there could be greater amounts of ground activity associated with continued surveying and conveying of Native allotments and other management activities by the BLM. As a result, there would be a greater likelihood of effects to cultural resources in the Planning Area under Alternative B than under the No Action Alternative.

4.4.11.2 Oil and Gas Exploration and Development Activities

Under Alternative B, the amount of area available for exploration along a geological feature known as the Barrow Arch, which is anticipated to hold significant deposits of hydrocarbons, would be greater than under the No Action Alternative. This area is also a key subsistence resource area noted for caribou and birds, and is likely to have a high density of undocumented archaeological, historical, and traditional land use sites, in addition to the numerous documented cultural resources in the area. The risk of damage to known and undocumented cultural resources would increase with the greater level of activity in the region occurring under Alternative B.

Effects of Disturbances

Under Alternative B, the level of disturbance associated with oil and gas exploration and development activities in the Planning Area would be higher than the No Action Alternative due to the greater acreage available for leasing. However, because most of activities would occur during the winter months, the potential for effects to buried cultural resources would be minor. As discussed for the No Action Alternative, the likelihood of surface disturbance affecting surface cultural resources would be minor because of their isolated occurrence and because of the variety of lease stipulations and ROPs that would govern oil and gas exploration activities. At staging sites such as Camp Lonely and Inigok, where potentially ground-disturbing activities occur year-round, the greater intensity and duration of these activities occurring under Alternative B would likely have a greater risk of affecting known and undocumented cultural resources. Year-round staging activities could also occur at existing facilities at West Dock and Oliktok Point for sealift offloading and storage of modules.

Under Alternative B, the effects of possible disturbance would be the same as those occurring under the No Action Alternative. Efforts to supply necessary materials for construction of gravel pads, airfields, and roads at this scale could increase the likelihood of damage to known or undocumented cultural resources in the Planning Area. The excavation of gravel material for the construction of the permanent facilities would be the primary source of potential effects to cultural resources. One approach to protect cultural resources would be a “roadless” scenario in which pipelines would not have associated all-weather gravel roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only effects on cultural resources resulting from pipeline construction would be associated with the placement of VSMs, and would depend on the depth at which the VSMs were set. If buried pipelines were used, effects to cultural resources could occur during excavation, construction, and burial, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities.

Effects of Spills

Under Alternative B, the effects of oil spills on cultural resources would be the same as those that would occur under the No Action Alternative. In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would probably not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. Warm oil, however, could melt through the snow and ice and impact cultural resources buried near the surface. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur. Oil spills at cultural resource sites, either at the surface or buried, would make radiocarbon dating of that site problematic or impossible. The spilled oil would seep into organic materials used for radiocarbon dating such as charcoal, bone, and wood and contaminate them so that their radiocarbon dates could be inaccurate.

4.4.11.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative B, several lease stipulations and ROPs would minimize the effects of oil exploration and development activities on cultural resources. Required Operating Procedure E-13, which corresponds to Lease Stipulation 74 of the No Action Alternative, calls for a survey of resources prior to any ground disturbing activity. Required Operating Procedure I-1, which corresponds to Lease Stipulation 63 of the No Action Alternative, would be effective in reducing cultural and resource conflicts through an orientation program for personnel that would teach the importance of not disturbing archaeological resources, as well as sensitivity to community values, customs, and lifestyles. The “K” lease stipulations would require setbacks along rivers, streams, lakes, cabins, and the coast, providing effective protection to cultural resources in these areas. Lease Stipulations K-1, K-2, K-3 and K-7, which correspond to Lease Stipulations 24, 39, and 62 of the No Action Alternative, would effectively minimize the loss of cultural resources through setbacks from certain rivers, lakes, and areas where concentrations of subsistence cabins and campsites occur. Prior to any undertaking (i.e., ground-disturbing activities such as the construction of buried pipelines) on federal lands, the NHPA would require that an archaeological resource survey be completed. If cultural resources were identified during such a survey, BLM guidelines and policy would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Officer. In addition, the BLM is working with the NSB to establish a cabin and campsite registry and authorization program to provide for the long-term protection and management of traditional subsistence cabins on BLM-administered public lands. A Memorandum of Understanding outlining this program is provided in Appendix L.

4.4.11.4 Conclusion

The probability of impacts would increase under this alternative as compared to the No Action Alternative because of the increase in the amount of land that could be impacted. Effects to cultural resources from oil and gas activities could occur in leased areas of the Planning Area and would continue for the duration of operations through abandonment. Known cultural resources would not be affected, but the presence of undocumented cultural resources in the Planning Area cannot be discounted. Multiple sales over the available portions of the Planning Area increase the likelihood of effects to undocumented cultural resources.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). Activities that occur near these areas may have a greater likelihood of impacting cultural resources.

In general, impacts to cultural resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area and the potential for more oil and gas exploration and development activities, potential impacts to cultural resources under this alternative would be greater for oil and gas exploration and development activities, as compared to the No Action Alternative. Impacts could be greater, however, if oil and gas exploration and development activities occur in an area with a high concentration of cultural resources. These impacts would be effectively mitigated by lease stipulations and ROPs that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources, enforcement of lease stipulations and ROPs that prohibit collection of artifacts and require training of workers regarding avoidance of effects on cultural resources, and compliance with all federal laws, including the National Historic Preservation Act, requiring surveys for cultural resources in areas where ground-disturbing activities are proposed.

4.4.12 Subsistence

4.4.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, non-oil and gas-related activities requiring permits from the AO could be subject to the lease stipulations outlined in Appendix F, as well as any other applicable federal, state, and NSB regulations. Non-oil and gas activities would include air and watercraft use, scientific research and data collection, recreation, solid and hazardous waste removal and remediation, and overland moves. During baseline monitoring of subsistence species and other resources prior to possible lease sales, many of the scientific and data collection activities would be conducted at an increased intensity and for a longer period than usual.

Effects on Subsistence Species

The effects of non-oil and gas activities on subsistence species would be similar to those that would occur under the No Action Alternative. Activities would be, in most cases, of limited duration and magnitude, and effects on subsistence species would be limited to the immediate area of the activity. However, the duration, extent, and magnitude of effects could be greater under Alternative B than under the No Action Alternative. Under Alternative B, aircraft and watercraft traffic could increase during summer to support the activities (such as scientific research) that would be required prior to expanding lease areas, resulting in an increased affect to subsistence species through temporary and localized diversion, deflection, or disturbance of animals.

As baseline data are gathered preparatory to further lease sales under Alternative B, scientific research and data collection could increase as compared to the No Action Alternative. Clearance and inventory of cultural resources could increase in anticipation of further lease, development, and exploration activity in the Planning Area. Biological research and monitoring would increase to expand baseline data for future effects monitoring. The result of increased research and data collection would be temporary and localized diversion, deflection, or disturbance of subsistence species, including caribou, moose, wolf, wolverine, muskox, and spotted seals (USDOI BLM 2003).

Under Alternative B, there could be more recreation in the Planning Area than under the No Action Alternative, in response to publicity, but it would likely be limited to summer use of river corridors and existing areas. Recreation would result in a temporary and local effect on subsistence species.

Solid and hazardous waste removal and remediation, such as monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing and independent of additional lease availability. Under Alternative B, lease stipulations and ROPs would likely eliminate the need for further clean-up activity. The effect of solid and hazardous waste removal and remediation on subsistence species under Alternative B would be similar to those that would occur under the No Action Alternative. Over the short term, a localized deflection of subsistence species could occur. Long-term effects could include a decreased potential for contamination of subsistence species with the cleanup of waste sites.

Overland moves may increase in order to stage research camps and activities. Similar to the No Action Alternative, overland moves would occur only by permit and would be subject to lease stipulations and ROPs. These moves would be very rare, and would take place in the winter on frozen tundra, an adequate accumulation of snow pack, or on ice roads. Overland moves could temporarily deflect local subsistence species when they did occur.

Effects on Subsistence Harvest Patterns

Non-oil and gas activities that could affect subsistence harvest patterns include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. As discussed under the No Action Alternative, these activities could alter the availability of subsistence species in traditional harvest areas through direct interference with hunts. This direct interference could affect harvest patterns by requiring hunters to travel further because the subsistence resources are more wary than normal following a disturbance or are deflected from traditional harvest areas following the presence of vehicles, vessels, and aircraft. Nuiqsut residents noted in the *Alpine Satellite Development Plan EIS* that aircraft have diverted subsistence resources away from areas where hunters were actively pursuing them, directly interfering with harvests or causing harvests to fail (USDOI BLM 2004C). Increased travel distances would result in greater expenditures for fuel and equipment, as wear and tear on snowmachines, outboards, and four-wheel vehicles would occur.

Under Alternative B, aircraft could divert migrating or insect-avoiding caribou, as well as seals, walrus, and whales from subsistence use areas. In addition, there could be fewer animals taken during subsistence harvests under Alternative B because the available and desirable subsistence use area would be smaller. In addition, subsistence users could have to travel farther to harvest subsistence foods, resulting in more time spent in pursuit of subsistence species, increased fuel and time costs, and increased risk of equipment failure and meat spoilage. Nuiqsut subsistence users have repeatedly stated during scoping meetings that aircraft traffic reduces harvest access and success (Nukapigak 1998, Ahtuangaruak 2003, Kaigelak 2003, Olemaun 2003). The opening of areas to the north and west of Teshekpuk Lake could increase the amount of aircraft disturbance to subsistence species, relative to the No Action Alternative, thereby affecting Atqasuk and Barrow hunters. Under Alternative B, the effects of watercraft on subsistence harvest patterns would likely be the same as those discussed under the No Action Alternative.

The amount of scientific research and data collection associated with lease sales would likely be greater under Alternative B than under the No Action Alternative. Therefore, there would be an increased likelihood that these activities would affect subsistence harvest success. Research activities would predominately take place in the summer months. Aircraft-based biological surveys would have the greatest likelihood of affecting subsistence harvest patterns because they cover a large area, last a long time relative to other research activities, and are known to elicit responses from caribou and waterfowl. Archaeological, paleontological, and geological activities involving personnel walking on tundra would have some short-term effects on subsistence species.

Similar to the No Action Alternative, recreational users would likely frequent waterways used by subsistence hunters during the summer months, potentially causing resource conflicts. The effects of these conflicts on subsistence harvest patterns would likely be localized and of short duration. Since the amount of recreation that would occur would be more or less the same under the No Action Alternative and Alternative B, effects to subsistence harvest patterns would also be much the same.

As discussed under the No Action Alternative, solid and hazardous waste removal and remediation activities would have localized effects that would last for the duration of the activity. Evaluation activities would have little effect on long-term harvest patterns. Site cleanup and remediation activities could temporarily divert or disturb caribou, muskox, and grizzly and polar bears, but would have little effect on long-term subsistence harvest patterns.

Under Alternative B, it is possible that there would be more overland moves during the winter than under the No Action Alternative, which could result in greater deflection or diversion of caribou and harm to denned bears. The lease stipulation and ROPs would mandate procedures to protect denned bears and minimize impacts to caribou. Overall, the effects of overland moves on subsistence harvest patterns would likely be similar under the No Action Alternative and Alternative B.

4.4.12.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Under Alternative B, disturbances associated with oil and gas activities would be the same as those discussed under the No Action Alternative, but the effects on subsistence resources would be greater in magnitude, extent, and duration. Areas that would be unavailable for year-round occupation and development under the No Action Alternative would become available, and could be affected by oil and gas development. Development activity would last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation.

Subsistence Species

Should development proceed under Alternative B, the duration, severity, and extent of the effects of oil and gas development activities on subsistence species could be greater than under the No Action Alternative, as there would be a larger area open for year-round occupation and development, which would include ecologically sensitive areas that would not be open under the No Action Alternative. The amount of habitat loss and degradation would be greater under Alternative B than under the No Action Alternative. Oil and gas activities could divert caribou and waterfowl from normal habitat areas and deflect these species from normal migration routes until they were able to habituate to activities and infrastructure changes in these areas. Caribou might preferred habitats at times of nutritional or energy stress. Increases in fox populations associated with human activities could result in an increased risk for predation of molting geese. Changes in overwintering and seasonal fish habitat caused by oil development (e.g., turbidity, salinity changes, reduced dissolved oxygen, and possible spills) could harm fish populations. Some species, (e.g., wolves and wolverines) would avoid human activity, while others (e.g., bears and foxes) would be curious and could become nuisance animals.

Subsistence Harvest Patterns

Under Alternative B, oil and gas activities would occur over a wider area than under the No Action Alternative and could inhibit subsistence users from harvesting in their traditional use areas to a greater degree. Subsistence users tend to avoid areas of oil infrastructure and activity for the reasons noted in the No Action Alternative. Hunters from Barrow and Atqasuk would be affected by development north and west of Teshekpuk Lake, where numerous subsistence camps, cabins, and ice cellars are located. Nuiqsut subsistence users have stated during scoping meetings and public testimony that air traffic reduces harvest success. The opening of the areas north and west of Teshekpuk Lake could increase the amount of aircraft disturbance to subsistence species, as compared to the No Action Alternative. As discussed in Section 3.4.2 (Subsistence), Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass depend on TLH caribou as a subsistence species. If oil and gas activities were to deflect, divert, or reduce the TLH caribou population, harvest of caribou by area residents could be reduced until the caribou were able to habituate to the increased activity and infrastructure in the area. Oil and gas activities in the northeast portion of the Planning Area could affect Nuiqsut subsistence and activities, deflecting migrating caribou away from traditional harvest locations, reducing harvest access and success. If TLH caribou were to move outside of their normal migration routes, Anaktuvuk Pass could suffer a shortage of caribou, its main subsistence resource, until the normal migration route was resumed. A greater expenditure and risk on the part of the subsistence hunters from Anaktuvuk Pass would be required. In the past, when the herd has failed to pass near the community, hunters had to fly to other locations in search of subsistence food, increasing community stress and the time necessary for harvest success, as well as reducing the connection with traditional areas (SRBA 2003b).

Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine field and 27 percent occurred 6 to 15 miles from the Alpine field. Oil and gas development could divert subsistence users a distance of 5 to more than 25 miles from facilities. Given current high gasoline costs on the North Slope, this would add considerable cost to subsistence harvesters.

Nuiqsut, Barrow, and Atqasuk subsistence users harvest wolves and wolverines in the Planning Area. These species could be displaced by further development in the area (Brower 1997). Alternative B would have a greater effect on subsistence caribou harvests than the No Action Alternative because the areas of potential activity would be large, the duration of oil and gas activity in the area (approximately 40 years) would be longer, and the geographical extent of possible development (from the Colville River to the Ikpikpuk River) would be greater.

Waterfowl could be affected by activity in newly opened areas during construction, development, and production. Helicopter traffic and persons walking on tundra or gravel pads would be the most likely sources of disturbance to nesting and molting waterfowl (USDOI BLM and MMS 2003). Increases in predator populations near developed areas could cause locally severe nesting failures (Burgess 2000, Johnson 2000b). However, these effects should be relatively minor, geographically widespread, and occur during the relatively brief period when these animals are present in the area. Some aspects of oil and gas development could create new habitat favorable to waterfowl survival, such as reclaimed gravel pits, dust fallout, and water impoundments near roads (Johnson 2000a, b; McKendrick 2000; Ritchie and King 2000; Sedinger and Stickney 2000). A possible indirect effect of development in the Teshekpuk Lake area would be the placement of restrictions on harvests of waterfowl on the North Slope, the Y-K Delta areas, and along the Pacific Flyway (USDOI BLM and MMS 1998), in response to reduced waterfowl populations. These restrictions would reduce subsistence harvests.

Subsistence fish harvests take place in all seasons, primarily in freshwater rivers and lakes. Nuiqsut's primary harvest area for fish is located in the northeast quarter of the Planning Area, in the Colville River and its delta channels and near Fish and Judy creeks, where development is already in the planning stages. A loss or reduction in Nuiqsut's fish harvest would be a hardship for the community, as fish provide approximately one-third of all subsistence harvest by weight in the community. Barrow residents harvest fish during caribou harvest activities along the coast and in the Teshekpuk Lake and Chipp and Ikpikpuk rivers areas. Atqasuk residents fish in several lakes near Teshekpuk Lake and in the Chipp and Ikpikpuk rivers. Under Alternative B, exploration and development activities could impact fish harvest patterns; however, the lease stipulations and ROPs should be effective in protecting these resources to ensure subsistence harvests. Therefore, effects of Alternative B on subsistence fishing would not be much greater than the No Action Alternative.

As noted for the No Action Alternative, oil and gas development could inhibit subsistence harvesters' use of the traditional harvest areas, which could reduce harvest success; increase the cost, effort, and risk involved with subsistence harvest; increase the and wear and tear on equipment for harvesting subsistence foods; and reduce the enjoyment of eating traditional foods, should harvests be reduced.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following termination activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

Subsistence Species

As discussed under the No Action Alternative, the magnitude of the effects of a crude oil spill on subsistence resources would depend on the context of the spill, the area covered by spilled product, and the amount of time the product was in the environment before clean-up efforts commenced. Oil spills on snow or frozen tundra would be typically contained and cleaned up relatively quickly, regardless of the area covered. It might be impossible to completely clean spills into waterways in open water or broken ice conditions (USDOI BLM 2003). As there would potentially be more oil and gas activity occurring over a larger area under Alternative B than under the No Action Alternative, the likelihood that oil spills would affect subsistence species would be greater under Alternative B.

Crude oil spills could affect caribou and waterfowl populations if the oil were on the ground and over a large area. This type of event has occurred even at natural seeps at Cape Simpson and Fish Creek (Ebbley and Joesting 1943). It is likely that only a very large spill on land would have population level effects on terrestrial mammals and waterfowl. In the case of a small or large spill that did not enter waterways, the effects would be localized, although contamination could last several years (USDOI BLM 2003). Tundra vegetation could also be contaminated by oil spills, which could harm mammals eating the oiled vegetation or using it for nesting or bedding.

If oil were to be spilled in waterways in large volumes, waterfowl, fish, and marine mammals could be fouled, contaminated, or killed. In the case of a large spill, the effects could spread beyond the immediate vicinity of the spill, depending on the season. For example, during ice breakup, sheet flow could carry oil over a vast area, which could include nearshore and offshore waters. Small and large spills would not necessarily be immediately toxic to fish, but could contaminate them for years even in cleaned habitats (USDOI BLM 2003). Waterfowl and marine mammal populations could be affected by the death of animals from hypothermia caused by oiling, reactions to toxic components of spilled oil, and gastric distress resulting from attempts to clean themselves. In addition, scavengers feeding on their remains, such as foxes, could also be harmed.

Subsistence Harvest Patterns

Large spills could affect subsistence patterns by reducing populations of subsistence species, contaminating subsistence species or their habitats, or rendering resources as unfit to eat. These effects could reduce the amount of subsistence foods harvested, cause changes in traditional diets, increase risks and wear and tear on equipment if users were required to travel farther to obtain subsistence resources, and cause social stress due to the reduction or loss of preferred foods harvested in the traditional fashion. Effects on subsistence harvest patterns would be greater under Alternative B than under the No Action Alternative because oil and gas activity would likely occur over a larger area and the likelihood of an oil spill occurring would be greater.

4.4.12.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs are intended to protect subsistence resources to the same extent as the 1998 Northeast IAP/EIS ROD prescriptive lease stipulations under the No Action Alternative. Under Alternative B, oil exploration and development would be allowed over a wider area and in more sensitive areas and habitats than under the No Action Alternative; however, ROPs (e.g., ROPs H-1 and H-2) would be effective in minimizing conflicts between subsistence uses and oil and gas-related activities. During scoping, subsistence users stated that the proposed revision to the 1998 Northeast IAP is a breach of faith and that opening up more areas in the Planning Area would have severe negative effects on subsistence users from Barrow and Nuiqsut (Ahmaogak 2003).

Local municipal government and tribal governments generally have few paid staff and limited funding. Local government official and tribal leaders feel they are overtaxed when asked to provide meaningful input to BLM on permitted activities. These officials and leaders contend that the change from the prescriptive lease stipulations in the 1998 IAP to performance-based ROPs and lease stipulations similar to those in the Northwest IAP/EIS ROD would place them in the position of having to defend subsistence interests, because compliance is now defined in terms of meeting a management objective rather than meeting an absolute prescriptive standard. To effectively respond, they would have to further stretch their existing capabilities to review and comment on increasingly numerous industry proposals and their impact on subsistence.

The BLM holds that performance-based lease stipulations and ROPs would provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on on-going monitoring to insure that these procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

Effectiveness on Subsistence Species

Under Alternative B, several ROPs and lease stipulations would address subsistence species. Required Operating Procedure A-2 would be effective in seeking to avoid human-caused changes in predator populations (i.e., avoid attracting wildlife to food and garbage). Required Operating Procedures A-4 to A-7 would be effective in minimizing the impact of contaminants (spills) on wildlife and the environment and to protect subsistence resources. Required Operating Procedures B-1 and B-2 would be effective in maintaining populations of and habitat for fish and invertebrates.

Required Operating Procedure C-1 would be effective in protecting bear denning and birthing sites during overland moves. Required Operating Procedures C-2 to C-4 would be effective in protecting streams and prevent additional freeze down of deep-water pools harboring overwintering fish and invertebrates. Required Operating Procedure E-

1 would be effective in protecting subsistence use and access to traditional subsistence fishing areas and minimize the effects of oil and gas development on fish resources. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would be effective in maintaining free passage of marine and anadromous fish and to protect fish habitat as well as subsistence use and access to traditional subsistence fishing. Required Operating Procedure E-7 would be effective in minimizing disruption of caribou movement and subsistence use by elevating pipelines to a minimum of 7 feet as opposed to the 5-foot minimum in the 1998 Northeast IAP/EIS ROD. Required Operating Procedure E-9 would be effective in minimizing human caused increases in populations of species that prey on ground nesting birds. Required Operating Procedure E-10 would be effective in preventing migrating waterfowl from striking oil and gas related facilities during low-light conditions. Required Operating Procedure E-11 would be effective in minimizing the take of species listed under the Endangered Species Act (e.g., spectacled and/or Steller's eiders and yellow-billed loons) and minimizing disturbance to other species caused by interaction with oil and gas facilities.

Required Operating Procedure F-1 would be effective in minimizing the effects of low-flying aircraft on wildlife. Lease Stipulations K-1 and K-2 would be effective in minimizing the disruption of natural flow patterns; changes to water quality; changes to floodplain and riparian areas; and loss of fish spawning, rearing, or overwintering habitat through setbacks along rivers and around lakes. Lease Stipulations K-3, K-5, K-6, and K-7 would be effective in protecting fish and wildlife habitat and minimizing disturbance of caribou and alteration of migration patterns in the Teshekpuk Lake region and in coastal areas.

Effectiveness on Subsistence Harvest Patterns

In general, the ROPs and lease stipulations seek to protect specific resources by establishing spatial buffer zones around facilities and infrastructure, scheduling disruptive activities for periods with the least potential for conflicts with other users, making efforts to include community residents in project planning, monitoring effects on subsistence resources, and minimizing interference of oil and gas exploration and development activities and structures with subsistence resources and users. The effectiveness of these measures depends heavily on their ongoing implementation, enforcement, and local participation. Required Operating Procedure A-4 would be effective in minimizing the impact of contaminants (spills) on fish, wildlife, and the environment, and to protect subsistence activities and resources. Required Operating Procedure E-1 would be effective in protecting subsistence use and access to traditional subsistence hunting and fishing areas. Lease Stipulation E-3 would be effective in maintaining free passage of marine and anadromous fish and protect subsistence use and access to traditional subsistence hunting and fishing. Required Operating Procedure E-7 would be effective in minimizing the disruption of caribou movement and subsistence use by requiring that pipelines and roads be designed to allow the free movement of caribou and the safe and unimpeded passage of subsistence hunters. Ground pipelines would be elevated a minimum of 7 feet to facilitate wildlife passage and subsistence passage and access, ramps would be placed, after consultation with appropriate federal, state, and NSB regulatory and resource management agencies, in areas where facilities or terrain funnel caribou movement, and pipelines and roads would be separated by 500 feet where possible.

Required Operating Procedure F-1 would be effective in minimizing the effects of low-flying aircraft on wildlife, traditional subsistence activities, and local communities. This ROP is designed to minimize aircraft disturbance of caribou and bird populations and sensitive habitat areas, especially near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting). Required Operating procedures H-1 and H-2 are subsistence-specific mitigation procedures designed to provide opportunities for participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas-related activities including seismic exploration. Required Operating Procedure H-2 would define potentially affected cabins or campsites and would provide for additional consultation requirements for geophysical exploration beyond those required in ROP H-1. Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers to minimize cultural and resource conflicts with local inhabitants. Of special concern is aircraft use near traditional subsistence cabins and campsites during spring goose and fall caribou and moose hunting.

Lease Stipulations K-1 and K-2 would be effective in minimizing impacts to subsistence cabins and campsites and disruptions to subsistence activities by prohibiting permanent oil and gas facilities (e.g., gravel pads, roads and airstrips, and pipelines) through setbacks along/around the Colville, Ikpikpuk, Miguakiak, Kikiakrorak and Kogosukruk rivers, Fish and Judy creeks, and Deep Water Lakes areas. Lease Stipulation K-3 would be effective in protecting subsistence resources and access to the Teshekpuk Lake area by ensuring that there would not be unreasonable conflicts with traditional subsistence uses and access or impacts to seasonally concentrated fish and wildlife resources. Lease Stipulation K-6 would be effective in minimizing impacts to subsistence activities in coastal areas through a setback of ¾ of a mile from the coastline, to the extent practicable, as well as the use of previously occupied sites (e.g., Camp Lonely, various Husky/USGS drill sites and DEW-Line sites).

4.4.12.4 Conclusion

Most impacts associated with oil and gas development would be localized and would not substantially affect subsistence species, as long as the activities occurred outside of key habitat areas or migratory zones when animals were present, In addition, the ROPs and lease stipulations discussed above would be effective in protecting subsistence species and helping to resolve conflicts between the oil and gas industry and local residents as long as the BLM does not overly invoke exception clauses. Even in the best case scenario of species protection, however, subsistence users would still be constrained by the presence of oil and gas facilities from harvesting subsistence resources, would question the health of those resources, and would tend to harvest resources at least 5 miles from areas of development, increasing the distance hunters must travel with each new wave of development. The power imbalance in negotiations having to do with land use in the National Petroleum Reserve – Alaska would limit the efficacy of the consultation process in that rule changes and exceptions to lease stipulations and ROPs could be approved unilaterally by the BLM. Without a veto power, local governments, tribal councils, and non-government organizations could be limited in their ability to protect their communities' subsistence harvests, and feel less inclined to partner and cooperate with the BLM in land use and management in the National Petroleum Reserve – Alaska. As expressed in public scoping testimony, local residents are fearful for the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children.

4.4.13 Sociocultural Systems

4.4.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, the effects of non-oil and gas activities on sociocultural patterns would be greater than under the No Action Alternative. There would be a greater amount of scientific research and data collection undertaken prior to lease sales and as part of federal land management responsibilities. These research efforts and associated aircraft use could cause temporary and localized diversion or deflection of subsistence species for as long as the studies were under way. It is not expected that the amount of recreational and solid and hazardous waste removal and remediation would be greater under Alternative B, but more overland moves could be required to support scientific and other activities in the new areas available for leasing. Several families from Atqasuk, Barrow, and Nuiqsut use cabins, camps, caches, and other sites along the coast and inland to Teshekpuk Lake for subsistence activities. Use of this area helps maintain family connections and a feeling of relatedness and stability, which could be reduced by increased activity in the areas formerly closed to leasing. In general, effects from non-oil and gas activities under Alternative B would be temporary and localized, and would be unlikely to affect overall sociocultural patterns.

4.4.13.2 Oil and Gas Exploration and Development Activities

Oil and gas exploration, development, and production in the areas formerly unavailable for leasing north of Teshekpuk Lake and in areas outside the setbacks established in the lease stipulations and ROPs would require a seasonal network of ice roads, permanent gravel roads, runways, and pads, and a year-round corridor for pipelines and powerlines to each pad and production facility.

Effects of Disturbances

The kinds of effects on sociocultural patterns from disturbances caused by oil and gas activities under Alternative B would be the same as the No Action Alternative, but would be greater in intensity, area, and duration. Increases in the amount of area available for leasing and exploration would have a corresponding increase in the effects to subsistence harvests as compared to those for the No Action Alternative. The development proposed for the Planning Area would require increased staging and overland travel during the winter, and in summer would require increased use of aircraft for supplies, equipment, and crew changes, as compared to the No Action Alternative. In all seasons, noise, lights, personnel, and traffic near oil and gas-related infrastructure could temporarily deflect or divert caribou in areas where activities are occurring; however, gravel pads could attract caribou during some seasons as insect-relief habitat. These effects could change the distribution, timing, and location of the caribou harvest, which could require increased effort and expenditure on the part of subsistence hunters, resulting in sociocultural consequences such as increased stress and a decreased sense of well-being. Oil and gas development could divert subsistence users from facilities at distances from 5 to more than 25 miles. Given the high gasoline costs on the North Slope, this would add additional cost to subsistence harvests. Increased fuel costs and wear and tear on equipment would increase the need for wage labor to support subsistence pursuits and reduce the time available to pursue subsistence activities, which would result in sociocultural consequences, such as increased stress and a decreased sense of well-being. Increases in the speed, range, and reliability of outboards and snowmachines have facilitated the mixed subsistence and wage economy, but are unable to compensate for impacts to subsistence harvest activities from continued development and production activities in important subsistence harvest areas.

As discussed under the No Action Alternative, long-term change to sociocultural patterns would result from a weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under this alternative. These changes are already occurring to some degree on the North Slope because of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes the teaching of Iñupiat language and culture, the Arctic Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and successfully to prevent the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could occur over the long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and termination activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

The effects of oil spills would be the same as discussed in the No Action Alternative; however, under Alternative B there would be a greater likelihood that a spill event could occur with the potential to damage important habitats and subsistence use areas. Effects would vary in severity depending upon the timing and location of the spill event, but fish, waterfowl, and marine and terrestrial mammals could all be affected. An oil spill could result in contamination of subsistence resources and would be a threat to the health and lifeways of the affected communities. If a large oil spill occurred in a traditional use area, then subsistence users would have to travel further to harvest uncontaminated resources, which would result in high effects to sociocultural patterns as long as the residents believed that the subsistence resources were contaminated.

Activities associated with cleanup of an oil spill could have an effect on sociocultural systems. In the event that a large spill contacted and extensively oiled habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because it is expected that oil spills from activities would be small, chronic events and would normally be contained on the drill pad, effects from the spills themselves and potential disruptions from clean-up activities would be unlikely to cause excessive disturbance to sociocultural systems or the surrounding environment.

4.4.13.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs proposed under Alternative B would provide equivalent or greater setbacks from rivers and lakes than under the No Action Alternative, but would allow drilling within lakes outside those setbacks. While federal trust responsibilities would remain unchanged under all alternatives, during scoping, residents stated that the proposed lease stipulations and ROPs under Alternative B would be more permissive to lessees, and would diminish what local residents consider to be the BLM’s trust responsibilities in supporting and maintaining subsistence uses in the Planning Area. In their view, the BLM would be shifting the responsibilities for enforcing the lease stipulations and ROPs to other local, state and federal agencies (Ahmaogak 2003, Napageak 2003).

The BLM perspective on the effectiveness of mitigation measures differs significantly. The BLM proposes the new approach to mitigation measures in order to achieve equivalent protection as would occur under the No Action Alternative, while providing greater flexibility. The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision, while the new approach proposed for Alternative B is not well known or understood, and some local residents doubt that the new approach would provide equivalent protection. The flexibility of the new approach places greater reliance on close, on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers involved in Planning Area activities in order to effectively minimize cultural and resource conflicts with local inhabitants. This orientation program, as it relates to subsistence pursuits and cultural concerns, would: 1) provide sufficient detail to notify personnel of applicable lease stipulations and ROPs, as well as inform them about specific types of environmental, social, traditional, and cultural concerns that relate to the region; (2) address the importance of not disturbing archaeological and biological resources and habitats, and provide guidance on how to avoid disturbance; 3) be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas where personnel would be operating; 4) include information about avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation; and 5) include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low flying aircraft (e.g., aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall moose hunting seasons, and flights near North Slope communities).

4.4.13.4 Conclusion

New lease sales in the areas formerly unavailable to leasing north of Teshekpuk Lake could cause societal stress in Barrow, Nuiqsut, and Atqasuk. Construction and operation of oil facilities could discourage families from using and maintaining traditional camps, cabins, and caches in the affected areas, which could affect social organization and cultural values in these communities. Development in these areas would increase North Slope residents' concerns about encroachment and potential risks to subsistence resources in terms of access, availability, and contamination of caribou, fish, and waterfowl. Visits to traditional camps and cabins are a vehicle for transmitting traditional and family history and knowledge to younger generations, and the discontinuation of such visits would decrease social cohesion in these communities. In addition, as harvests decrease, resources would no longer be available in amounts suitable for sharing, resulting in changes to Iñupiat social organization and cultural values.

4.4.14 Environmental Justice

4.4.14.1 Activities Not Associated With Oil and Gas Exploration and Development

The non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. They could temporarily divert, deflect, or disturb subsistence species from their normal patterns. Non-oil and gas activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel further in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, and increased wear and tear on snowmachines, outboards, and four-wheel vehicles. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. Under Alternative B, these effects could be slightly greater than under the No Action Alternative, but would still be minor, temporary, short term, and generally highly localized.

4.4.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under Alternative B, disturbances caused by oil and gas activities would be the same as those discussed under the No Action Alternative, but their effects on subsistence would be increased in magnitude, extent, and duration. Areas that would be unavailable for year-round occupation and development under the No Action Alternative would be available for lease and year-round surface occupation under Alternative B, and could be affected by oil and gas development. Development activity could last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation. This time frame would likely represent the duration of effects for species unable to habituate to the oil and gas development activities.

Alternative B could have long-term effects on several terrestrial mammal species. In particular, effects on caribou herds would likely be greater than under the No Action Alternative (Section 4.3.9; Mammals). It is expected that effects on waterfowl harvested for subsistence would be more frequent and more widespread than under the No Action Alternative, given the greater area available for petroleum leasing. Little or no effect on marine mammals would be expected from onshore activities under Alternative B, but noise and disturbance associated with offshore barge and vessel traffic could impact bowhead whale migration patterns. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under Alternative B, as under the No Action Alternative, could cause local effects on fish populations. All of these effects would be experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation was completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

As discussed elsewhere, the magnitude of effects of a crude oil spill on subsistence resources would depend on the context of the spill, the volume and area covered by spilled product, and the amount of time the product was released before clean-up efforts commenced. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills directly into a water body, particularly in difficult to contain conditions such as breakup or broken ice, could spread widely and have effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). Potential effects on subsistence harvest patterns would be greater under Alternative B because oil and gas activity would potentially occur over a larger area in the Planning Area than under the No Action Alternative, and there would thus be a greater potential for oil spills. A major oil spill on the North Slope would result in effects that would impact Iñupiat subsistence users more than any other human group.

4.4.14.3 Effectiveness of Stipulations and Required Operating Procedures

The lease stipulations and ROPs for Alternative B would protect subsistence resources to the same extent as the lease stipulations under the No Action Alternative. Required Operating Procedures H-1 and H-2 would be highly effective in reducing conflicts between subsistence uses and oil and gas-related activities.

4.4.14.4 Conclusion

Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating in the National Petroleum Reserve - Alaska (SRBA 2003a, b). These effects would continue under Alternative B, and would be somewhat greater than under the No Action Alternative. Most effects of disturbance would still be short term, but the extent and magnitude would likely increase. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

4.4.15 Coastal Zone Management

4.4.15.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, non-oil and gas activities would be subject to all applicable lease stipulations and ROPs, as well as any other federal, state, or NSB regulations pertaining to the activities in question. These activities would be subject to permitting, and would include the activities noted in Section 4.2.1.1 (Activities Not Associated with Oil and Gas Exploration and Development) and evaluated for the No Action Alternative in Section 4.3.15.1 (Coastal Zone Management). As non-oil and gas activities are normal occurrences under existing BLM management practices, they would, in most cases, be of limited duration and magnitude, and effects on neighboring uses, primarily subsistence resources and harvest patterns of nearby communities, would be limited to the immediate area of the activity. Coastal Zone Management regulations would be adhered to.

4.4.15.2 Oil and Gas Exploration and Development Activities

As described in Section 4.3.15 (Coastal Zone Management) of this document, Section 307(c)(3)(B) of the CZMA requires applicants to certify that each of their activities that affects any land use or water use in the coastal zone complies with, and would be implemented consistent with, the state's coastal program. In the following discussion, ACMP standards for uses and activities are used to evaluate activities and effects that would occur under Alternative B. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale, affecting the accuracy of this assessment.

Effects of Disturbances

Coastal Development (11 AAC 112.200)

Water dependency is a prime criterion for development along the shoreline. The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine shores, lakeshores, and river waterfronts. Under Alternative B, almost the entire Beaufort Sea coast within the Planning Area would be open to leasing. Lease Stipulation K-6 would be highly effective in discouraging permanent oil and gas facilities within ¾ mile of the coast, and other ROPs and lease stipulations would address sensitive issues areas along parts of the coast and near deep-water lakes and major creeks and rivers.

Other lease stipulations and ROPs in place under Alternative B would further reduce the potential for conflicts with this policy around lakes and rivers. Specifically, ROPs and lease stipulations related to waste-prevention, handling, and disposal and spills; ice roads and water use; facility design and construction; abandonment; protections for subsistence and traditional use sites; and other activities restrictions would be effective in reducing conflicts, making Alternative B consistent with the statewide standard.

Natural Hazard Areas (11 AAC 112.210)

This statewide standard permits coastal districts and state agencies to identify and designate areas in which natural hazards are known to exist that may present a threat to life or property. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Flooding, earthquakes, active faults, tsunamis, landslides, volcanoes, storm surges, ice formations, snow avalanches, erosion, and beach processes in the Planning Area should be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). Alternative B would be required to comply with the statewide standard.

Coastal Access (11 AAC 112.220)

Districts and state agencies shall ensure that projects maintain and, where appropriate, increase public access to, from, and along coastal water. It is expected that Alternative B would be consistent with this standard, although the larger leasing area along the Beaufort Coast could lead to some conflicts with access opportunities, as compared to the No Action Alternative.

Energy Facilities (11 AAC 112.230)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent practicable, on 16 criteria within the energy facilities standard. Lease stipulations and ROPs in place under Alternative B would be effective in reducing conflicts, making the alternative consistent with the statewide standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained (11 AAC 112.230 (a) [3] and [14]). Under Alternative B, ROPs and lease stipulations would be effective in protecting biologically sensitive areas, although leasing would be permitted in coastal areas that would be off limits under the No Action Alternative. The NSB CMP also requires that transportation facilities and utilities be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under Alternative B would also be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats; Air, Land, and Water Quality; and Historic, Prehistoric, and Archeological Resources.

Utility Routes and Facilities (11 AAC 112.240) and Transportation Routes and Facilities (11 AAC 112.280)

These statewide standards require that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. Utility routes and facilities along the coast must avoid, minimize, or mitigate alterations in drainage patterns, disruption in wildlife transit, and blockage of existing or traditional access.

The NSB CMP contains several additional policies related to transportation and utilities that would be relevant to this analysis. All but one are best-effort policies, and are subject to some flexibility. Transportation development, including pipelines, which significantly obstructs wildlife migration, is subject to three conditions (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Interference with caribou movements would be temporary and brief under Alternative B; caribou migrations and overall distribution should not be affected. Lease stipulations and ROPs in place under Alternative B would be effective in reducing conflicts, making the alternative consistent with the statewide standard.

Transportation facilities would 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), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires consolidation of transportation facilities and utilities. Lease stipulations and ROPs required under Alternative B would be highly effective in reducing conflicts, making this alternative consistent with the statewide standard.

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 water features associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. Lease Stipulation K-6, in particular, would be effective in ensuring compliance with this standard.

Sand and Gravel Extraction (11 AAC 112.260)

The ACMP statewide standards indicate sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits if no practicable noncoastal alternative is available to meet the public need. Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Substantially more gravel could be required under Alternative B than under the No Action Alternative, but ROPs and lease stipulations would place restrictions on gravel mining locations and thus effectively reduce conflicts to ensure compliance with this standard and the NSB policies.

Subsistence (11 AAC 112.270)

The statewide standard for subsistence indicates a project within a designated subsistence use area must avoid or minimize impacts to subsistence uses of coastal resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under Alternative B, most of the Beaufort Sea coast would be open to leasing. As a consequence, access to subsistence resources could be more limited than under the No Action Alternative. Disturbances and oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals. The impacts would result in more difficult and somewhat reduced success at subsistence harvests for Barrow, Atqasuk, and Nuiqsut hunters. Subsistence-hunter concerns about access to resources, resource disturbance, and resource contamination would be greater than for the No Action Alternative. Lease stipulations would offer protection to subsistence resources and activities. Surface, air, and foot traffic near the oil fields would be expected to increase more than under the No Action Alternative and would potentially displace larger numbers of caribou, moose, muskox, grizzly bears, wolves, and wolverines. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects on caribou, potential conflict with the subsistence policies would be greater under Alternative B than under the No Action Alternative, although Alternative B would likely still comply with the statewide standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies would be somewhat greater under Alternative B than under the No Action Alternative.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in substantially decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities.

The development scenario under Alternative B predicts that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River potentially could affect the subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or causing subsistence users to perceive them as tainted. However, the number and size of oil spills estimated for Alternative B would still be small. It is anticipated that the potential for effects from spills and associated clean-up activities would be greater under Alternative B than under the No Action Alternative, but the impact on subsistence resources and harvest patterns would remain minor.

Conflict with policies to protect subsistence resources would be possible during the exploration, development, and production phases. Under Alternative B, ROPs and lease stipulations designed to protect subsistence resources, and to establish procedures and advisory bodies to address subsistence concerns, would be effective in minimizing policy conflicts. Therefore, Alternative B should be consistent with the statewide standard.

Habitats (11 AAC 112.300)

The statewide standard for habitats contains an overall standard policy, plus policies specific to nine habitat areas: offshore areas; estuaries; wetlands; tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes (including associated floodplains and riparian management areas); and important upland habitat. The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under Alternative B, fewer sensitive habitat areas would be excluded from leasing than under the No Action Alternative. However, applicable ROPs and lease stipulations would provide effective protection for fish, birds, and terrestrial mammals, and their habitats. Therefore, conflicts with the ACMP standards would be minimized to the degree possible, making activities under Alternative B consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to avoid, minimize, or mitigate significant adverse impacts to habitat resources. This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents or minimizes 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 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 ROPs and lease stipulations placed on permits. Alternative B ROPs and lease stipulations would be effective in reducing potential conflicts, and the activities would be consistent with the statewide standard.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid, minimize, or mitigate significant adverse effects.

It is expected that caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of aircraft overflights, but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would be greater under Alternative B than under the No Action Alternative and could displace some large mammals, though not enough to substantially affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to avoid, minimize, or mitigate significant adverse impacts to natural water flow; active floodplains; and natural vegetation within riparian management areas. Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in Section 11 AAC 112.260. The ROPs and lease stipulations in place under Alternative B would be effective in reducing conflicts, and would be consistent with the statewide standard.

Air, Land, and Water Quality (11 AAC 112.310)

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. North Slope Borough policies (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11) address water quality issues, and development must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). Under Alternative B, there could be some short-term conflict with these policies due to potential oil spills, which would likely to be more frequent under Alternative B than under the No Action Alternative. However, the ROPs and lease stipulations in place under Alternative B would be effective in reducing conflicts, and the alternative would be consistent with the statewide standards.

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 these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of drilling muds, cuttings, and fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA. The Alaska Oil and Gas Conservation Commission (AOGCC) has primacy for this program. Some wastes are disposed through the annulus of producing wells, an activity that is exempt from the Underground Injection Control program. However, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges of drilling muds, cuttings, and drilling fluids are closely regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. There would be no inherent conflict between the proposed activities of Alternative B and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (11 AAC 112.310, 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 B in Section 4.4.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Historic, Prehistoric, and Archaeological Resources (11 AAC 112.320)

The ACMP 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, including natural processes.

The NSB 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) also requires that development not disturb newly discovered historic or cultural sites prior to archaeological investigation. It is likely that new cultural and paleontological sites would be discovered under Alternative B. No conflicts with these policies would be expected; however, ROPs and lease stipulations would be highly effective by requiring an inventory of traditional use sites prior to conducting any activities. Therefore, Alternative B would be consistent with the statewide standard.

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 use sites. No conflict with these policies would be expected.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

Effects of Spills

Because of the interrelated nature of the ACMP and NSB CMP policies, the potential effects of spills were addressed with the effects of disturbances under each major policy area above.

4.4.15.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above should be sufficient for Alternative B to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZMP conflicts over the life of the alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but the scale of development and enforcement of applicable lease stipulations and ROPs should be effective in minimizing the conflicts and quickly returning the development to compliance with policies and standards.

4.4.15.4 Conclusion

It is expected that disturbance and oil spills associated with oil and gas activities would cause short-term and localized impacts to the TLH caribou and other terrestrial fish, birds, mammals, and bowhead whales and other marine mammals. In general, impacts to subsistence and other coastal zone resources from non-oil and gas activities, and from exploration and development activities, would be additive, except where these activities occurred in areas previously disturbed during exploration or development.

These impacts would likely be greater under Alternative B than under the No Action Alternative, as would subsistence-hunter concerns about access to resources and resource contamination. The greater degree of impacts would result from opening additional area to leasing in caribou, waterfowl, and fishing areas, and because the expected level of development would be greater. Conflicts with ACMP and NSB CMP policies related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Implementation of ROPs and lease stipulations would effectively ensure that Alternative B would comply with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between Alternative B and the policies addressed in this section.

4.4.16 Recreational Resources

4.4.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative B, impacts to recreation resources from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves would be very similar to recreation effects from the No Action Alternative that were addressed in Section 4.3.16.1 (Recreational Resources). The level of activities would likely increase as a result of higher levels of oil and gas exploration and development activities.

Temporary structures, vehicles, noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term effects on the experience of solitude, naturalness, or primitive/unconfined recreation. As under the No Action Alternative, the short-term impacts from Alternative B would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction of the activity (500 acres). All of the identified non-oil and gas activities would be transitory and short term; the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area would be small. If such activities were encountered, the recreation experience and opportunity for solitude on the North Slope would be diminished. Depending on the activity, there may be some increased likelihood of an encounter with recreationists because of the propensity to concentrate on major rivers and coastal areas.

A longer-lasting impact would be green trails resulting from overland moves. These trails do not necessarily develop over the entire route of an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They are typically more difficult to recognize from the ground. Vegetation can also be damaged along these trails from broken stems or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails. Because overland moves would be relatively constant from year to year and generally follow the same route(s), several thousand miles of intermittent green trail in some phase of recovery would likely be visible from the air during any one summer season. Though still relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

4.4.16.2 Oil and Gas Exploration and Development Activities

Under Alternative B, seismic work would occur throughout most of the Planning Area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Mobile seismic camps would consist of a train of trailer sleds pulled by tractors. These moving camps and associated noise and activities would result in a short-term effect on the primitive setting of the Planning Area and a loss of solitude and naturalness. The effects would be confined primarily to the activity site viewshed or noiseshed, or within approximately ½ mile in any direction. As many as five seismic operations could take place in a season, temporarily affecting approximately 2,500 acres. The potential effect on recreation opportunities and experience would be minimized by the fact that very little recreation takes place in the area.

A longer lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route; they would be visible for about 2 to 5 years. Assuming two to five operations per season for the first 10 years of the lease, the number of miles of intermittent green trails during any summer season could peak at several hundred to thousands of miles. The number of miles of trail visible would decline as this phase of exploration slows. Though relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of from 10 to 99 (75) exploration and delineation wells are anticipated under Alternative B. From one to five (three) wells would be drilled annually. Drilling would primarily occur over several winter seasons using ice pads, roads, and airstrips, although summer drilling could occur within lakes in the Teshekpuk Lake Caribou Habitat Area. Temporary on-site location of structures (e.g., drill rigs); noise from generators, vehicles, and aircraft; human presence; and associated activity all would have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences. These impacts would be expected to be greatest within a 2-mile radius of the drill site, which is 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 8,000 to 40,000 (24,000) acres. This would be equivalent to about 0.2 to 1 percent of the Planning Area and the potential effect on recreation opportunities and experience would be further minimized by the fact that most drilling occurs during winter when very little recreation takes place in the area.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating 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 would be 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 noticeable from the air for 2 to 5 years and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken, especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, and that half of the sites are vacated, approximately 250 to 2,500 (1,875) acres would be in various states of recovery.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

Two to 16 (12) production pads, 110 to 220 (220) miles of pipeline, and zero to two (one) staging bases are anticipated under Alternative B. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad or staging area site (or an area of about 8,000 acres).

Pipelines also would impact recreation values. Pipelines would be elevated a minimum of 7 feet above the ground surface. There would be little if any pipeline associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines would be expected to be minimal beyond about ½ mile. This equates to about 640 acres per mile of pipeline. Impacts to recreation values from a staging base would be similar to those resulting from a production pad and its facilities, or about 8,000 acres impacted per staging base. Accordingly under this alternative, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of 244,800 acres (i.e., [8,000 acres/pad x 12 pads] + [8,000 acres/staging base] + [640 acres/mile x 220 miles of pipeline]). This would be equivalent to about 5 percent of the Planning Area. Short-term, routine/daily inspection flights also would impact solitude and naturalness along the length of all pipelines as long as they are in use. The potential effect on recreation opportunities and experience would be greatest for development activities because it would entail year-round activity and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nevertheless, the effects would be expected to be minor because they would impact only a small portion of the Planning Area and because there is such a small amount of recreation use in the area. The actual effects would depend greatly on where development fields were located relative to major watercourses and the Beaufort Sea coast. The area subject to recreation effects from development under Alternative B would be approximately 2½ times the affected area under the No Action Alternative.

Future potential for formal wilderness or wild and scenic-river designation would likely be reduced in limited areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills 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, effects on solitude, naturalness, or primitive and unconfined recreation opportunities resulting from spills likely would be confined to the same area described above as impacted by the development.

A large spill that would reach a river, especially the Colville River, and move rapidly downstream would have substantial short-term (and possibly long-term) impacts on recreation values. Under Alternative B, outstandingly remarkable river values along the Colville River would not receive any special protection under the Wild and Scenic Rivers Act, although buffer areas are included in applicable ROPs and lease stipulations for other reasons. As such, management activity near the Colville River (and other major watercourses) would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any major impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude wilderness or wild and scenic river designations in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 6 percent of the Planning Area under Alternative B, about 2 times the area that would be similarly affected by the No Action Alternative. In addition, there could be portions of the area that were explored unsuccessfully that would experience lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.3 million acres (94 percent) of the Planning Area would likely retain substantial wilderness values. For perspective, the Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The “outstandingly remarkable values” that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with Alternative B, primarily from an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near the pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river’s outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable lease stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite “free flowing” nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the “outstandingly remarkable values” noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.4.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the lease stipulations and ROPs do not specifically address recreation activities and there is no current intention to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the performance-based lease stipulations and ROPs required for development of Alternative B would serve to protect recreation values in the area. For example, areas excluded from leasing and several ROPs and lease stipulations address protection of subsistence values and wildlife in the Planning Area. Also, buffer requirements serve to minimize potentially damaging activity in and near creeks, rivers and lakes. Since wildlife viewing, big game hunting and boating are major factors attracting recreationists to the Planning Area, these lease stipulations and ROPs associated with Alternative B also serve to protect and preserve recreation values.

4.4.16.4 Conclusion

There would be approximately 2,000 to 3,000 acres in temporary effects on recreation values from activities other than oil and gas exploration and development. Short-term, temporary effects from ongoing oil and gas exploration activities would impact approximately 8,000 to 40,000 (24,000) acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 1,875 acres. Seismic operations would result in many hundreds to thousands of miles of green trails. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities would not accumulate.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunities over an area of approximately 244,800 acres (or 5 percent of the Planning Area) for the life of production fields and pipelines. The area subject to recreation effects would be approximately 2½ times the level of effects for the No Action Alternative. Lease stipulations to mitigate for these impacts would be similar for both alternatives. In general, impacts from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped.

4.4.17 Visual Resources

4.4.17.1 Activities Not Associated with Oil and Gas Exploration and Development

Under Alternative B, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than introducing something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more than a few hundred feet away.

4.4.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative B, the impacts from exploration would be the same as those under the No Action Alternative, except that more exploration and delineation wells would likely be drilled, and some drilling could occur during summer in lakes in the Teshekpuk Lake Caribou Habitat Area. The number of exploration and delineation wells would range from 10 to 99 (75), and the number of drilling rigs would range from one to five. Therefore, the area of long-term disturbance associated with the new wells would range from 100 to 990 (750) acres (a 10-acre footprint per well). Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow-covered landscape. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails—a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a "ring effect" around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, from 500 to 4,950 (3,750) acres would be in various states of recovery from greening and ring effects under Alternative B. Because greening and ring effects visually modify existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would also leave behind a marker pipe, which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from several hundred feet.

Effects of Development

Production rigs (up to nine with an average height of 208 feet under the No Action Alternative) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also introduce strong contrast to the natural browns landforms and greens of the vegetation. In addition, burn-off flares and general work lighting would contrast against the dark night sky. Drill rigs, because of their height and color, could be seen and dominate the attention of the casual observer if they were located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from staging bases, pads, roads, airstrips, gravel pits, and CPFs would range from 140 to 1,570 (1,120) acres. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

The number of pipeline miles would range from 110 to 220 (220), impacting up to 1,320 acres (5 to 6 acres per mile). There would be no on-the-ground activity associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 7 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, the pipeline would attract and dominate the attention of the casual observer if located within the Foreground-Middleground Zone.

Other facilities associated with development would include gravel mine sites, bridges, roads, airstrips, and communications towers. Disturbance associated with gravel mine sites would generally occur below the ground surface, with only stockpiled materials being visible aboveground. While these sites could be large in size or footprint, very little material would remain as stockpile at any one time. If located within the Foreground-

Middleground Zone, only bridges, because of their contrast with smooth water bodies, and communications towers, because of vertical height above the horizon, would be likely to attract the attention of a casual observer.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.4.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no ROPs and lease stipulations specific to visual resources, ROPs and lease stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under Alternative B. In addition, approximately 213,000 acres would be closed to leasing and development, further protecting visual values to the northeast of Teshekpuk Lake.

4.4.17.4 Conclusion

Under Alternative B, visual impacts would be greater than those under the No Action Alternative, because a smaller area (approximately 213,000 acres) would be closed to leasing and development northeast of Teshekpuk Lake, and there would be more overall exploration and development. Several thousand miles of seismic lines and up to 5,000 acres associated with exploratory drilling could be in various states of recovery from greening and ring effect. An additional 750 acres of disturbance would be associated with drilling sites each winter. It is anticipated that up to 220 miles of pipeline would be constructed under this alternative, creating surface disturbance of approximately 1,320 acres. There could also be approximately 1,120 acres of disturbance associated with staging bases, pads, roads, airstrips, gravel pits, and CPFs. In general, impacts to visual resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. However, once exploration and development/production ceased in an area, visual resources could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area and the potential for more oil and gas exploration and development activities, impacts to visual resources under this alternative would be about twice as great for oil and gas exploration activities, and four times as great for oil development activities, as compared to the No Action Alternative.

4.4.18 Economy

4.4.18.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the Alternative B, there would be recreational employment that would generate approximately 30, 1-week long float trips per year. This is equivalent to one person working for 8 months.

4.4.18.2 Oil and Gas Exploration and Development Activities

Under Alternative B, the most important economic effects would be increased revenues and employment. Increased property-tax revenues and new employment would be created by constructing, operating, and servicing of facilities associated with oil and gas activities.

As explained in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), scenarios were developed based on the assumption that oil prices would range between $20 and $30 per bbl (in constant dollars), with a more likely long-term average of $25 per bbl. Revenues and employment are estimated based on these three scenarios. At $25 per bbl, peak annual oil production is projected to be 68 million barrels (Table 4-5). Based on the latest information from the Alaska Department of Revenue, the ANS West Coast price of oil averaged $25.64 per barrel from March 1999 to March 2004. The Department's revenue forecast assumes that, over the long-term, oil prices will average $22 per barrel, which is the lower end of the price range (of $22 to $28 per barrel) by which OPEC determines its production quota policies (ADR 2004a). In early October 2004, the price of oil was near $50 per bbl.

The number of workers needed to operate oil and gas infrastructure would be determined by the scale of the infrastructure rather than the amount of oil or gas produced. A wide range of production volume would be handled by a given level of infrastructure. Under Alternative B, once the infrastructure was in place, the number of workers needed to operate a facility would be independent of the amount of product flowing through it. The economic effects of oil activities would include employment generated by exploration, development, and production. State and NSB property-tax revenues would be directly proportional to the value of onshore facilities. State royalty income and state severance tax revenues would be proportional to production.

Effects on Revenues

Tables 4-10, 4-11, and 4-12 show projected property tax revenues for the NSB and State of Alaska, royalties for the NSB, State of Alaska, and the federal government, and severance taxes for the State of Alaska at $20, $25, and $30 per bbl, respectively. Potential revenues would be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist.

The State of Alaska depends heavily upon oil royalties and taxes to fund its annual operating budget. Approximately 80 percent of the state's general fund unrestricted revenues are derived from petroleum revenue, and 35 percent or more of all state revenues are derived from the oil industry (ADR 2003b). Royalty tax payments from within the National Petroleum Reserve – Alaska are treated differently than those from other state or federal lands. Federal law establishes a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska.

The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough, and is subject to local property tax limitations. The 2002 property tax rate for the NSB was 18.5 mills (ADCED 2003), leaving the state portion of the property tax at 1.5 mills. The NSB faces a declining property tax base because of depreciation of petroleum-production facilities that comprise most of the assessed valuation. Alternative B would help expand assessed property valuation and resultant taxes to the NSB.

An estimate of the potential property tax revenues that would be generated under Alternative B can be calculated using a unit factor estimate of $0.50 per barrel (ADR 2003b). The estimated property taxes using the per barrel unit factor for $20, $25, and $30 per bbl of oil are shown in Tables 4-10, 4-11, and 4-12.

Effects on Employment

Under Alternative B, the gains in direct employment would include jobs in petroleum exploration, development, production, and related activities. Tables 4-13, 4-14, and 4-15 show the employment effects by place of residence at $20, $25, and $30 per bbl of oil, respectively. Employment is expressed as annual average jobs by place of residence for each phase of activity.

The employment effects were calculated using a model developed by Northern Economics, Inc. The model incorporates exploration, development, and production activities and expenditures associated with Alternative B at the different oil price scenarios. Employment multipliers were derived using an input-output model of the state economy. The employment effects shown in the table represent the number of potential direct, indirect, and induced jobs that would be held by NSB residents and resident workers from the rest of Alaska (does not include out-of-state workers). The regional breakdown of employment by place of residence was based on the Northwest IAP/EIS.

Table 4-10. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative B at $20 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
2	$6.475	$0.525	$8.448	$8.448	$16.897	$25.340
3	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
4	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
5	$8.788	$0.713	$11.466	$11.466	$22.931	$34.390
6	$8.788	$0.713	$11.466	$11.466	$22.931	$41.268
7	$7.863	$0.638	$10.259	$10.259	$20.517	$36.924
8	$6.938	$0.563	$9.052	$9.052	$18.104	$32.580
9	$6.013	$0.488	$7.845	$7.845	$15.690	$28.236
10	$5.550	$0.450	$7.241	$7.241	$14.483	$26.064
11	$4.625	$0.375	$6.035	$6.035	$12.069	$21.720
12	$4.163	$0.338	$5.431	$5.431	$10.862	$19.548
13	$3.700	$0.300	$4.828	$4.828	$9.655	$17.376
14	$3.238	$0.263	$4.224	$4.224	$8.448	$15.204
15	$3.238	$0.263	$4.224	$4.224	$8.448	$15.204
16	$2.775	$0.225	$3.621	$3.621	$7.241	$13.032
17	$2.313	$0.188	$3.017	$3.017	$6.035	$10.860
18	$2.313	$0.188	$3.017	$3.017	$6.035	$10.860
19	$1.850	$0.150	$2.414	$2.414	$4.828	$8.688
20	$1.388	$0.113	$1.810	$1.810	$3.621	$6.516
Total	$99.900	$8.100	$130.346	$130.346	$260.692	$441.640

The estimated royalties and severance payments are based on currently available information on the tax structure for the National Petroleum Reserve – Alaska.[1] The model incorporates the projected production schedule for oil, and the assumed wellhead values under Alternative B.

During the last decade, between 22 and 29 percent of Alaska's oil industry workers have been nonresidents of Alaska (Fried and Windisch-Cole 2003). These workers, who commute to residences outside the state, would not generate any significant induced employment in the local economy of the NSB and would have a negligible effect on the economy of the rest of the U.S.

"Direct employment" refers to jobs directly involved in oil and gas exploration, development, and production. "Indirect employment" refers to jobs that support exploration development and production activities. Examples of indirect jobs include helicopter pilots and mechanics on the North Slope, as well as jobs involved with providing

[1] Federal Royalty Rate is 16.67 percent; Oil Severance Tax Rate is 12.5 percent for the first 5 years and 15 percent for later years.

food to workers on the North Slope. Both direct and indirect workers spend a part of their earnings for food, housing, clothing, etc. The additional jobs created by this spending are referred to as "induced employment."

During the exploration phase, the potential number of direct, indirect, and induced jobs generated for North Slope residents would be five jobs at $20 per bbl, 35 jobs at $25 per bbl, and 46 jobs at $30 per bbl of oil. The range of potential jobs for the rest of Alaska during the exploration phase would be from 94 at $20 per bbl to 915 at $30 per bbl of oil.

Table 4-11. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative B at $25 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$4.625	$0.375	$8.118	$8.118	$16.237	$24.350
2	$6.475	$0.525	$11.366	$11.366	$22.731	$34.090
3	$12.950	$1.050	$22.731	$22.731	$45.462	$68.180
4	$22.192	$1.799	$30.280	$30.280	$60.560	$88.729
5	$32.287	$2.618	$44.048	$44.048	$88.096	$129.070
6	$37.016	$3.001	$50.482	$50.482	$100.964	$174.702
7	$43.746	$3.547	$59.660	$59.660	$119.321	$206.466
8	$45.748	$3.709	$62.405	$62.405	$124.810	$215.974
9	$45.748	$3.709	$62.405	$62.405	$124.810	$215.974
10	$43.746	$3.547	$59.660	$59.660	$119.321	$206.466
11	$39.655	$3.215	$54.127	$54.127	$108.253	$187.344
12	$37.016	$3.001	$50.482	$50.482	$100.964	$174.702
13	$33.013	$2.677	$44.992	$44.992	$89.985	$155.686
14	$28.922	$2.345	$39.459	$39.459	$78.917	$136.564
15	$25.557	$2.072	$34.869	$34.869	$69.739	$120.682
16	$22.192	$1.799	$30.280	$30.280	$60.560	$104.800
17	$20.191	$1.637	$27.536	$27.536	$55.071	$95.292
18	$18.189	$1.475	$24.791	$24.791	$49.582	$85.784
19	$16.188	$1.313	$22.046	$22.046	$44.092	$76.276
20	$14.098	$1.143	$19.257	$19.257	$38.514	$66.662
21	$12.097	$0.981	$16.512	$16.512	$33.025	$57.154
22	$11.459	$0.929	$15.612	$15.612	$31.225	$54.020
23	$8.094	$0.656	$11.023	$11.023	$22.046	$38.138
24	$7.368	$0.597	$10.079	$10.079	$20.157	$34.898
25	$4.729	$0.383	$6.434	$6.434	$12.868	$22.256
26	$3.828	$0.310	$5.401	$5.401	$10.802	$18.804
27	$3.190	$0.259	$4.501	$4.501	$9.002	$15.670
28	$2.727	$0.221	$3.689	$3.689	$7.378	$12.748
29	$2.002	$0.162	$2.745	$2.745	$5.489	$9.508
Total	$605.046	$49.058	$834.990	$834.990	$1,669.981	$2,830.989

Total NSB resident employment during the development phase would range from potentially 156 jobs at $20 per bbl to 510 jobs at $30 per bbl of oil. For the rest of the state, there would be a potential for 2,219 jobs at $20 per bbl, 5,082 jobs at $25 per bbl, and 7,265 jobs at $30 per bbl of oil.

Fewer jobs would be generated during the production phase than during the development phase. Potential jobs for NSB residents would range from 17 jobs at $20 per bbl to 64 jobs at $30 per bbl of oil. For the rest of Alaska, the production phase would potentially generate 793 jobs at $20 per bbl, 2,067 jobs at $25 per bbl, and 2,942 jobs at $30 per bbl of oil.

Table 4-12. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative B at $30 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$6.013	$0.488	$13.263	$13.263	$26.525	$39.780
2	$8.788	$0.713	$19.384	$19.384	$38.768	$58.140
3	$18.038	$1.463	$39.788	$39.788	$79.576	$119.340
4	$30.286	$2.456	$53.876	$53.876	$107.752	$156.816
5	$43.108	$3.495	$76.653	$76.653	$153.306	$223.098
6	$49.503	$4.014	$86.450	$86.450	$172.900	$294.342
7	$59.296	$4.808	$105.416	$105.416	$210.832	$360.660
8	$61.209	$4.963	$108.919	$108.919	$217.839	$372.738
9	$61.847	$5.015	$110.087	$110.087	$220.174	$376.764
10	$59.296	$4.808	$105.416	$105.416	$210.832	$360.660
11	$53.841	$4.366	$95.779	$95.779	$191.558	$327.744
12	$49.838	$4.041	$88.625	$88.625	$177.250	$303.234
13	$44.384	$3.599	$78.988	$78.988	$157.977	$270.318
14	$38.292	$3.105	$68.184	$68.184	$136.367	$233.376
15	$34.289	$2.780	$61.030	$61.030	$122.059	$208.866
16	$30.286	$2.456	$53.876	$53.876	$107.752	$184.356
17	$26.921	$2.183	$47.890	$47.890	$95.779	$163.872
18	$24.194	$1.962	$43.071	$43.071	$86.142	$147.414
19	$21.466	$1.741	$38.253	$38.253	$76.505	$130.956
20	$18.915	$1.534	$33.582	$33.582	$67.163	$114.852
21	$16.825	$1.364	$29.931	$29.931	$59.862	$102.420
22	$14.672	$1.190	$26.858	$26.858	$53.716	$92.598
23	$10.733	$0.870	$19.126	$19.126	$38.253	$65.478
24	$10.095	$0.819	$17.959	$17.959	$35.917	$61.452
25	$6.092	$0.494	$10.805	$10.805	$21.609	$36.942
26	$5.454	$0.442	$9.637	$9.637	$19.274	$32.916
27	$2.089	$0.169	$3.651	$3.651	$7.301	$12.432
Total	$805.771	$65.333	$1,446.494	$1,446.494	$2,892.988	$4,851.564

In terms of total statewide effects on employment, Alternative B could generate 3,282 jobs at $20 per bbl, 8,278 jobs at $25 per bbl, and 11,740 jobs at $30 per bbl.

Because of the development of facilities or the continued use of facilities that were taxable by the NSB, the NSB would recover additional revenues, which would most likely be used for ongoing infrastructure construction and operations. In turn, NSB-government jobs would be generated.

4.4.18.3 Effectiveness of Stipulations and Required Operating Procedures

No lease stipulations or ROPs were developed to address economic concerns.

Table 4-13. Effects on Employment (Expressed as Annual Average Jobs) for Alternative B at $20 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	2	3	5
Development phase	93	63	156
Production phase	9	8	17
Rest of Alaska			
Exploration/delineation phase	23	70	94
Development phase	957	1,261	2,219
Production phase	349	444	793
Total Statewide Effects			
Total exploration/delineation	25	73	98
Total development	1,050	1,324	2,374
Total production	358	452	810

Table 4-14. Effects on Employment (Expressed as Annual Average Jobs) for Alternative B at $25 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	13	22	35
Development phase	212	144	357
Production phase	24	21	45
Rest of Alaska			
Exploration/delineation phase	172	520	692
Development phase	2,193	2,889	5,082
Production phase	910	1,157	2,067
Total Statewide Effects			
Total exploration/delineation	185	541	727
Total development	2,405	3,033	5,439
Total production	934	1,178	2,112

Table 4-15. Effects on Employment (Expressed as Annual Average Jobs) for Alternative B at $30 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	17	29	46
Development phase	303	206	510
Production phase	34	30	64
Rest of Alaska			
Exploration/delineation phase	228	687	915
Development phase	3,135	4,130	7,265
Production phase	1,295	1,647	2,942
Total Statewide Effects			
Total exploration/delineation	245	715	960
Total development	3,438	4,336	7,775
Total production	1,329	1,676	3,005

4.4.18.4 Conclusion

The combined average annual property taxes to the NSB and State of Alaska would range from $5 to $32 million depending on the price of oil and the resulting infrastructure development. This would be a 2 to 6-fold increase in annual property taxes paid as compared to the No Action Alternative. The annual average royalty paid to government would double from amounts estimated to be paid under the No Action Alternative. The royalty is estimated to range from $15 million to $107 million for the federal government and $15 to $107 million for the state and the NSB combined, depending on the price of oil and resulting infrastructure development. The estimated average annual State severance tax ranges from $22 million to $180 million, depending on the price of oil. This is twice the amount that would occur under the No Action Alternative.

It is anticipated that under Alternative B, annual NSB resident employment would increase in the range of 156 to 510 jobs during the peak of development, and 17 to 64 jobs during production. During development and production, this would be a 2- to 4-fold gain over employment levels under the No Action Alternative. It is anticipated that the annual employment of Alaska residents (excluding residents of the NSB) would to increase in the range of 2,219 to 7,265 jobs at the peak of development, and level off to 793 to 2,942 jobs during production, over 4 times the number of jobs created under the No Action Alternative.

The proximity of Nuiqsut to Planning Area enhances the community's opportunities to benefit from development and production activities associated with Alternative B. These opportunities could extend to community businesses that might provide goods and services, as well as residents who might obtain work as a result of the development and production activities.

4.5 Alternative C

Alternative C is intended to allow the maximum amount of oil and gas activities permitted by law. Alternative C would utilize the same performance-based lease stipulations and ROPs developed for Alternative B to mitigate the impacts of energy development and other land uses on resources in the Planning Area.

No areas within the Planning Area would be unavailable for leasing; however, additional seasonal and spatial lease stipulations would be applied to protect environmentally sensitive areas (Map 2-3). These areas, which are described in Section 2.2.1 (Areas with Additional Stipulations) and in the lease stipulations outlined in Section 2.6 (Lease Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes

For the resources discussed in the following section, a single value, or a range of values, are given to describe the amount of area that could be impacted by oil exploration and development. If a range of values is given, it represents the level of oil exploration and development, and associated resource impacts, for oil prices of $20 per bbl and $30 per bbl. The range of values better describes the types of impacts that could occur if oil prices are higher, or lower, than predicted to occur during the life of the amendment. If a single value is given, or a value is enclosed in parentheses after a range of values, it represents the level of oil activity, and associated resource impacts, projected to occur if oil prices average $25 per bbl during the life of the amendment.

4.5.1 Air Quality

4.5.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the ground-impacting-management activities that would affect air quality would be the same as those under the No Action Alternative. These activities would have only a transitory effect on local air quality.

4.5.1.2 Oil and Gas Exploration and Development Activities

The entire National Petroleum Reserve – Alaska is a PSD Class II Area, which allows a moderate incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA 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 (acid rain) and freshwater bodies, or effects on plants.

Under the State Implementation Plan, the ADEC has jurisdiction for regulating and permitting air quality emissions within the Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including obtaining construction and operating permits. Construction air quality permits include PSD requirements.

Effects of Exploration and Development

Exploration

During the exploration phase, emissions would be produced by: 1) vehicles used to gather seismic and other geological and geophysical data; 2) diesel powered-generating equipment required for drilling exploratory and delineation wells; 3) vehicles and aircraft used in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Pollutants generated would primarily consist of NO_x (although both NO and NO_2 would be generated, ambient air standards are set only for NO_2), CO, and SO_2.

If permanent facilities, such as gravel airstrips, storage pads, and connecting roads were built, fugitive dust emissions would occur. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations.

For all of these operations, the best available control technology would be applied under the USEPA air quality regulations. The main emissions would be NO_x, with lesser amounts of SO_2, CO, and PM_{10}. Once in the atmosphere, NO_x gradually converts to NO_2. The level of pollutants associated with exploration is expected to be similar for all alternatives.

Development

During the construction and drilling phases, the primary emission sources would be 1) piston-driven engines or turbines used to provide power for drilling, 2) heavy construction equipment used to install modules and pipelines, and 3) various vehicles and aircraft. The principal development-phase emissions would consist of NO_x, with lesser amounts of SO_2, CO, and PM. Based on assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) are projected as follows for construction: NO_x (17.7), SO_2 (1.3), CO (4.2), and PM_{10} (1.3). Emissions for drilling would be: NO_x (26.7), SO_2 (3.0), CO (5.9), and PM_{10} (1.3). These estimates assume that the typical development in the Planning Area would be similar in size to the proposed Alpine Satellite Development Plan and that only one development would be under construction at a time.

Aircraft would bring materials and crews to the development sites. Based on estimates developed for the Alpine Satellite Development Plan, an estimated 40 to 70 one-way aircraft flights each month would be needed initially to service a CFP and associated satellite fields (USDOI BLM 2004C). The number of flights occurring each month could increase to as many as 340 and 90, at the peak of construction and drilling activities, respectively. A similar number of flights would be expected to service a development in the Planning Area. These flights could generate up to 1.2 tons of CO, 0.14 tons of NO_x, 0.9 tons of VOCs and other hydrocarbons, and 0.03 tons of SO_x annually.

During the production phase, the primary source of emissions would be turbines for power generation and gas compression, and power generation for heating, oil pumping, and water injection. The emissions would consist mainly of NO_2, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOCs) from oil/water separators, 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 VOCs 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 VOCs. However, flaring would burn up any emissions of VOCs, 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 (but never completely absent). Based on the assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) during production are projected as follows: NO_x (2,080), SO_2 (27.2), CO (595), and PM_{10} (20.5; USDOI BLM 2004C). These projections assume that 17 fields were in production at the same time.

It is estimated that up to 220 flights would occur monthly during the operations phase for Alternative C, based on flight estimates developed for the Alpine Satellite Development Plan. At peak flight activity, 0.8 tons of CO, 0.1 tons NO_x, 0.6 tons of VOCs and other hydrocarbons, and 0.02 tons of SO_x would be generated annually, assuming 17 fields would be in production at the same time.

Construction and production activities can produce fugitive dust emissions. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations in the winter, as well as during the summer months. Because excessive fugitive dust can adversely affect human health and the environment, concentrations are controlled by state and USEPA air quality standards. Control measures include posting speed limits and watering road surfaces.

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 not include activities that would affect air quality substantially more than previously discussed.

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

Based on studies provided for Alternative B (Section 4.4.1; Air Quality), emissions from expected Planning Area operations would be less than those modeled for the Beaufort Sea Sale 144 EIS. That EIS showed that the concentration of NO_2 was the highest out of all the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and federal ambient air quality standards.

Air quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a typical field that might be developed in the Planning Area), 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 because of 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 C 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.

Effects of Spills

Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOCs from an offshore facility or pipeline oil spill would likely evaporate almost completely within a few hours after the spill occurred. Ambient concentrations peak within the first several hours after the spill starts and are reduced by 2 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 high in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land in the Planning Area, 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 persist for a shorter time. Also, since a diesel spill would probably be smaller than some potential crude-oil spills, any air quality effects would likely be even lower than for other spills.

Oil or gas blowouts could catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of oil spilled into water. This type of burning would be less likely in the 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 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 emit about 10 percent of the burned crude oil as oily soot (and minor quantities of other pollutants) into the air (USDOI MMS 1996a:Table IV.B.12-4; USDOI BLM and MMS 2003).

Effects of Oil-Spill Clean-up Activities on Air Quality

In-situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily affect air quality, but the effects would be minor (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, CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels. Ambient levels of VOCs were high within about 325 feet of the fire, but were substantially lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAHs) were found to be minor, 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 moderate short-term effect on air quality.

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 3 miles downwind of an in-situ burn. This estimate is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration.

Effects of Accidental Emissions

Sources of air pollutants related to oil and gas operations include accidental emissions resulting from gas or oil blowouts. Typical emissions from such accidents consist of VOCs; only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and PM. Accidental emissions likely would have a minor 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 (VOCs). It is estimated that the probability of experiencing one or more blowouts in drilling the wells projected for Alternative C would be minor. 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 VOCs. Since 1974, 60 percent of the blowouts have lasted less than 1 day, and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. For catastrophic oil blowouts, in-situ burning may be the only effective technique for spill control. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99 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 EIS*; USDOI MMS 1996c). 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 45 miles off the coast of Africa locally deposited oily residue in rainfall 30 to 50 miles 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 occur on the North Slope would not cause noticeable fallout problems. Along the TAPS, 500 bbl of a spill 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 would be the major, though not the only, potential air quality risk. Recent examination of PAHs in crude oil and smoke from burning crude oil indicated that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater 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 for bronchitis.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities could have impacts similar to those of construction since it is anticipated that similar vehicles and other emission sources would be used. Because abandonment would not occur at a single location for any substantial length of time, the impact of air emissions at any single location would be minor and short term. Impacts would be less than those associated with construction if gravel fill was left in place, because there would be less use of the heavy vehicles and machinery that emit air emissions. During and following abandonment, production facilities would no longer contribute to North Slope air emissions.

Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only). Visibility can 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 used the VISCREEN model and found that noticeable effects on air quality occurred on only a few days—those with the most restrictive meteorological conditions. No effects were found during average conditions. Those results would be expected to be typical of other development projects that could occur in the Planning Area.

A substantial increase in ozone concentration would not be likely to result from exploration, development, or production scenarios associated with Alternative C. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the National Petroleum Reserve – Alaska during the summer, temperatures remain relatively low for much of each day (Brower et al. 1988). Also, activities that would occur 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 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 (Table 3-1). The highest 8-hour average ozone concentration is 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 USEPA cannot enforce the standard until the legal issues are resolved. Because the projected ozone precursor emissions from Alternative C are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk oil fields, ozone concentrations should not 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 SO_2 concentration as low as 12.0 $\mu g/m^3$ 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 lichens 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 limited number of sources of SO_2 emissions, it is assumed that the ambient concentrations at most locations would be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under Alternative C is expected to be minor. For the proposed Liberty development project, BPXA had found that maximum modeled pollutant concentrations were well below levels that can damage lichens. 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 North Slope area. Monitoring the vascular plant and lichen communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

Native Views on Air Emissions

Leonard Lampe, then Mayor of Nuiqsut, reported 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). 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, Alternative C would be expected to have a moderate effect with respect to these observations.

4.5.1.3 Effectiveness of Stipulations and Required Operating Procedures

No lease stipulations or ROPs were developed to address air quality impacts. Mitigation of air quality impacts would result from operators’ use of the best available technology to control discharges.

4.5.1.4 Conclusion

An unlikely large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (VOCs) as a result of evaporation from the spill. The VOC concentrations would be very minor and normally limited to only ½ to 1 mi^2. Moderate or greater winds would further reduce the VOC concentrations in the air.

Under Alternative C, effects on air quality from emissions would likely only constitute 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. Because of the atmospheric dispersion of emissions, the other effects of air pollutant concentrations caused by exploration, 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. Air emissions associated with development under Alternative C would be approximately 4 to 5 times the level for the No Action Alternative, and about 30 and 20 percent greater than levels associated with the final Preferred Alternative and Alternative B, respectively.

4.5.2 Paleontological Resources

4.5.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the types of non-oil and gas activities would be the same as those described for the No Action Alternative; however, there would likely be an increase in the level of aircraft and survey activity associated with environmental studies and monitoring. Despite increased activity, the impact to paleontological resources, which are deeply buried, would still be minor.

4.5.2.2 Oil and Gas Exploration and Development Activities

Under Alternative C, the level of seismic activity is expected to be similar to that of the final Preferred Alternative and Alternative B. While the types of impacts to paleontological resources would remain the same as for the No Action Alternative, the increased level of seismic activity would increase the potential for impacts to occur. In the areas open to exploration under this alternative, the deeply buried context of most paleontological remains generally precludes any major impact to the resource. Any impacts associated with the increased seismic activity are expected to be minor.

Paleontological resources are not ubiquitous in the Planning Area as are wildlife and habitat, and their locations are much less predictable. As a result, it is possible that oil and gas exploration or development activities would not impact paleontological resources.

Effects of Disturbances

Under Alternative C, the level of activity in the Planning Area would increase. However, because most of the activity would occur during the winter months, the potential for impacts to paleontological resources is extremely minor. The likelihood of impacting surface paleontological material also is minor due to their isolated and rare occurrence.

The drilling of 12 to 122 (91) exploration and delineation wells could occur under Alternative C, a 3-fold increase over the No Action Alternative. No more than six drilling rigs are expected to be operating at any one time. The drilling activity would occur over the span of several seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be utilized. Permanent pads, roads, or airstrips could be constructed; therefore, ground disturbance could occur and buried paleontological material could be impacted. The other substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. Drilling the borehole could impact scientifically important paleontological material; however, the likelihood of that occurrence is minor.

Disturbance from production and service wells, drill pads, staging bases, airstrips, gravel pits, and mainline and gathering pipeline could occur under Alternative C. The amount of area impacted by these activities would be nearly 4 times that for the No Action Alternative. Surface disturbance resulting from this work would impact approximately 190 to 1,975 (1,380) acres, but subsurface impacts associated with these activities would be minor. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. It is anticipated that a pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and/or pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs are set it is possible, but highly unlikely, that paleontological resources would be impacted. Overall, ground disturbance from development has a minor impact on paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities, as these activities would have been previously disturbed by construction and development activities.

Effects of Spills

Under Alternative C, the effects of spills to paleontogical resources would be the same as discussed under the No Action Alternative. If present, surface paleontological material could be impacted; however since the occurrence of paleontological remains is rare, the probability of an impact is minor.

4.5.2.3 Effectiveness of Stipulations and Required Operating Procedures

As discussed under Alternatives B, the ROPs and lease stipulations under Alternative C would be highly effective in protecting known and previously unknown paleontological resources and preserving their research potential and, ensuring that impacts to paleontological resources would be minor.

4.5.2.4 Conclusion

The types of impacts to paleontological resources from activities not associated with oil and gas exploration and development would be similar in nature to what has been described previously. Based on the amount of surface area disturbance, the potential impacts to paleontological resources from oil and gas exploration and development could increase about 4-fold and 25 and 50 percent from levels associated with alternatives A, B, and D respectively. Impacts could be greater if exploration and development occurred in an area with abundant paleontological resources. However, the ROPs and lease stipulations proposed to protect paleontological resources under this alternative are the same as those proposed for the final Preferred Alternative and alternatives A and B, and would be highly effective.

4.5.3 Soil Resources

During oil and gas exploration and development, various activities could cause impacts to soil in the Planning Area. These activities include seismic activities, construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates.

4.5.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, use of OHVs, recreational camps, paleontological and archaeological excavations, and overland moves could affect soil in the Planning Area under Alternative C.

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would be little affected by the increased availability of land for oil and gas leasing. There could be some increase in the use of OHVs in the Planning Area, if development occurred, because of a greater amount of roads within the area. However, impacts to soil from this increase would likely be minor.

4.5.3.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months, although some seismic surveys could occur on Teshekpuk Lake during the summer. Under Alternative C, impacts to soil resulting from seismic exploration, and the amount of area surveyed, would be similar to those for the other alternatives, although much of the survey focus would be on lands near Teshekpuk Lake. Two-dimensional survey areas vary in size, but for this analysis a 600 mi^2 (384,000 acres) area was used. Assuming that 250 miles of seismic surveys were conducted, the area impacted by seismic lines would be approximately 6,060 acres (250 miles long by 200 feet wide), although, not all of the area within the 200-foot-wide path would be overrun with a vehicle. Trails would also be made by camp move vehicles, which traverse about 30 miles. Trails would also be made while traveling to and from the survey area. A camp move trail is about 12 feet wide, and a typical camp train would involve two or three strings of trailers. Trailer strings could use the same trail, but doing so would cause more severe, longer lasting damage to soils than the use of separate trails. For this analysis it was assumed that 2½ individual camp string trains would use different trails to minimize disturbance, and thus would impact a path 30 feet wide. Given 30 miles of trail within the survey area and an additional 106 miles entering and leaving the Planning Area, approximately 1,290 acres would be impacted by camp move trails. Thus, the total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 1,290 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 1,000 to 2,500 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, moderate and high-level disturbances would likely be more frequent with 3-D surveys.

Seismic activities could alter the thermal balance of the soil, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

Exploration

Under Alternative C, impacts to soil from activities associated with oil and gas exploration would be similar to those described for the No Action Alternative. It is anticipated that under Alternative C there would be a greater number of exploration and delineation wells drilled, which would result in greater impacts to soil resulting from the construction of well collars and both multi- and single-year ice pads. Ice road construction might also be greater under Alternative C in terms of total miles constructed (probably up to 50 per year).

The area of soil impacted around the perimeter of a typical multi-year ice pad (500 feet by 500 feet) would be approximately 6 acres. Under Alternative C, it is assumed that 7 to 70 (52) exploration wells and 5 to 52 (39) delineation wells would be drilled from ice pads in the Planning Area. Impacts could occur on 72 to 732 (546) acres over a period of about 10 to 20 years.

The construction of well collars during exploration requires digging a hole that would impact approximately 16 square feet of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil could occur around the well collar.

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, staging areas, roads, and airstrips would result in the loss of soil productivity in the areas of gravel placement. Under this alternative, 2 to 17 (12) fields would be developed, resulting in 160 to 1,675 (1,170) acres of soil productivity lost by gravel placement.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 3,400 (2,400) acres under the Alternative C.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that one to eight (six) gravel mine sites would be necessary, resulting in a total of 30 to 300 (210) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would remove soil and impact soil productivity at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under Alternative C than under the No Action Alternative.

Pipelines

Under Alternative C, impacts from pipeline construction would be similar to those described for the other alternatives. The total area disturbed by the drilling of holes for VSMs and the deposition of the resulting spoil would amount to 0.03 acres of soil being disturbed per pipeline mile under Alternative C, or 3 to 10 (6) acres.

The extent of impacts associated with buried pipelines could also be greater under Alternative C, given the potentially greater number of fields developed. However, it is not possible to quantify how many more buried pipeline segments would be required under Alternative C than under the other alternatives.

Effects of Oil and Gas Development on Permafrost

As discussed under the No Action Alternative, structures must be designed to avoid thawing their own foundations. Roadways and buildings must be elevated on thick gravel berms or pads, or on pilings. Gravel berms for roads can be as high as 6 feet above the tundra surface to ensure that the subgrade remains frozen. These roads have visual impacts on the landscape, and can intercept natural drainage and create ponds that thicken the active layer and initiate thermokarst (Walker 1996). Pipelines generally must be built on VSMs to ensure that the heat from the transmission of warm fluids does not thaw the surrounding permafrost, causing differential settlement. Heated buildings can also thaw the permafrost, leading to thaw settlement, if they are not elevated on pilings or their foundations insulated and refrigerated. On pads with closely spaced wells, extensive refrigeration with passive heat pipes and insulation is required to ensure that the heat from fluids does not melt the permafrost.

Effects of Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in the settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Under Alternative C, impacts to soils from oil spills would be the same as those described in the No Action Alternative. Under Alternative C, the greater amount of leasing, development, and production of oil would result in a larger number of small spills of crude and refined oil in the Planning Area. There would also be a greater chance of a large oil spill occurring; nonetheless, a large spill would still be a very rare event.

4.5.3.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, the lease stipulations and ROPs would be the same as those discussed for Alternative B. Many of the lease stipulations and ROPs, as discussed under Alternative B, would directly or indirectly limit potential impacts to soils in the Planning Area. These protections would be similar, to slightly greater, than those provided for the No Action Alternative.

4.5.3.4 Conclusion

Under Alternative C, impacts to soils from activities other than oil and gas development would include minor impacts from activities such as 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 would vary from 1 year to one or more decades.

Impacts from oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. Short-term impacts would occur on up to 6,600 and 250,000 acres of soil from 2-D and 3-D seismic surveys, respectively, during a 25-year period. Another 30 to 300 (225) acres could be impacted by exploration and delineation wells. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. Oil and gas development and operation would affect soils by constructing gravel pads, roads, staging areas, and airstrips, excavating material sites, constructing VSMs, and spilling oil and other chemicals. Long-term impacts would occur on an estimated 630 to 5,685 (4,005) acres of soil from field and staging area development, and 30 to 300 (210) acres from gravel extraction activities. These impacts would be permanent except for those associated with spills, which would allow recovery within a few years to 1 or more decades.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Under Alternative C, the amount of soil impacted from oil and gas exploration could exceed those of the No Action Alternative by nearly two-fold, but would be similar to those for the final Preferred Alternative and Alternative B. During development, the amount of soil impacted from oil and gas activities could exceed those of the No Action Alternative by nearly five-fold, and those of Alternative B and the final Preferred Alternative by about 20 and 50 percent. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soil associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since they are located in the area having high oil potential. Lease stipulations and ROPs have been identified to protect soil resources and are the same as those developed for Alternative B.

4.5.4 Water Resources

4.5.4.1 Surface Water and Groundwater Resources

An additional 211,000, 213,000 and 600,000 acres would be available for oil and gas leasing under this alternative as compared to the final Preferred Alternative, Alternative B, and the No Action Alternative, respectively. Thus, impacts to water resources could be greater under this alternative if development occurs in areas closed to leasing under the other alternatives, or more areas are explored and developed under this alternative than under the other alternatives.

Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the types of non-oil and gas activities that could occur in the Planning Area would be the same as those discussed for the other alternatives. These activities, which include aircraft and watercraft use, collection and excavation for scientific research, hunting camps, recreational use of the area, and use of the area by local natives for subsistence, should occur at the same frequency and intensity as under the other alternatives. All of these activities have the potential to impact water resources. However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Temporary tent camps would be located on existing pads or on well-drained soils along river terraces or uplands, set back from the stream or lakeshore with minimal surface disturbance. Excavation and collection activities would be done by hand shovel over several square feet, with replacement of the vegetative layer once completed. Recreational activities permitted by the BLM would follow the National Outdoor Leadership School's "*Leave No Trace, Alaskan Tundra*" program to minimize impacts to vegetation and to reduce wastewater, human waste, and solid waste disposal. Thus, permitted recreational activities would have minimal impacts on water resources in the Planning Area under Alternative C.

Winter occupation or moves would use low-ground-pressure vehicles and trailers at temporary locations with adequate snow cover. All fuel, waste, and hazardous materials would be stored in accordance with ADEC guidelines, and removed seasonally. As under the other alternatives, gray water and human wastes would be handled in accordance with ADEC regulations, thus minimizing impacts to water resources.

Aircraft use could take place any time of the year in the Planning Area, but would be most common in the summer months because of better weather and the ability to use lakes for landing. Aircraft could be used to support recreation, surveying, scientific research, and transportation of personnel and supplies. The main impact expected from aircraft would be local fuel oil spills.

Under Alternative C, permanent-landing facilities would not be permitted on lakes or streams, and watercraft use would be limited to the summer months, for transportation, recreation, and supply purposes. As with aircraft, no permanent facilities to support watercraft refueling or repair would be permitted on lakes or rivers. Watercraft would have the same potential for local fuel oil spills or leaks as aircraft landing on lakes and rivers. Therefore, local impacts to water bodies from aircraft (float planes) and watercraft are possible, and would be expected to consist of local fuel oil spills. Aircraft and watercraft would be required to carry spill containment and clean-up materials, so these spills should be contained and removed relatively quickly.

Potential impacts to water resources form non-oil and gas activities would be the same under Alternative C as under the other alternatives. Overall, these activities would have few, if any, impacts to water resources. In addition, any spills would be contained and removed quickly, in accordance with BLM and ADEC guidelines for use of aircraft and recreational vehicles in the Planning Area.

Oil and Gas Exploration and Development Activities

The effects of oil and gas exploration and development under this alternative would be the same as for the final Preferred Alternative and Alternative B, except that all of the area northeast of Teshekpuk Lake would be open for leasing. The amount of acreage in the Planning Area potentially affected by oil and gas activities would be the largest under this alternative, and would be considerably larger than under the No Action Alternative (approximately 600,000 more acres). Thus, the potential for impacts to water resources as a result of oil and gas activities would be the greatest under Alternative C. Drilling on and near Teshekpuk Lake greatly increases the risk for an oil spill in this fish-bearing lake. Therefore, Alternative C is less protective of water resources than the No Action Alternative, particularly for Teshekpuk Lake.

Effects of Disturbances

Thermokarst. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). While extensive thermokarst along recent seismic trails in the Planning Area has not been observed, impacts to tundra vegetation and surficial compaction (precursors to thermokarst) have been found (Jorgenson et al. 2003). The tundra vegetative mat has been shown to recover in 7 to 10 years where damage has not been severe (Abele et al. 1984). Observations by the BLM and others indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season (NRC 2003). Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Under Alternative C, most of the Planning Area would be open to leasing, and a greater area would be open to leasing than under the other alternatives. Important ROPs to limit thermokarst would include the restriction on bulldozing of trails, the requirement that snow and frost cover be of sufficient depth to protect the tundra before overland activities could commence, and the requirement that trails could not be used repeatedly to avoid formation of ruts. These ROPs, along with the minor impact of modern seismic equipment, should minimize thermokarst erosion of the tundra.

The types of impacts to the tundra from thermokarst should be the same as under the other alternatives. Because more seismic line mileage would be expected under Alternative C than under the other alternatives, the total area of potential thermokarst impact could be greater.

Ice Road and Pad Construction. Under Alternative C, ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pad construction would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minor and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Under Alternative C, the potential impacts of ice roads on water resources would be greater than under the other alternatives because more of the Planning Area would be open for leasing, and more ice pad and road construction would be likely to occur. These impacts would be temporary in nature, and it is expected that long-term impacts to surface water quality would be minor.

Ice Road/Pad Water Use. Under Alternative C, water from lakes could be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake would depend on the depth of the lake and the depth of unfrozen water in the lake. As under the other alternatives, water withdrawal from fish-bearing lakes would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet deep if known to be fish-bearing or connected to a fish-bearing stream; water could be withdrawn from lakes that are 5 to 7 feet in depth if they contain only ninespine stickleback or Alaska blackfish. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream.

Drilling Water Use. Drilling requires water for making drilling mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camps that accompany drill rigs. Under Alternative C, water withdrawal from lakes for drilling water would be governed by the same ROPs as those for ice roads and pads. Therefore, it is expected that impacts to surface water resources would be negligible because of ROPs governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Many lakes are found in the areas closed to leasing under the other alternatives. Because more of the Planning Area would be open to leasing under Alternative C, and higher levels of exploration and development are projected, more lakes could potentially be impacted by water withdrawal during the winter months than under the final Preferred Alternative (5 percent more area available for leasing, 50 percent more development) Alternative B (5 percent more area, 20 percent more development) and the No Action Alternative (17 percent more area, 5 times more development). The ROPs and lease stipulations listed in Section 2.6.3 (Alternative B and Alternative C Lease Stipulations and ROPs) would be protective of water resources in fish-bearing lakes, but given the greater number of lakes, Alternative C could potentially have more impact on lakes, especially non-fish bearing lakes, than the No Action Alternative.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased. Under all the alternatives, snow removal and compaction by oil and gas operations would be prohibited over lakes and streams.

Under Alternative C, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative would be protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities. However, lakes without fish could be subject to impacts due to snow compaction if this activity were authorized by the AO.

Because a greater number of lakes could be affected by winter activities, as noted above, including snow compaction, under Alternative C, impacts to lakes from snow compaction could be greater under this alternative than under the other alternatives.

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 in areas with low-flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al. 1987a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structures are needed to minimize drainage problems during the spring snow melt.

Under Alternative C, drainages would be protected by the lease stipulations and ROPs that require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be minimal under this alternative.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low water and keeping culverts free of snow and ice (Walker et al. 1987a, b).

Lease stipulations and ROPs developed for Alternative C to mitigate for disturbances to drainages, streams, and rivers by exploration and production activities are the same as those developed for Alternative B. These lease stipulations, which are basically the same as those for drainage disruption, regulate bridges, culverts, winter crossings, removal of ice bridges, and any temporary facilities constructed near rivers. They also include setbacks for specified rivers. These lease stipulations and ROPs should minimize impacts to stream channels.

Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more channel erosion and sedimentation under this alternative than under the other alternatives. However, if lease stipulations developed to protect water resources and quality were followed, this potential increased impact to stream channels should be minimal.

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, and lake shoreline flow patterns; erosion and sedimentation; ice damming; and aufeis formation (NRC 2003). Locating gravel pits at a safe distance from streams and lakes could minimize these impacts. Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more gravel removal along lakes and streams under this alternative than under the other alternatives.

Under Alternative C, gravel removal would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO. Gravel mining sites would also to be kept to a minimum in the Planning Area, and, where possible, be designed so that wildlife could use them after mining was completed. These lease stipulations are protective of streams, rivers, and lakes and should keep impacts to floodplains to a minimum.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily through the use of temporary impoundments, diversions, and sedimentation changes in streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope. Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

Pipelines are designed to minimize leaks and operators would have spill prevention and clean-up plans and equipment in place. Any leaks would generally be small. Therefore impacts to water resources from pipeline leaks should be minimal under Alternative C.

Because more of the Planning Area would be open to oil and gas leasing under Alternative C, there would potentially be more pipelines built under this alternative than under the other alternatives. However, if the ROPs and lease stipulations are followed, the associated increased impact to water quality should be minor.

Effects of Spills

It is likely that oil spills in the Planning Area would generally be less than 25 bbl in quantity and average around 3 to 5 bbls, and that blowouts would be rare. Most oil spills should occur during production operations, rather than during exploration drilling.

Surface Oil Spills. The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded, or flooded tundra during the summer months can reach temperatures of about 64 °F (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Under-Ice Oil Spills. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice. The spread of an under-ice oil spill may be dispersed by currents in excess of 6 to 12 inches per second (Cammaert 1980; Cox et al. 1980). If the ice is marine ice and moves during spring breakup, the oil contained with the ice moves with the ice. Thus, under-ice oil spills can be quite difficult to detect and especially difficult to remediate.

Lease Stipulation E-2 restricts permanent oil and gas facilities near and within water bodies in the Planning Area. These lease stipulations require a setback of 500 feet from major streams and fish-bearing lakes, and 100 feet from non-fish-bearing water bodies, to protect these water bodies from possible oil spills. The AO has final decision authority on the location of drilling platforms.

Under Alternative C, the lease stipulations and ROPs for oil and gas drilling, especially the setbacks from streams and lakes, are similar to those under the other alternatives. Therefore, Alternative C should provide similar protection as is provided by the other alternatives, when potential oil spills are considered. However, more of the Planning Area would be open to oil and gas leasing under Alternative C than the other three alternatives. In particular, approximately 213,000 more acres would be available for oil and gas exploration and development to the northeast of Teshekpuk Lake under this alternative than under Alternative B; this area has a high density of deep-water lakes (see Map 3-8). Under the final Preferred Alternative, Teshekpuk Lake (211,000 acres) would be deferred from leasing.

4.5.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

The only types of non-oil and gas activities in the Planning Area that could affect freshwater quality would be ongoing subsistence and recreational activities, primarily along rivers and lakes in the ACP, and use of lakes by float planes and watercraft. These activities have been ongoing for many years, and impacts to freshwater quality appear to have been negligible. Impacts to water quality would be the same under this alternative as those occurring under the other alternatives.

Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, exploration activities that could affect water quality within the Planning Area include seismic survey activities, ice road construction, ice pad construction, and drilling fluid storage and disposal. Spills of crude oil or produced waters would be attributed predominantly to development activities.

Damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al. 1987a, b).

While the NRC (2003) and others have indicated that short-term impacts such as compaction of the vegetative mat, diversions of shallow water tracks, and limited ponding, can be estimated at about 1 percent of the acreage impacted by seismic lines per season, newer low-ground-pressure equipment could reduce impacts substantially, to a total of about 75 acres for each 2-D survey, and 495 acres for each 3-D survey, under Alternative C. If it is assumed that 1 percent of the persistent high damage area would result in thermokarst erosion, up to 26 acres (assumes 250 miles of 2-D seismic surveys and five 3-D seismic surveys) could be affected long term during a 25-year period.

As discussed for the No Action Alternative, use of water for ice road construction could affect water quality through a change in water chemistry in lakes from which water was drawn; through restrictions to water circulation in shallow lakes that impact the oxygen content of the water; through changes in water chemistry along the roadbed during and after meltout; and through modification of the local hydrology along the ice road. As discussed under the No Action Alternative, studies in other areas of the North Slope have shown that water withdrawal from lakes for ice roads and pads has not measurably affected water quality.

Mud pits and surface discharge of exploration drilling muds and cuttings would be prohibited. The preferred and normal means of disposing of drilling wastes, including muds and cuttings, would be reinjection into wells, which would not cause impacts to surface water quality. Under this scenario, there likely would be no impact from drilling fluids used in exploration.

Effects of Development

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by the effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity and suspended sediment concentrations. Thermokarst erosion could cause the State of Alaska turbidity standard to be exceeded within and downflow of thermokarst features.

If aboveground oil pipelines resulted from development under Alternative C, they could range from 110 to 330 (220) miles in length and affect from up to 165 to 495 (330) acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction was complete, impacts from elevated pipelines should be minimal. If underground pipelines were constructed, potential impacts during construction could double, also through temporary impoundments, diversions, and sedimentation during construction. Buried lines could also result in thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines was done during winter, these impacts would be greatly reduced.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer-term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts have been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities.

Effects of Spills

Dissolved-oxygen concentrations in tundra waters could be affected by oil spills in the summer. 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 would be negligible. In addition, sediment respiration has even less effect in the thicker water column of lakes deep enough to not freeze solid in winter.

The primary effect of a small spill on tundra water quality, however, would be direct toxicity rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill, as shown in a National Petroleum Reserve – Alaska experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years (Miller et al. 1978; Barsdate et al. 1980; Hobbie 1982).

As noted in the 1998 Northeast IAP/EIS, an oil spill reaching Teshekpuk Lake would likely have a minor effect on water quality (USDOI BLM and MMS 1998). 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 percent of the lake surface) could be considered an effect on water quality. This effect would persist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected if an oil spill were to reach any of the lakes in the Planning Area.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are locally and marginally at toxic levels. Effects of spills less than 1,000 bbl can be considered negligible. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the State of Alaska water quality chronic criterion of 0.015 ppm in an area of 100,000 acres or larger. Concentrations above the 1.5-ppm State of Alaska acute criterion could occur over 10,000 acres or more during the first several days of such a spill.

Under Alternative C, more construction of gravel structures, gravel roads, ice roads and pads, and more drilling in environmentally sensitive areas, would be expected. Thus, impacts to surface water quality would be greater under this alternative than under other alternatives.

4.5.4.3 Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, lease stipulations and ROPs would be effective in protecting water resources because they would require setbacks from rivers and fish-bearing lakes for oil and gas activities, place limits on the withdrawal of water from fish-bearing lakes, and regulate the construction of gravel roads, ice roads and pads, and pipelines.

Also, oil spill prevention and response procedures would be outlined, as would oil spill clean-up procedures. Refueling would be regulated and thereby kept away from rivers and lakes, particularly fish-bearing lakes. The required snowpack would be present on the tundra before seismic equipment would be allowed to make overland moves during winter. Drilling would not be allowed in streams, rivers, or fish-bearing lakes. The "K" lease stipulations would be somewhat more protective of water resources than the lease stipulations for the No Action Alternative, because they would provide more specific setback requirements for streams, rivers, and lakes.

Lease stipulations and ROPs would be effective in protecting water quality under Alternative C. Required Operating Procedures A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and clean-up plans. Required Operating Procedure B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. Required Operating Procedure's C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. Lease Stipulation D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there was no feasible or prudent alternative. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there was no feasible or prudent alternative. Lease Stipulation G-1 may require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Lease Stipulation K-1 should protect aquatic, floodplain, and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Lease Stipulation K-2 would protect aquatic and riparian areas adjacent to deep-water lakes, but would allow exceptions if there were no feasible or prudent alternative.

4.5.4.4 Conclusion

Under Alternative C, the impacts of activities other than oil and gas exploration and development would likely be similar to those under the No Action Alternative. The most likely impacts on the water resources in the Planning Area would be from gravel roads, pads, and structures, and would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways, which would disrupt drainage patterns.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. The potential short-term impacts from exploration and delineation would be water removal from lakes, and, during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 25 acres. Long-term impacts from development of gravel roads, pads, and pits could impact up 590 to 5,370 (3,780) acres. This is 5 times greater than for the No Action Alternative, and 20 and 50 percent greater than for Alternative B and the final Preferred Alternative, respectively. Both aboveground oil pipelines (not including infield lines) and buried pipelines could impact an additional 1.5 acres per pipeline mile. After construction was complete, impacts from elevated pipelines should be minimal. Buried gas lines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on gravel roads, pads, and pipelines were done during the winter impacts could be reduced. While any surface-disturbing activity could affect water resources, the lease stipulations and ROPs under Alternative C would protect most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools.

4.5.5 Vegetation

4.5.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area, and at more or less the same frequency and intensity as under the other alternatives, despite the increased availability of land for oil and gas leasing. There could be some increased use of off-road vehicles in the Planning Area due to an increase in the amount of roads associated with development. However, additional impacts to vegetation from this increase would likely be small.

4.5.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Under Alternative C, impacts to vegetation from activities associated with oil and gas exploration would be similar to those that would occur under the other alternatives, except that the frequency and total number of seismic surveys would differ somewhat. It is anticipated that under Alternative C there would be a greater number of exploration and delineation wells drilled, which would increase the impacts of well collar construction and the impacts of both multi-year and single-year ice pads. Ice road construction could also increase in terms of total miles constructed, but the 50-mile estimate used for the other alternatives would probably be an upper end for the number of ice road of miles within the Planning Area per year.

The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies discussed for Alternative B, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 200 acres (assuming 250 miles of 2-D and five 3-D camp move trails over a 25-year period).

The area of vegetation impacted around the perimeter of a typical multi-year ice pad (500 feet by 500 feet) would be approximately 6 acres. Under Alternative C, it is assumed that 7 to 70 (52) exploration wells and 5 to 52 (39) delineation wells, or a total of 12 to 122 (91) wells, would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, these impacts may occur on 36 to 366 (270) acres spread between six to 61 (45) different sites over a period of about 10 years. This would be about 20 percent more impact than for Alternative B, 50 percent more impact than for the final Preferred Alternative, and 3 times the area that would be impacted under the No Action Alternative.

The construction of well collars during exploration requires the digging of hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil can also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.07 to 0.73 (0.55) acres of vegetation being destroyed under Alternative C, assuming construction of 12 to 122 (91) well collars.

Development

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the destruction of vegetation in the areas of gravel placement. Under this alternative, two to 17 (12) fields would be developed, resulting in a total of 160 to 1,675 (1,170) acres of vegetation destroyed by gravel placement.

The increased construction and use of facilities under Alternative C would result in a larger area impacted by dust than under the other alternatives. Assuming that each field developed would have an average of 5 miles of some combination of roads, pads, and airstrips, with a potential for a 10-mile perimeter, dust would impact up to 36 acres of vegetation per field. Assuming development of two to 17 fields, the total area of potential impact by dust would be 72 to 612 (432) acres under Alternative C.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 400 to 3,400 (2,400) acres under Alternative C.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that one to eight (six) gravel production sites would be necessary, resulting in a total of 30 to 300 (210) acres impacted. Excavation of gravel and stockpiling of overburden would destroy vegetation at these sites.

Pipelines. Under Alternative C, impacts from pipeline construction would be similar in nature to those described for the other alternatives. The total area disturbed by each VSM would be about 14 square feet. Overall, 0.03 acres of vegetation would be disturbed by VSMs per pipeline mile, resulting in approximately 3 to 10 (6) acres of disturbance.

Impacts associated with buried pipeline could be greater under Alternative C than the other alternatives, given the potential increase in the number of fields developed. With an increase in the number of fields developed, the likelihood of river crossings that would require segments of buried pipe would also increase.

Air Pollution. The potential for impacts to vegetation from air pollution would be slightly greater under Alternative C, given the potential for additional oil and gas fields and processing facilities, as compared to the other alternatives. However, it is unlikely that impacts to vegetation from pollutants would substantially alter the plant communities in the Planning Area.

Effects of Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, water impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place, would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrips could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth, although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, and complete restoration to preexisting conditions is improbable.

Effects of Spills

The greater amount of leasing, development, and production of oil that would occur under Alternative C, relative to the other alternatives, would result in a greater number of small spills of crude and refined oil in the Planning Area. The chance of a large oil spill occurring would also be greater under Alternative C; however it would still be a very rare event.

Most oil spills cover less than 500 square feet (<0.01 acres), although a pressured aerial mist may cover substantially more area (Ott 1997). The average spill would cover 0.1 acre; about 155 acres could be impacted during the lifetime of development in the Planning Area under Alternative C, and about 3 times the amount that would be impacted under the No Action Alternative. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery (Jorgenson 1997).

4.5.5.3 Effectiveness of Stipulations and Required Operating Procedures

Alternative C would have the same lease stipulations and ROPs as those outlined under Alternative B. Development in the Planning Area would result in impacts to vegetation and plant communities. The ROPs and lease stipulations associated with Alternative C would be effective in minimizing destruction of vegetation and alteration of plant communities.

4.5.5.4 Conclusion

Under Alternative C, impacts to vegetation from activities other than oil and gas development would include minor impacts from aircraft landings, archaeological and paleontological excavations, camps, and overland moves. The duration of these impacts would be short term ranging up to 5 months, and recovery would vary from 1 to several years.

Impacts associated with oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. The effects of oil and gas development and operation would include destruction of vegetation during the construction of under gravel pads, roads, and airstrips, excavation of material sites, construction of VSMs, and spills of oil and other chemicals. An estimated 665 to 5,985 (4,215) acres would be directly and indirectly impacted from development (approximately 730 more acres than for Alternative B, 1,405 more acres than for the final Preferred Alternative, and 3,465 more acres than for the No Action Alternative); vegetation impacted by oil spills could comprise another 155 acres. Plant communities could also be altered by dust deposition, gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. These impacts would be permanent except for those associated with spills, which would be cleaned up, allowing for recovery within a few years to several decades.

It is assumed that impacts to vegetation types or communities would occur in proportion to their occurrence within the Planning Area. However, increased development in the area around Teshekpuk Lake, and across the 213,000 acres that would be off-limits to oil and gas leasing and development under Alternative B but would be open to leasing under Alternative C, could disproportionately impact wet vegetation classes. A higher percentage of wet vegetation communities occur in areas in the northern portion of the Planning Area. This area is also considered to have the highest potential for oil reserves, which would increase the likelihood that these areas would be developed under Alternative C.

Under Alternative C, development would be unlikely to substantially affect any common plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope, plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the No Action Alternative and Alternative B, and may be protected under the final Preferred Alternative, but would not be protected under Alternative C. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir's fleabane, Drummond's bluebell, and Hartz's bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003), and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.6 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 Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. All of the Northeast National Petroleum Reserve – Alaska would be open to oil and gas leasing under Alternative C. The Goose Molting Area, in particular, contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass. Under Alternative C, these areas would be more likely to be developed and these vegetation classes would likely be impacted to a greater extent than under the other alternatives.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.6.1 Soils

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. Impacts from winter exploration and well drilling would also be minor. Development would cause the loss or disturbance of 560 to 5,105 (3,590) acres of wetland 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. 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.

4.5.6.2 Water Resources

Water Resources

Seismic impacts should be minimal. Construction of gravel roads, pads, and structures associated with oil and gas development could cause impacts to water resources in the Planning Area. The potential long-term impacts from exploration and delineation would occur from water impoundments, diversions, thermokarst erosion and sedimentation on approximately 24 acres of wetlands. Long-term impacts from development of gravel roads, pads, and pits could directly and indirectly impact 560 to 5,105 (3,590) acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice pad and ice road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water. Gravel construction of pads, within-field roads, and field airstrips, and gravel removal would impact about 1,310 acres of wetlands for the 12 fields proposed. Gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long term (decade-or-more) effects from development of gravel roads, pads, and pits could occur on 560 to 5,105 (3,590) acres of wetlands. Oil spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes, and could cause ponds or small lakes to remain toxic to sensitive species for several years.

4.5.6.3 Vegetation

Impacts from activities, other than oil exploration and development, would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor.

Impacts from oil exploration would include vegetation disturbance on 6,980 and 45,125 acres of wetlands per survey from 2-D and 3-D seismic surveys, respectively. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines, and 95 percent for camp trails, resulting in approximately 190 acres of long-term impacts to wetlands. Ice road construction would have impacts on up to 205 acres, and ice pads on 29 to 285 (190) acres, of wetlands per year. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of staging areas, gravel pads, roads, airstrips, pipelines, pump stations, and the excavation of material sites, would cause the destruction of vegetation on 180 to 1,875 (1,310) acres of wetlands and the alteration in plant species composition on an additional 450 to 3,810 (2,690) acres. These impacts would be permanent, assuming that gravel pads would remain after production ended, although some plant species would be able to grow on the pads (McKendrick 2000). This would represent about 0.1 percent of the Planning Area, and, as such, no plant species or community would likely be affected. If a development facility were to be placed over a rare plant population, the effects on that population could be high. However, careful siting of facilities after site-specific environmental analysis, as required by ROP E-12, should avoid and protect rare plant species.

Lease stipulations and ROPs would be effective in limiting the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modification, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Approximately 30 to 285 acres of wetland vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska under the Alternative C, and the most likely sources of gravel occur in the floodplains of rivers in the Planning Area.

4.5.6.4 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations identified above for soil, water, and vegetation resources would apply to wetlands. These lease stipulations would be effective in minimizing impacts to wetlands from waste discharges and spills, and from direct and indirect surface impacts associated with non-oil and gas and oil and gas activities. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.5.6.5 Conclusion

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Under Alternative C, all of the Planning Area would be available for leasing.

Impacts from oil exploration would include disturbance on up to 6,980 (2-D) and 47,500 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 180 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about 209 acres annually, and ice pad construction would impact about 520 acres of wetlands during the life of the project.

The effects of oil and gas development and operation would include destruction of vegetation during the construction of under gravel pads, roads, and airstrips, excavation of material sites, construction of VSMs, and spills of oil and other chemicals. An estimated 665 to 5,985 (4,215) acres would be directly and indirectly impacted from development (approximately 730 more acres than for Alternative B, 1,405 more acres than for the final Preferred Alternative, and 3,465 more acres than for the No Action Alternative). 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). Long-term direct and indirect impacts to wetland vegetation would occur on approximately 0.01 to 0.13 percent of the Planning Area.

4.5.7 Fish

4.5.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

It is expected that non-oil and gas ground activities occurring under Alternative C would be similar to those occurring under the other alternatives. Any impacts to fish or fish habitat resulting from these activities should be minor and have no measurable effect on fish populations within the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Potential threats to overwintering fish from seismic surveys in the Planning Area would primarily stem from: 1) stress associated with acoustic energy pulses transmitted into the ground directly over overwintering pools; and 2) physical damage to overwintering habitat caused by seismic vehicles. Large overwintering pools might allow fish to flee immediate areas of intense stress, whereas fish occupying small pools might not have that option. Depending on proximity, adult fish could suffer no more than temporary discomfort, whereas intense acoustical pulses could be lethal to juveniles. Given that overwintering habitat represents only about 5 percent of the Planning Area, it is unlikely that seismic transmissions would occur directly over overwintering sites with any degree of regularity. Furthermore, seismic crews could avoid known overwintering areas.

Under Alternative C, seismic exploration in Teshekpuk Lake could occur during the summer open water period using airgun arrays and explosives (although the use of explosives is unlikely). Impacts from Vibroseis and airgun arrays under Alternative C would be identical to those for Alternative B.

Pressure pulses from airguns have long rise times and cause relatively little injury to fish. Explosives, in comparison, have shorter rise times and are generally more detrimental to fish (Wright and Hopky 1998). The received impulse depends on the mass of the charge, the depth of the charge, the distance from the charge to fish, and the depth of the fish. The peak pressure generated by an airgun array is less than that produced by a small charge of explosives. Most blast injuries to fish involve damage to air or gas-containing organs (Yelverton 1981). All of the species of fish present in Teshekpuk Lake have swim bladders and would be vulnerable to explosives. During exposure to shock waves, the swim bladder oscillates and may rupture, causing hemorrhages in nearby organs. In extreme cases, the oscillating swim bladder may rupture the body wall of the fish. The use of explosives in Teshekpuk Lake would likely result in the mortality of some fish present in the lake. The number of fish impacted would depend on the frequency and size of the charge used and the location of charges relative to fish in the lake.

The level of seismic activity may be marginally higher under Alternative C than under Alternative B and the final Preferred Alternative, but any impacts would be localized. Therefore, seismic activities associated with Alternative C are expected to be minor and not have a measurable effect on fish populations within and adjacent to the Planning Area.

Effects from Water Demand. Most freshwater bodies are less than 6 feet in depth and typically freeze to the bottom. It has been estimated that by late winter, ice cover can decrease available freshwater habitat in North Slope rivers and streams by approximately 97 percent (Craig 1989b). Overwintering areas are therefore limited to deep-water pools and channels in rivers and streams, and to lakes deep enough to provide sufficient under-ice free water during winter. In standing waters, 7 feet is considered the minimum depth for supporting overwintering fish (PAI 2002). Because of the importance of limited overwintering area to Arctic fish, ROPs and lease stipulations specifically regulate the winter withdrawal of water from lakes, rivers, and streams. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be similar to those for the other alternatives. Under Alternative C, water withdrawal would increase proportionately to increased exploration and development, however, careful adherence to ROPs and lease stipulations should offer adequate protection to fish. Winter water withdrawal associated with Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Exploratory Drilling. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be similar to those developed for the No Action Alternative and Alternative B. The number of exploratory wells could increase by 3-fold under Alternative C relative to the No Action Alternative, but the prohibition of drilling in rivers and streams should provide fish with adequate protection. Therefore, exploratory drilling activities associated with Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Gravel Extraction. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be identical to that for the No Action Alternative. Under Alternative C, gravel extraction would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area, and could even enhance habitat.

Effects from Pad, Road, and Pipeline Construction. Relative to the No Action Alternative, a greater number of pads and roads (2- to 4-fold increase), and pipelines (3-fold increase) would be constructed under Alternative C, and would be dependent on the amount of recoverable oil and gas reserves eventually brought into production. Rigorous adherence to pre-development environmental assessment, structure siting, and construction codes should adequately protect fish from construction and operation-related impacts. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be nearly identical to that discussed under the No Action Alternative. The construction and placement of drill pads, roadways, pipelines, bridges, and culverts under Alternative C should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Causeways. Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be nearly identical to that discussed under the No Action Alternative. The future construction of a causeway or dock would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area, even if there were a greater level of activity associated with exploration and development, relative to other alternatives.

Effects from Waterflooding. Oil fields in the northern portion of the Planning Area would likely receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area under Alternative C. These facilities, which have been operational for years, have not been shown to have a serious effect on fish migrating or foraging in the intake area. If seawater intake facilities were constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. Therefore, under Alternative C, waterflooding would not be expected to have a measurable effect on anadromous and amphidromous fish, regardless of any increase in exploration and development activities.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

Under Alternative C, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be nearly identical to those discussed under the other alternatives. Under Alternative C, the number of small spills is estimated to be 5 times greater than the number of spills projected to occur under the No Action Alternative, and two of these spills could be large (>500 bbl). Rigorous adherence to oil spill safety protocols and clean-up policies would effectively protect critical fish habitat. Therefore, oil spills would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area under Alternative C.

Effectiveness of Stipulations and Required Operating Procedures

The effectiveness of lease stipulations and ROPs in protecting freshwater, anadromous, and amphidromous fish and fish habitat under Alternative C is identical to the effectiveness of those for Alternative B, and similar to those developed for the final Preferred Alternative and for the No Action Alternative.

Conclusion

Activities proposed under Alternative C should have only minor effects on fish and their habitats. By opening up additional lands near Teshekpuk Lake to leasing, fish in this lake and other deep-water lakes and streams would have a greater potential to be impacted by spills and habitat degradation, resulting in greater risks to fish under this alternative than under the other alternatives.

In general, impacts to fish from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to fish from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production cease in an area, fish populations and habitat could recover, reducing overall effects in the Planning Area. Surface disturbance and spill-related impacts associated with Alternative C are projected to be several-fold greater than for the No Action Alternative. Performance-based ROPs and lease stipulations developed for this alternative, however, would ensure the exploration and development activities are set back from fish habitats and that procedures are in place to clean up most spills before they can harm fish or their habitats.

4.5.7.2 Marine Fish

Activities Not Associated With Oil and Gas Exploration and Development

Most non-oil and gas activities, including recreational fishing, would be quite limited in scope and duration. In addition, recreational fishermen do not target marine fish. Therefore, it is not expected that non-oil and gas activities occurring under the Alternative C would have a measurable effect on marine fish in the vicinity of the Planning Area.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Seismic surveys could be conducted within the Planning Area during the winter months, from early December to mid-May and on Teshekpuk Lake during the summer. Because marine fish and their habitat lie outside the Planning Area in winter and Teshekpuk Lake during the summer, seismic activities associated with Alternative C would not be expected to have a measurable effect on marine fish populations.

Effects from Water Demand. Water used in the building of drill pads, roads, and airstrips would likely be withdrawn from freshwater sources proximal to the site of construction. These activities would have no effect on marine fish or their environment. Water withdrawal for the purposes of waterflooding, which would have implications for the marine system, is discussed separately below under the “Effects from Waterflooding” subheading.

Effects from Exploratory Drilling. Most exploratory drilling would be conducted within the Planning Area during the winter months, from early December to mid-April. Because marine fish and their habitat lie outside the Planning Area in winter, most exploratory activities associated with Alternative C would not be expected to have a measurable effect on marine fish populations. Exploratory drilling could also be conducted from current production pads or platforms within a lake body during summer in the TLCH Area, but impacts to marine fish would be minor.

Effects from Gravel Extraction. It is doubtful that gravel extraction would be permitted along the coastal tidal zone. Small numbers of fourhorn sculpin and Arctic flounder could migrate upriver in summer, but any encounter with a gravel site would be a chance occurrence, and would involve only a minor segment of any population. Fourhorn sculpin and Arctic flounder regularly inhabit and forage in highly turbid coastal waters near river outfalls and plumes. Gravel extraction would not benefit fish populations by creating overwintering habitat, as it might for freshwater fish, since all marine fish overwinter at sea.

Effects from Pad, Road, and Pipeline Construction. Under Alternative C, a greater number of pads, roads, and pipelines associated with expanded exploration and development activities relative to the No Action Alternative would occur, primarily inland rather than in coastal areas. The construction of pads, therefore, is not expected to have a measurable effect on marine fish populations within and adjacent to the Planning Area under Alternative C. Under Alternative C, the general level of protection to freshwater, anadromous, and amphidromous fish and fish habitat offered by ROPs and lease stipulations for this alternative would be nearly identical to those developed for the No Action Alternative.

Effects from Causeways. Under Alternative C, restrictions on the use, design, and monitoring of causeways that might be constructed along the coast in the future would be nearly identical to those discussed under the No Action Alternative. Any future construction of causeways or docks would not be expected to have a measurable effect on marine fish populations within and adjacent to the Planning Area even if there were a greater level of activity associated with exploration and development, relative to the other alternatives.

Effects from Waterflooding. Under Alternative C, waterflooding is not expected to have a measurable effect on marine fish, for the same reasons given above for anadromous and amphidromous fish, even if there were a greater level of activity associated with exploration and development, relative to the other alternatives.

Effects of Spills

The threat to marine fish from an oil spill is contingent upon the spill reaching coastal waters at volumes capable of affecting large nearshore areas. Because oil spills in the Planning Area are expected to be small, and given the stringent oil-spill-response safety requirements for operations on the oil field, there is a minor likelihood that an inland spill would reach coastal/marine waters of the Planning Area at volumes capable of causing a biologically measurable impacts to marine fishes.

Effectiveness of Stipulations and Required Operating Procedures

Under Alternative C, the general level of protection to fish and fish habitat offered by lease stipulations and ROPs would be identical to that discussed under Alternative B, and similar to that for the final Preferred Alternative. Lease Stipulation K-6 specifically prohibits permanent oil and gas development within ¾ mile inland from the coastline, unless the AO grants an exception. Thus, greater protection is afforded marine fish under the Alternative C than the No Action Alternative.

Conclusion

In general, marine fishes of the Beaufort Sea are insulated from many potential environmental impacts associated with oil and gas development in the Planning Area. Most of the coastal tidal area of the Planning Area is shallow and lies within the winter landfast ice scour zone. Thus, the marine habitat and the fish occupying it are outside the Planning Area proper during winter and would not be subject to disturbances associated with seismic surveys, exploration drilling, and water withdrawal. Although species like fourhorn sculpin and Arctic flounder may move upriver during summer, most members of these marine species remain in shallow coastal waters. The bulk of the population would not be directly subject to the effects of river gravel extraction; pad, road, and pipeline construction; sedimentation from gravel erosion; and the potential blockage of migratory corridors.

Because marine species are abundant and widely distributed throughout the Beaufort Sea, it is also highly unlikely that any point impact associated with oil and gas development in the Planning Area (the occurrence of which is unlikely) could substantially affect these marine species at the population level. One exception might be a catastrophic oil spill that could cause sublethal genetic or physiological abnormalities that might be propagated through the broader population. However, given that oil spills in the Planning Area are expected to be small, and the stringent oil-spill-response safety requirements for operations on the oil field, such an event is unlikely.

4.5.7.3 Essential Fish Habitat

Although there are no federally-managed fisheries in the Beaufort Sea, the ranges of the five species of Pacific salmon under the jurisdiction of the North Pacific Fisheries Management Council extend into the Beaufort Sea. Freshwater EFH for salmon includes all streams, lakes, ponds, wetlands, and other water bodies that have been historically accessible to salmon. Marine EFH includes all estuaries, tidewater and tidally submerged habitats, and marine areas used by Pacific salmon seaward to the 200 mile limit of the U.S. Exclusive Economic Zone.

Of the five species of Pacific salmon, three (chinook, sockeye, and coho salmon) are extremely rare, and no spawning populations or sites have been identified in the Beaufort Sea for these species (Craig and Haldorson 1986, Fechhelm and Griffiths 2001). Small runs of pink and chum salmon occur in the Colville River (Bendock 1979b, McElderry and Craig 1981), and in recent years pink salmon have been taken near the Itkillik River as part of the fall subsistence fishery (George 2004). No known spawning sites for these species have been identified. Although both species are taken in the Colville River and Itkillik River fall subsistence fisheries, they constitute only a minor portion of total catch (Pedersen and Shishido 1988 *in* Craig 1989b; Moulton 1994, 1995, 1996b, 1997). The salmon populations in and adjacent to the Planning Area can be considered marginal.

Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities were to jeopardize the fish species upon which the fisheries depend. It is not expected that non-oil and gas activities would have a measurable effect on fish populations, and therefore subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

Oil and gas activities should not have a measurable effect on subsistence fisheries within and adjacent to the Planning Area under Alternative C. Under Alternative C, the general level of protection to freshwater, anadromous, and amphidromous fish and fish habitat offered by lease stipulations and ROPs would be identical to that discussed under Alternative B.

Effectiveness of Stipulations and Required Operating Procedures

Protections provided by the performance-based ROPs and lease stipulations under the final Preferred Alternative and alternatives B and C are similar to prescriptive-based lease stipulations developed for the No Action Alternative. The Tingmiaksiqvik River is afforded protection under Alternative B and the final Preferred Alternative, but not under Alternative C or the No Action Alternative. Oil and gas development would be allowed in Teshekpuk Lake under Alternative C; this area would be closed to leasing under the No Action Alternative and final Preferred Alternative.

Conclusion

It is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the Alternative C. Lease stipulations developed for all alternatives afford similar levels of protection.

4.5.8 Birds

This section discusses the potential effects to birds that could result from management action in the Planning Area under Alternative C. Activities that could affect birds in the Planning Area include oil and gas exploration and development, subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could result in: (1) temporary or permanent habitat loss; (2) various types of disturbance that could result in displacement from foraging, nesting and brood-rearing habitats; (3) increased predation pressure from predators attracted to areas of human activity; and (4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills.

4.5.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, activities not related to oil and gas exploration and development that could affect birds in the Planning Area would be the same as those described under the other alternatives: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. The potential for disturbance, displacement, or mortality from non-oil and gas related activities would likely be similar under all alternatives. Lease stipulations to protect waterfowl, shorebirds, raptors, and other birds and their habitats would help to mitigate the potential effects of non-oil and gas activities on birds under Alternative C.

4.5.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Seismic Exploration

Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when most birds are not present in the Planning Area. Under Alternative C, the types of effects of winter exploration activities on the bird species that would be present in the Planning Area would be the same as those discussed under the other alternatives. Although impacts associated with winter exploration would likely be minor under any of the alternatives, there could be a slightly greater effect to birds under Alternative C, because a greater area would be available for exploration than under the other alternatives, and much of this area has a high level of bird use. The direct effects of exploratory activities would likely include the temporary displacement of a small number of birds from preferred feeding or roosting areas.

During winter exploration activities, potential indirect impacts to birds could result from the construction of ice roads and ice pads and the associated water withdrawal. The types of effects that could result from ice road and ice pad construction under Alternative C would be the same as those described under the other alternatives, and would primarily involve the temporary alteration of tundra habitats. Water withdrawal for ice road construction could also temporarily alter habitats adjacent to water source lakes, which could affect nesting or brood-rearing loons and waterfowl. Rolligons and track vehicles used during winter exploration could also temporarily affect tundra vegetation, resulting in minor impacts to tundra habitat of nesting birds. A larger area would be available for oil and gas exploration activities under Alternative C, as compared to the other alternatives. Therefore, the potential impacts resulting from exploratory activities would also be greater under Alternative C. Under Alternative C, moderate effects to birds could occur in the Goose Molting Area, the entire area of which would be unavailable for oil and gas leasing under the No Action Alternative and portions of which would be unavailable for leasing under Alternative B. However, Lease Stipulation K-4 would mitigate some potential impacts in the Goose Molting Area by prohibiting water extraction and other oil and gas activities that could affect goose feeding habitat along lakeshore margins.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to bird nesting near the lakeshore, only birds using open water habitats in the lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities, such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting surveys after the completion of the nesting and brood-rearing periods would eliminate the potential for nest abandonment and loss of productivity. The use of explosives for seismic surveys under Alternative C would likely cause disturbance similar to that described for seismic activities using airgun arrays. However, the use of explosives could potentially cause bird mortality if diving birds were feeding near the charge.

Predators, such as glaucous gulls, ravens, and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Increased levels of predation could have moderate impacts on tundra-nesting birds. Under Alternative C, ROPs A-2 and E-9 would mitigate the potential effects of increased predation, and the overall effect to birds would likely be similar under the four alternatives. However, it would likely be difficult to prevent ravens from nesting on oil field structures and increased levels of predation from ravens may be difficult to mitigate under any alternative.

Oil and Gas Development

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, heavy equipment use, and oil-spill clean-up activities, could cause disturbances that would affect tundra-nesting birds. Under Alternative C, the types of disturbances to birds would be the same as those discussed under the other alternatives. These disturbances could result in moderate impacts that could result in temporary or permanent displacement of birds from preferred foraging, nesting, and brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition, rate of survival, and reproduction. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the bird species and the number of individuals in the area, and the time of year. Impacts from disturbance would most likely occur in habitats with high bird concentrations, or if species with low population numbers or declining populations, such as the buff-breasted sandpiper or yellow-billed loon, were disturbed.

The potential for disturbance to birds from activities on roads and pads would likely be greater under Alternative C, as compared to the other alternatives, because areas that support high bird concentrations occur in the Teshekpuk Lake Goose Molting Area and would be available for oil and gas leasing under Alternative C, but not under the other alternatives. This area is of international importance for molting brant and other geese, and the highest densities of nesting shorebirds in the Planning Area occur in areas northeast and northwest of Teshekpuk Lake (Map 3-19). Disturbance that resulted in a reduction in the breeding success of geese and other waterfowl could impact the success of subsistence and sport hunters in Alaska, the lower 48 states, Canada, Russia, and Mexico. Disturbance effects could impact shorebirds if development occurred in areas of high shorebird concentration located north of Teshekpuk Lake. Lease Stipulation K-4, however, would help to mitigate potential disturbance to birds in the Goose Molting Area by providing setbacks from lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; and protect the goose molting lakes from disturbance from oil and gas activities by requiring features that would screen or shield human activity from the view of any goose molting lake, and by minimizing ground traffic from May 20 through August 20. In addition, Lease Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This lease stipulation could also help to reduce the potential impacts to waterfowl habitats in coastal areas. Although these lease stipulations would be in place under the other alternatives, there would be a greater potential for disturbance to waterfowl and other birds under Alternative C because there would be a larger area of high bird use in which activities could occur.

Air-Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of disturbance effects to waterfowl and other bird groups from aircraft would be the same under Alternative C as those discussed under the other alternatives. Aircraft disturbance could have moderate impacts on tundra-nesting birds or on molting geese that could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting and brood-rearing areas. However, some birds could acclimate to aircraft activity by either remaining in habitats located near aircraft activities, or by moving to nearby habitats. This may not be the case for brant, as they apparently do not habituate well to aircraft traffic (Derksen et al. 1992).

Compared to the other alternatives, it is likely that there would be a greater amount of disturbance to birds under Alternative C, as aircraft traffic, including take-offs and landings, could occur in the entire Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area (where surface activity was prohibited under the No Action Alternative). Under Alternative C, Lease Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and other potentially disturbing activities, such as vehicular and air traffic, would be restricted. These lease stipulations would help to mitigate for potential aircraft disturbance should oil and gas facilities be located within the Goose Molting Area. However, the potential for disturbance would be greater under Alternative C than under the other alternatives, given the larger area available for oil and gas leasing.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting waterfowl, could occur in offshore waters of the Planning Area from mid-July through October. The impacts of disturbance from barge traffic would likely be minor and displaced waterfowl would probably move to adjacent habitats or return to original habitats after the barges passed though the area. There would be a greater likelihood for disturbance to molting waterfowl under Alternative C than under the No Action Alternative because much of the area adjacent to the coast would be open for leasing under Alternative C, but unavailable for oil and gas development under the No Action Alternative. There could also be a potential for more offshore vessel traffic under Alternative C, as compared to the final Preferred Alternative and Alternative B, given the larger area that would be available for oil and gas leasing in the Goose Molting Area under Alternative C. It is likely that more development would occur in the Goose Molting Area under Alternative C, which would increase the likelihood that barge traffic would be required in the offshore waters of the Planning Area to transport equipment and supplies.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Disturbance from watercraft activity along rivers could affect birds such as ruddy turnstones, semipalmated plovers, and Baird’s sandpipers that use gravel bars. The results of disturbance may include failure to nest or nest abandonment. Under Alternative C, these activities would be more likely to disturb waterfowl and other birds, than under the No Action Alternative, because there would be a greater likelihood that facilities would be located in areas of high bird use within the Teshekpuk Lake Special Area. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training, to minimize the potential disturbance to waterfowl, would be identified.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. During the construction of oil field roads and pads, tundra covered by gravel, as well as tundra associated with gravel mine sites, would be lost as nesting, brood-rearing, and foraging habitat for birds. Under the development scenario for Alternative C, the amount of habitat directly lost could be as great as 1,970 acres. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. Birds that use drier habitats may be more affected by habitat loss than those that use wet habitats because less dry habitat is available in the National Petroleum Reserve – Alaska. Loss of dry habitat could be especially important for buff-breasted sandpiper, which is a species of concern with low population numbers that uses dry habitats. The potential impacts of habitat loss to birds would be greater under Alternative C than under the other alternatives, because a greater amount of tundra would be covered by gravel placement, and because areas of high bird use north of Teshekpuk Lake that would be closed to leasing and development under the No Action Alternative and Alternative B would be open to development under Alternative C. In addition, compared to the other alternatives, under Alternative C there would be an increased potential for birds to be affected by a functional loss of habitat in areas near roads and pads if development-related disturbances precluded birds from utilizing these habitats. The lease stipulations and ROPs, which would apply under Alternative C as well as the other alternatives, would help to mitigate the potential effects of habitat loss.

Temporary Habitat Loss. Temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. Water withdrawal from lakes during ice-road construction could temporarily affect birds in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative C, the types of effects to birds resulting from temporary habitat loss would be the same as those discussed under the other alternatives. Under Alternative C, there would be a greater potential for temporary habitat loss to impact birds than under other alternatives because of the increased size of the development scenario under Alternative C, and because areas of high bird use north of Teshekpuk Lake that would be closed to leasing and development under the No Action Alternative and Alternative B would be open to development under Alternative C. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by bird populations. Lease stipulations and ROPs that would apply under Alternative C would help to mitigate potential effects of habitat loss.

Mortality

Bird mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment is discussed under the No Action Alternative. The potential impacts to bird populations as a result of collisions in areas of oil and gas development would likely be minor. There would be an increased risk of bird collision with offshore barge and vessel traffic under Alternative C as compared to the No Action Alternative. There could also be a greater potential for bird collisions with offshore vessel traffic under Alternative C than under the other alternatives, given the larger area available for development in the Goose Molting Area under Alternative C, which could increase the potential for development and associated vessel traffic in that area.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing impoundments of water. Delay in the melting of ice roads could also cause the complete loss of nesting habitat for a season, or cause compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same level as, those caused by traffic during construction and production. If pads, roads, and airstrips were not revegetated, their value to birds would be reduced. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that existing in the area at the time of disturbance could be created and used by birds, though the precise mix of habitat types would likely not be the same as what originally existed. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material's toxicity and the amount ingested, ingestion of foam could cause sickness or mortality, though the numbers of birds harmed or killed would be very small.

Effects of Spills

Oil spills would have similar types of effects to tundra-nesting birds under all alternatives. However, there would be an increased risk of an offshore spill occurring under Alternative C because there would be increased barge traffic. Offshore spills would have the potential to spread through the action of wind and currents, and could affect molting waterfowl along the coastline or in Harrison and Smith bays, as well as shorebirds feeding in littoral habitats in the Colville River Delta.

In the remaining portion of the Planning Area, the potential for an oil spill to affect birds would be greatest under Alternative C, given that none of the Goose Molting Area would be excluded from oil and gas leasing. Lease Stipulations K-1, K-3, K-4, and K-6, which would provide setbacks from specified rivers, lakes, and the Beaufort Sea coast within which permanent oil and gas facilities would be prohibited, would help to mitigate the potential effects of an oil spill on terrestrial habitats under Alternative C. If a facility was permitted within the ¼–mile buffer around fish-bearing lakes under Alternative C, there could be a slightly greater potential for an oil spill in the Deep Water Lakes Area to impact waterfowl. Lease Stipulation K-2 would require consultation with regulatory agencies prior to the construction of a permanent facility within the buffer zone. Although Lease Stipulation K-2 was designed specifically to mitigate potential impacts to fish habitat, it may also help protect loons and waterfowl associated with lakes in the Deep Water Lakes Area.

Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe. Waterfowl along the shoreline or in marine habitats and shorebirds in the littoral areas of the Colville River Delta could be impacted during the fall molting and staging period. Under the final Preferred Alternative and alternatives B and C, the potential that an oil spill would enter a major river or stream would be minimized by Lease Stipulation K-1. This lease stipulation would provide setbacks of ½ to 1 mile from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines would not necessarily be prohibited in some of these areas. The No Action Alternative has similar lease stipulations.

4.5.8.3 Effectiveness of Stipulations and Required Operating Procedures

Numerous ROPs and lease stipulations were developed for Alternative C to protect birds and their habitat within the Planning Area. These include the “A” ROPs, which would be effective in ensuring that solid, liquid, and hazardous wastes do not impact birds or their habitats, and in reducing the potential for garbage to attract animals that may prey upon birds to exploration and development sites. The “B” ROPs would be effective in ensuring that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while the “C” ROPs govern seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP “F.” Several of the “K” lease stipulations would be effective in protecting birds and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area. Lease Stipulation K-4 provides for a number of effective measures designed to reduce the effects of development on molting geese by establishing setbacks from lake shorelines within which construction of permanent oil and gas facilities would not be permitted, regulating water extraction from lakes, and minimizing or eliminating disturbance from aircraft during critical periods. However, this lease stipulation also allows construction of facilities, such as platforms on lakes, if these structures are located more than ¾ mile from the shoreline. Activities at offshore platforms could increase disturbance to molting geese.

4.5.8.4 Conclusion

Under Alternative C, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic; routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be similar to those described for the other alternatives. In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

The potential for these disturbances to impact birds would be about 6 times greater under Alternative C than the No Action Alternative, because a greater percentage of the Planning Area would be available for leasing, including portions of the area of high bird use in the Teshekpuk Lake Special Area. Impacts to birds from disturbances could be even greater if oil and gas activities occurred in areas with high bird concentrations, with high quality habitat, or used by species of concern. The potential for habitat loss and alteration to affect tundra-nesting birds would also be greater under Alternative C, as compared to the other alternatives. Under this alternative, the amount of tundra habitat that would be lost to gravel infrastructure would be greater, and there would be a higher potential for infrastructure to be located in areas of high bird use in the Teshekpuk Lake Special Area. The potential for bird mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic, and for an oil spill to impact tundra-nesting birds, would also be greater under Alternative C, as compared to the other alternatives, given the increased amount of infrastructure and development activity. Lease stipulations and ROPs established for Alternative C would help to mitigate potential impacts to tundra-nesting birds.

4.5.9 Mammals

4.5.9.1 Terrestrial Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Impacts to terrestrial mammals under Alternative C would be similar to those that would occur under the other alternatives, but could be more frequent, greater in extent, or longer in duration. 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 the camps and along aerial survey routes. The disturbance reactions of caribou and other terrestrial mammals would likely be brief, lasting for a few minutes to an 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. Impacts from recreation and overland moves would be the same as under the No Action Alternative. Current management practices and lease stipulations addressing land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

Oil and Gas Exploration and Development Activities

Under Alternative C, oil and gas leasing and exploration would be allowed throughout the Planning Area with no exclusions. Lease stipulations and ROPs would be in effect that would provide seasonal and spatial protection to certain environmentally sensitive areas, including Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Rivers Area, Coastal Area, and Teshekpuk Lake. Terrestrial mammals would be exposed to greater potential impacts under Alternative C compared to the other alternatives, given the leasing of all lands surrounding Teshekpuk Lake.

Effects of Disturbances

Impacts to terrestrial mammals under Alternative C would be similar to those discussed under the other alternatives, but would be greater in frequency and extent, due to the greater number of seismic surveys, the larger area open to surveys, and the high oil and gas potential of the northern portion of the Planning Area.

A larger 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. It is expected that the reactions of caribou and other terrestrial mammals to disturbance would be brief, although large numbers of wintering TLH caribou could be encountered, depending on the location. Some caribou and other large mammals would likely be displaced from the general area of the seismic work. Some terrestrial mammals would avoid seismic camps, while others, such as foxes, could be attracted to the camps by food odors. The potential for disturbance to hibernating grizzly bears would be greater under Alternative C than the other alternatives because of the increased level of seismic activity occurring in the Planning Area. However, bears are present at low density. Muskox and moose would most likely be present in their greatest numbers in the southern portion of the Planning Area, so impacts would be similar to those that would occur under Alternative B, although the larger number of surveys would likely result in greater impacts. A greater number of lemmings and voles could be killed or disturbed by surface vehicles. However, these impacts would have a minor effect at the population level.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake.

Exploratory Drilling. Under Alternative C, it is projected that seven to 70 exploration wells and five to 52 delineation wells would be drilled. Impacts to terrestrial mammals would be greater than those discussed under the No Action Alternative and Alternative B, as more exploration would occur, and potentially in the area to the north of Teshekpuk Lake which is rated “high” for oil and gas potential and which would be excluded from drilling under the No Action Alternative and Alternative B. Most exploratory drilling would be conducted during the winter when wildlife are largely absent, although wintering TLH caribou could be present in large numbers. Exploratory drilling could also occur during summer from current production pads or platforms within lakes in the TLCH Area. If more exploration activity occurred in the southern portion of the Planning Area moose, muskox, and grizzly bears could experience a greater level of impacts than under the other alternatives.

The implementation of ROPs and lease stipulations should ensure that exploratory drilling impacts to terrestrial mammals are minor. These ROPs and lease stipulations would include provisions to avoid known grizzly bear dens by ½ mile, methods to avoid attracting wildlife to food and garbage, provisions to protect stream banks from damage during overland moves, provisions to minimize the effect of low-lying aircraft on wildlife (particularly over caribou winter ranges), and provisions to minimize the disturbance and hindrance of caribou in the TLCH Area.

Oil and Gas Development. The entire Planning Area would be made available for leasing under Alternative C. The primary effects of oil and gas development on terrestrial mammals would be similar to those outlined under the No Action Alternative, and would result from the 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 habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of calving areas and interference in the movement of insect-harassed TLH caribou between insect-relief habitat and foraging areas. These impacts would likely be greater under Alternative C than under the other alternatives, given the larger development scenario, and the inclusion of the high potential lands in the northern portion of the Planning Area.

<u>Caribou</u>

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. If a field were developed in the region surrounding Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH caribou for calving, insect relief, migration, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the other alternatives. However, given the greater possibility that a field would be developed within the calving, insect-relief, migration, and wintering grounds of the TLH caribou, impacts to caribou could be substantially greater and more likely under Alternative C, than under the other alternatives. Overall, the level of impact would be dependent on the specific location of any oil field. A field in the central or southern portion of the Planning Area would not impact the TLH caribou calving grounds, although such a development could still affect the migratory movements of TLH and WAH caribou, and their winter habitat.

Development in the TLH caribou calving grounds could displace some calving animals within 2½ miles of roads. Movements of some cows and calves across roads would also likely be reduced, and cow caribou might avoid crossing the roads during the calving season. Some TLH caribou movements during the insect-relief season (late

June-August 15), including movements to coastal insect-relief habitats, could be affected by pipelines and road traffic, depending on facility placement and design.

Traffic could result in local disturbance and displacement of caribou within about 1 mile of the disturbance. A pipeline linking oil fields in the Planning Area with facilities at the Alpine and Kuparuk River Unit oil fields would result in the disturbance and displacement of some caribou during winter construction, given vehicle traffic along ice roads and air traffic. It is expected that these disturbances would be short term and occur within about 1 mile of the pipeline corridor. A connecting pipeline between a northern field development and the Alpine and Kuparuk River Unit oil fields could impede caribou migrations.

Construction of permanent roads would increase access to the area for public and subsistence hunting. Caribou would be most affected by increased hunting pressure. However, other species (moose in particular) may also be affected depending on the location of the roads. The overall number of animals taken is unlikely to increase dramatically since most hunting would be for subsistence use, but roads could focus hunts in particular portions of the Planning Area. Hunting pressure and harvests have increased for many wildlife species near the TAPS since its construction, but have not produced adverse population effects (TAPSO 2001). It is unlikely that the more remote roads associated with oil and gas development in the Planning Area would have as great an effect on wildlife populations as has occurred along the TAPS corridor.

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. Unless an oil field were to be developed in the southern portion of the Planning Area, development would be unlikely to impact moose. Under Alternative C, impacts to moose would be similar to those that would occur under the other alternatives, although they could be greater in duration and spatial extent, given the larger overall development scenario under Alternative C.

If gravel were mined from the southern portion of the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could destroy or degrade between 20 and 50 acres of moose habitat for each gravel pit.

Muskox

Muskox occur in low densities in the Planning Area, although they may be present year-round. 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 placement at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities. Under Alternative C, impacts to muskox would be similar to those discussed under the other alternatives, although they could be greater in duration and spatial extent due to the larger overall development scenario. Impacts to muskox would be greater if development were to occur in the southern portion of the Planning Area.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. Under Alternative C, impacts would be similar to those that would occur under the other alternatives, although the extent and duration of the impacts could be greater because of the larger overall development scenario, depending on the location of the field development. Grizzly bears are present in low numbers in the northern portion of the Planning Area, but may be attracted to development activities. It is likely that the greatest number of bears would be encountered during development in the southern portion of the Planning Area, since the greatest amount of suitable habitat is located in this area.

Wolves

Under Alternative C, oil and gas development would have a minor impact on wolves, similar to the final Preferred Alternative and Alternative B, but would be greater than the impact that would occur under the No Action

Alternative. Potential effects to wolves would 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 associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be affected. However, wolves are generally not abundant in the Planning Area.

Wolverines

Wolverines are uncommon in the Planning Area and sightings have been infrequent. Documented sightings and harvest locations suggest that wolverines could be encountered along rivers and in the vicinity of Teshekpuk Lake. The potential effects of oil and gas development on wolverines 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 could be sensitive to oil exploration and development activities and avoid areas near oil development. If caribou abundance were affected by oil development, wolverines could also be affected. Alteration of riparian habitats through gravel excavation or buried pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas for wolverines. Under Alternative C, some wolverines could be displaced near (within a few miles) oil field facilities. Impacts under this alternative are likely to be greater than those that would occur under the other alternatives, given the larger overall potential development area.

Foxes

Under Alternative C, impacts to foxes would be similar to those discussed under the other alternatives, although they could be greater in duration and extent. Oil and gas development activities could affect Arctic foxes by increasing the availability of food and shelter. An increase in the fox population associated with oil development could 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 were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur.

Other Mammals

Small rodents and their predators would be affected locally (i.e., through 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 could increase local densities of ground squirrels. Under Alternative C, impacts would be slightly greater than those that would occur under the final Preferred Alternative and Alternative B, and greater than those that would occur under the No Action Alternative, given the larger overall scale of the development scenario.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas. However, pads, roads, and the airstrip, if left in place, could provide some insect-relief habitat for caribou. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou, and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material’s toxicity and the amount ingested by fox, this could cause mortality, though the numbers of fox killed would likely be very small.

Effects of Spills

Typical refined products that are spilled on the Alaska North Slope include aviation fuel, diesel fuel, engine 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 material spilled, the location of the spill, and the effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on terrestrial mammals or their habitat.

The impacts of oil spills on terrestrial mammals are described under the No Action Alternative (Section 4.3.9; Mammals). Compared to the No Action Alternative, the risk of oil spills could be greater under Alternative C, given the greater extent of development. Activities occurring in the vicinity of Teshekpuk Lake could increase the likelihood that a spill would reach the lake under Alternative C. The majority of impacts to terrestrial mammals would result from disturbance associated with spill clean-up activities, rather than from direct oiling.

Effectiveness of Stipulations and Required Operating Procedures

Alternative C would include the same lease stipulations and ROPs that were outlined under Alternative B. (Section 4.4.9.1; Terrestrial Mammals). They would provide similar protection to terrestrial mammals as those developed for the No Action Alternative.

Conclusion

Under Alternative C, impacts to terrestrial mammals would be similar to those discussed under the other alternatives, but would be greater in frequency and extent because of the greater number of seismic surveys, the larger area open to surveys, the high oil and gas potential of the northern portion of the Planning Area, and the potential for greater development to occur in the Planning Area, including areas currently off-limits to surface development activities.

Among the terrestrial mammal populations that could be affected by management actions under Alternative C are the TLH and WAH 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 probably would not have any effects at the population level. The TLH caribou movements within calving, insect-relief, migration, and wintering areas could be disrupted by oil development activities. Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities into the caribou range. If a field were developed in the area surrounding Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH for calving, insect relief, migration, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east. Impacts expected under Alternative C would be greater than those under the other alternatives, given that all of the area north of Teshekpuk Lake would be available for development, except those areas protected by lease stipulations and ROPs. There would be an increase in the likelihood of impacts to calving areas and migration routes leading to insect-relief habitat, as well as an increased likelihood of development occurring within insect-relief habitat. The WAH caribou could be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could also be locally affected by activities associated with oil and gas exploration and development.

It is expected that impacts to terrestrial mammals in the vicinity of Teshekpuk Lake, and throughout the northern portion of the Planning Area, would be greater under Alternative C, particularly with respect to caribou calving and insect-relief habitat. Overall, impacts throughout the Planning Area would be greater under Alternative C than the other alternatives, given the greater overall scale of the planned development. In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.5.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would not be affected by the increased availability of land for oil and gas leasing.

Overland moves could disturb a small number of polar bears within approximately 1 mile of the vehicle train. Disturbance of maternity dens could result in den abandonment and death of cubs. Additionally, a few ringed seals could be disturbed if overland moves were to occur over floating, shore-fast ice. Recreational camps could attract a small number of polar bears, increasing the potential for negative human-bear interaction that could require that a small number of bears be shot in defense of human life and property. It is expected that small fuel spills would occur under Alternative C. These small spills should not negatively impact marine mammal populations in or near the Planning Area.

Under Alternative C, it is expected that the effects of non-oil and gas activities on marine mammals would be localized and short term, with no or minor effects to marine mammal populations.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

A small number of polar bears could be affected by seismic exploration occurring along the coast, although ROP C-1 would prohibit seismic activities within 1 mile of known or suspected polar bear dens or seal birthing lairs. The potentially greater amount of seismic exploration that would occur under Alternative C would increase the likelihood that polar bears would be disturbed, relative to the other alternatives, although the increase in impacts would be modest, given the relatively low number of bears denning in the Planning Area.

It is expected that aircraft traffic could potentially disturb marine mammals under Alternative C. The effects of aircraft traffic disturbance would be similar to those discussed under the other alternatives, but could be greater in extent, given the larger number of pads and production facilities anticipated under the development scenarios for Alternative C and the greater likelihood that fields would be developed near the coast. Aircraft would generally fly at 1,000 feet or higher AGL, minimizing the potential for disturbance to seals.

Under Alternative C, exploratory drilling near the coast during winter would have the same likelihood of displacing or attracting polar bears as under the other alternatives. Female polar bears denning within approximately 1 mile of the construction activity could be disturbed by vehicle traffic and construction noise, which could result in the abandonment of the den and the potential death of cubs. Polar bears could be attracted to drilling sites by food odors and curiosity, increasing the potential for negative human-bear interactions and the possible death of bears in defense of human life and property. Nonlethal means of deterrence would be used in most cases, minimizing the number of bears lost as a result of such encounters.

Under Alternative C, Lease Stipulation K-6 would prohibit the construction of permanent structures within ¾ mile of the coast, although exploration could occur in the area. The effects of exploration activities would be localized and would be unlikely to affect marine mammal populations. Most exploration and development activities would occur onshore, and would not likely affect individual marine mammals or populations.

Under Alternative C, the projected levels of activities associated with oil and gas leasing and development could be incrementally higher than under the other alternatives given the larger area that would be available for leasing and the greater likelihood that fields would be developed near the coast. Higher levels of development would result in a greater potential for disturbance to marine mammals from increased aircraft and overland traffic, and increased barge traffic to transport supplies and modules. It is assumed that development operations in the Planning Area would be staged out of the Prudhoe Bay or the Kuparuk River Unit facilities, with no dock or causeway constructed along the Planning Area coast. Materials and equipment would likely be moved to staging areas in the Planning Area using trucks over ice roads in the winter months. Under this scenario, increased summer barge traffic could result in local and short-term displacement of whales and seals, and local and short-term changes in marine mammal behavior, as barges and sealifts passed along the coast. It is not expected that local and short-term changes in distribution or behavior would reach levels that could result in high impacts to individual marine mammals or populations, although the fitness of some individuals could be impacted if disturbance were to become chronic. Mitigation measures that regulated the timing of shipments would minimize the potential for barge traffic to impact marine mammal populations. Under Alternative C, the effects of oil and gas activities on marine mammals should be localized and short term, with few effects to species populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or introduced to inclement weather prematurely, by activities within about a mile of their dens if these dens were not detected and avoided as required by ROP C-1.

Effects of Spills

Effects from a Large Spill. Under Alternative C, a large spill occurring near the Colville River could result in oil reaching the marine environment. Some spotted seals and beluga whales could be exposed to oil, as under the other alternatives.

Little or no contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected, because little oil would be likely to reach offshore feeding areas. Thus, as under the other alternatives, a spill in the Colville River Delta would not be likely to have any effects on marine mammal food chains.

Polar bears could be vulnerable to a spill in the Colville River Delta during winter or during spring break-up. As under the other alternatives, the number of polar bears affected would likely be small. Under Alternative C, as under the other alternatives, it is expected that few marine mammals would be affected by a large spill in the Planning Area.

Effects from Small Onshore Spills. As under the other alternatives, small onshore spills would not be expected to have effects on marine mammals unless the spills were to occur near and contaminate streams that enter the Colville River Delta, Fish Creek or Judy Creek, or the Kogru River. Spills reaching those waterways could impact a small number of ringed seals, spotted seals, or beluga whales. A small number of polar bears could also be affected, as under the other alternatives. Small onshore spills would not be likely to affect bearded seals, walruses, or gray whales occurring offshore of the Planning Area.

In general, the effects of small onshore spills to marine mammals under Alternative C are expected to be localized and minor with few impacts to the populations.

Effectiveness of Stipulations and Required Operating Procedures

Alternative C includes the same lease stipulations and ROPs as outlined under Alternative B. These ROPs and lease stipulations should provide similar levels of protection as those developed for the No Action Alternative.

Conclusion

Under Alternative C, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would be short term and localized, occurring within 1 mile of aircraft corridors, survey activities, recreational camps, and overland moves. Under Alternative C, oil and gas leasing and development activities would likely result in a greater level of noise and disturbance, primarily near the Colville River Delta and inner Harrison Bay, than under the other alternatives. Effects should be localized (within 1 mile of aircraft corridors and activities) and short term (generally less than 1 year). Lease Stipulation K-6 would minimize the potential for development to impact ringed seals, spotted seals, beluga whales, and polar bears in areas along the coast. While exploration could occur in this area under Alternative C, surface occupancy would generally not be allowed. The effects of seismic exploration would be limited to short-term, localized disturbance to denning or hauled out ringed seals, denning polar bears within approximately 1 mile of the activity, and displacement or attraction of non-denning polar bears. The effects of development under Alternative C are expected to be short term, with few effects on marine mammal populations.

A small number of ringed seals, spotted seals, beluga whales, and polar bears could be affected by oil spills entering the Kogru River, the Colville River, or drainages that empty into the Colville River, Fish Creek, or Judy Creek. It is expected that the impacts to marine mammals from a spill would be minor.

4.5.10 Threatened and Endangered Species

This section discusses the potential effects to bowhead whale and spectacled and Steller's eiders that could potentially result from management actions in the Planning Area under Alternative C.

4.5.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on Bowhead Whale

Under Alternative C, the effects of non-oil and gas activities on bowhead whale would be similar to those that would occur under the No Action Alternative, and would occur only when bowhead whales migrated exceptionally close to shore. It is not expected that non-oil and gas activities would have high impacts on individual bowhead whales or the population.

Effects on Spectacled and Steller's Eiders

Non-oil and gas activities that could affect spectacled and Steller's eiders under Alternative C would be the same as those listed under the other alternatives—private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. Under Alternative C, a larger area would be available for permanent oil and gas facilities and development than under the other alternatives. However, the potential for non-oil and gas activities to disturb, displace, or cause mortality would likely be similar under all four alternatives. Lease stipulations and ROPs would mitigate some of the potential effects of non-oil and gas activities.

4.5.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

The effects of non-oil and gas activities on bowhead whales would likely be greater under Alternative C than under the other alternatives, given the greater area available for development and the greater likelihood that developments would occur near the coast. Vessel activity in Harrison Bay and other areas off the coast of the Planning Area could increase under Alternative C when compared to the other alternatives. An increase in barge traffic along the coast to transport equipment and supplies for development within the Planning Area, and a potential increase in the number of staging areas along the coast, would increase the potential for impacts to migrating bowhead whales. Effects to bowhead whales would only be expected if bowhead whales were to migrate close to shore. Effects would be limited to short-term shifts of the southern edge of the migration corridor.

Spectacled and Steller's Eiders

Exploration. Seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when eiders are not present in the Planning Area. Indirect impacts to eiders could potentially result from construction of ice roads and ice pads, and the associated water withdrawal. Under Alternative C, the potential effects of ice road and ice pad construction would be similar to those described under the other alternatives, and would primarily involve the temporary alteration of tundra vegetation. Water withdrawal for ice road construction could also temporarily alter habitats adjacent to water source lakes, potentially affecting nesting or brood-rearing eiders. Rolligons and track vehicles used during winter exploration could also result in minor impacts to tundra vegetation. Since a larger area would be available to oil and gas exploration activities under Alternative C than under the other alternatives, the associated impacts to eiders could also potentially be greater under Alternative C. These impacts could occur in the Goose Molting Area, which is available for oil and gas leasing under Alternative C. However, Lease Stipulation K-4 would mitigate some potential impacts to eiders in the Goose Molting Habitat Area by prohibiting water extraction and other oil and gas-related activities that could affect feeding habitat along lakeshore margins.

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment, or winter exploratory activities. Under Alternative C, the potential for increased predation of eiders by predators attracted to development sites would be mitigated by ROPs A-2 and E-9, and the overall effects would likely be similar under all alternatives.

Development and Production Activities. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, use of heavy equipment, and oil-spill clean-up activities, could cause disturbances that would affect threatened eiders. Under Alternative C, the types of disturbances would be the same as those discussed under the other alternatives. These disturbances could result in temporary displacement from preferred foraging, nesting, and brood-rearing habitats, decreased nest attendance or nest abandonment, and increased energy expenditures that could the affect physiological condition and rate of survival or reproduction. The likelihood of impact to eiders would depend on the location of the disturbance, number of eiders in the area, and the time of year. The greatest impacts from disturbance would be likely to occur in habitats with high eider concentrations; the largest spectacled eider concentrations in the Planning Area occur in the wetlands north of Teshekpuk Lake (Map 3-33; USDOI BLM and MMS 1998). Steller's eiders are scattered throughout the Planning Area in low numbers, with no known areas of concentration.

The potential for disturbance to eiders from activities on roads and pads would likely be greater under Alternative C, as compared to the other alternatives, because areas that support medium to high spectacled eider concentrations are in the Goose Molting Area, which would be available for oil and gas leasing under Alternative C. Lease Stipulation K-4 would help to mitigate potential disturbance to eiders in the Goose Molting Area by providing setbacks from goose molting lakes within which permanent oil and gas facilities would be prohibited. Lease Stipulation K-4 would also protect goose molting lakes from excessive water extraction activities; provide for protection of shoreline habitats adjacent to these lakes; protect goose molting lakes from oil and gas disturbance by requiring features that would screen or shield human activity from the view of any goose molting lake; and minimize ground traffic from May 20 through August 20. In addition, Lease Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited, to the extent practicable, to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. Although these lease stipulations were primarily designed to provide mitigation for molting geese and caribou, they would also help to reduce potential impacts to nesting, brood-rearing, or molting eiders in the Goose Molting Area or in the Coastal Area. Although these lease stipulations would be in place under the final Preferred Alternative and alternatives B and C, there would be a greater potential for disturbance to eiders under Alternative C, because there would be a larger area in which oil and gas activities would occur.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of effects to eiders from aircraft would be the same under Alternative C as those that would occur under the other alternatives, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting and brood-rearing areas. However, some eiders could acclimate to aircraft activity by either remaining in habitats located near aircraft activities, or by moving to other habitats.

Compared to the other alternatives, it is likely that there would be a greater amount of disturbance to eiders from aircraft activity under Alternative C than the other alternatives. Aircraft traffic, including take-offs and landings, could occur in the entire Goose Molting Area, and facilities could be located in the portions of the Teshekpuk Lake Caribou Habitat Area where surface activity would be prohibited under the No Action Alternative. Lease Stipulations K-3 through K-6 would provide setbacks from various habitats surrounding Teshekpuk Lake and along the coast that are considered important for fish, birds, and caribou in the area. Within these setbacks, permanent oil and gas facilities would be prohibited, and restrictions placed on other potentially disturbing activities, such as vehicular and air traffic. These lease stipulations would help to mitigate for potential aircraft disturbance to eiders, should oil and gas facilities be located within the Goose Molting Area.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting and staging eiders, could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to nearby habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting eiders. There would likely be more offshore vessel traffic under Alternative C, than under the other alternatives, because of the larger area that would be available for oil and gas leasing in the Goose Molting Area under Alternative C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. The potential for these activities to disturb eiders would likely be greater under Alternative C than under the other alternatives, as there would be a greater likelihood that facilities would be located in areas of high spectacled eider concentration in habitats north of Teshekpuk Lake. Wildlife resource surveys would be conducted prior to development to identify suitable areas for conducting spill response training to minimize the potential for disturbance to eiders.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure could result in loss of eider habitat. During the construction of oil field roads and pads, tundra covered by gravel, as well as tundra associated with gravel mine sites, would be lost as nesting, brood-rearing, and foraging habitat for birds. Under the development scenario for Alternative C, the amount of direct habitat lost would range from 190 to 1,975 (1,380) acres. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of eider use in the areas to be developed.

In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice road construction could temporarily affect eiders in adjacent habitats if the lakes did not have adequate recharge capabilities. Under Alternative C, the types of effects to eiders resulting from temporary habitat loss would be the same as those discussed under the other alternatives. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by eider populations.

Mortality. Compared to the other alternatives, there would be an increased risk that eiders would collide with offshore barge and vessel traffic under Alternative C, as more area would be available for development north and east of Teshekpuk Lake that could increase the potential for development in that area and the amount of associated vessel traffic in offshore areas.

Effects of Abandonment and Rehabilitation

Bowhead Whale

Barges used to remove materials from the Planning Area could have localized impacts on bowhead whales if they were encountered during migration.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could impound water and reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. These impacts should be very minor, however, since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, habitat for eiders would be lost. If they were revegetated without removing the gravel, the habitat would not return to its historic use. If gravel was removed, habitat similar to that existing in the area could be created and used by eiders, although the habitat types would likely not be the same as what occurred in the area prior to disturbance. If foam insulating materials were used in pad construction, they could be broken up in the course of removal. Fine particles of foam that were not removed from the environment could be ingested by eiders. Depending on the material's toxicity and the amount ingested, this could cause mortality, though the number of eiders killed would be small.

Effects of Spills

Bowhead Whale

The potential for an oil spill to impact bowhead whales would be greater under Alternative C than under the other alternatives, because a larger area would be available for development and it is more likely that developments would occur near the coast. It is unlikely, however, that spilled oil would reach bowhead whale migration habitat. The southward edge of the migration corridor could be shifted northward due to any vessel activity associated with containment and clean-up activities occurring during the fall migration. In general, impacts to individual bowhead whales or the whale population would be minor, except in the case of a very large spill coincident with the fall migration, which is very unlikely.

Spectacled and Steller's Eiders

Oil spills would have similar types of effects to eiders under all alternatives. However, there would be an increased risk of an offshore spill occurring under Alternative C than the other alternatives because there would be more barge traffic. An offshore spill would have the potential to spread through the action of wind and currents and could affect molting eiders in Harrison and Smith bays.

There could be an increased risk that an oil spill would occur and impact eiders in onshore habitats north and east of Teshekpuk under Alternative C, as compared to the other alternatives, as more of this area would be available for leasing under Alternative C. In the remaining portion of the Planning Area, the potential effects of an oil spill to eiders would be similar under all alternatives. Excluding the Goose Molting Habitat Area and Teshekpuk Lake Special Area, the areas available for leasing would be the same under all alternatives, and similar lease stipulations would apply. There would be a greater potential that an oil spill would occur and impact eiders in the Deep Water Lakes Area south of Teshekpuk Lake under the final Preferred Alternative and alternatives B and C than the No Action Alternative, as a facility could be permitted within the ¼-mile buffer around fish-bearing lakes under the action alternatives. However, Lease Stipulation K-2, which would apply to the final Preferred Alternative and alternatives B and C, would prohibit permanent facilities within ¼ mile of fish-bearing lakes without prior consultation with regulatory agencies.

Oil entering a river or stream could potentially spread into delta or coastal areas where impacts to threatened eiders could be more severe. Lease Stipulation K-1 would help reduce the likelihood that an oil spill would enter a major river or stream. This lease stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines could be permitted in some of these areas.

4.5.10.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, thereby minimizing the potential for effects to individual bowhead whales and eiders. These measures should be equally, or more effective than the lease stipulation measures developed for the No Action Alternative.

4.5.10.4 Conclusion

Bowhead Whale

Under Alternative C, activities associated with non-oil and gas transport, seismic activities, and recreation could disturb bowhead whales if whales were to migrate near the coast, coincident with the presence of vessel or low altitude aircraft traffic. Bowhead whales could exhibit temporary avoidance behavior from vessel traffic associated with oil spill clean-up activities if these activities were to occur offshore of Harrison Bay, and during the fall migration. Effects from such exposures would not be likely to have a high impact on individual bowhead whales or the population. The lease stipulations and ROPs under Alternative C would effectively minimize the potential for spilled oil, fuel, and other toxic materials to reach the marine environment, thereby minimizing the potential for effects to individual bowhead whales or the population. Increased barge traffic associated with an increased number of staging areas along the coast could have short-term impacts on whales migrating close to shore. Noise from the barge traffic could result in a short-term shift of the southern edge of the bowhead whale migration away from the coast.

Spectacled and Steller’s Eiders

Under Alternative C, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be similar to those that would occur under the other alternatives. The potential for these disturbances to impact spectacled and Steller’s eiders would be greater under Alternative C than the other alternatives, as the entire Planning Area would be available for leasing, and the overall level of development would be greater. The potential for habitat loss and alteration to affect eiders would also be greater under Alternative C, as compared to the other alternatives, as the amount of tundra habitat that would to be lost to gravel infrastructure could be greater, and there would be a greater potential for infrastructure to be located in areas of high eider use near Teshekpuk Lake. The potential for eider mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic, or for an oil spill to impact threatened eiders, would be greater under Alternative C as compared to the other alternatives. In general, impacts to eiders from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to eiders from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development ceased in an area, eider populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Lease stipulations and ROPs established under Alternative C would be effective in reducing impacts to spectacled and Steller’s eiders.

4.5.11 Cultural Resources

4.5.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities on cultural resources would be the same as those discussed for the No Action Alternative, except that the geographic area affected would be greater. Aircraft and watercraft traffic, scientific investigations (e.g., archaeological and paleontological surveys and excavations), summer camps, removal and remediation of hazardous and solid waste material, overland moves, and recreation could affect cultural resources. Aircraft use would be unlikely to directly affect cultural resources, but could have minor indirect effects on cultural resources by making sites more accessible to recreationists and other users. Watercraft use could affect cultural resources by causing wakes that would increase the rate of erosion on waterways. The amount and types of recreational use occurring under Alternative C would not differ from that occurring under the other alternatives. However, the amount of scientific work occurring in the Planning Area would be greater under Alternative C, as a larger area would be opened up to development. Other ground activities could also be more prevalent, relative to the other alternatives, as the BLM continued surveying and conveying native allotments, resulting in an increased likelihood that effects to cultural resources in the Planning Area would occur. Ground-disturbing activities, such as scientific camps and hazardous and solid waste material removal and remediation, would be monitored or surveyed for cultural resources before these activities occurred.

4.5.11.2 Oil and Gas Exploration and Development Activities

Seismic testing and exploratory drilling could increase over the next 10 years. Effects to surface cultural resources could occur if seismic vehicles (even low ground pressure vehicles) were to pass over these resources. Surface cultural resources, which are structures of some type, can usually be visually detected and avoided, even when covered by snow. Surface cultural resources that are not structures would not be easily detected, but given their characteristics, would typically be sufficiently protected from impacts by snow cover and frozen vegetation. One exception would be human skeletal remains that lie on the ground surface. Because seismic data gathering activity would primarily occur during the winter using low-ground-pressure vehicles (ROP C-2), it is unlikely that this activity would affect undocumented subsurface cultural resources. Ice roads and pads used for exploratory drilling and would have similar effects.

It is worth noting that cultural resources are not as ubiquitous in the Planning Area as wildlife and vegetation. Cultural resources, because of their near-surface and surface contexts (as well as other factors), can be identified and avoided. As a result, oil and gas exploration or development activities would have minor impact on cultural resources because these activities could be conducted to avoid identified cultural resource locations. However, modern users tend to use the same areas used by prehistoric and historic Iñupiat, such as high, dry ground along rivers, streams and lakes, and may inadvertently damage these areas.

Effects of Disturbances

Under Alternative C, the amount of area impacted, and level of oil and gas exploration and development activities, would likely be greater than under the No Action Alternative. However, because most surface-disturbing activities would occur during the winter months, the potential for impacts to buried cultural resources would remain relatively minor. Surface cultural resources would not likely be affected because of their scattered occurrence, and because they would be protected by a variety of lease stipulations and ROPs governing oil and gas exploration activities.

Under Alternative C, the effects of possible disturbance would be the same as those occurring under the No Action Alternative. Efforts to supply necessary materials for construction of gravel pads, airfields, and roads at this scale could increase the likelihood of damage to known or undocumented cultural resources in the Planning Area. The excavation of material (e.g., gravel) for the construction of the permanent facilities would be the primary source of potential effects to cultural resources. One approach to protect cultural resources would be a “roadless” scenario in which pipelines would not have associated all-weather gravel roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only effect on cultural resources resulting from pipeline construction would be associated with the placement of VSMs, and would depend on the depth at which the VSMs were set. If buried pipelines were used, effects to cultural resources could occur during excavation, construction, and burial, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities unless the facilities to be abandoned were themselves historic.

Effects of Spills

Under Alternative C, the effects of oil spills on cultural resources would be the same as those that would occur under the No Action Alternative. In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would probably not alter or destroy buried cultural resources, but could affect surface cultural resources by covering these resources with oil or other spill material. Warm oil, however, could melt through the snow and ice and impact cultural resources buried near the surface. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur. Oil spills at cultural resource sites, either surface or buried, would make radiocarbon dating of that site problematic or impossible. Spilled hydrocarbons would seep into organic archaeological materials used for radiocarbon dating such as charcoal, bone, and wood, and contaminate them so that their radiocarbon dates could be inaccurate.

4.5.11.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs identified for Alternative B would also apply to Alternative C and would effectively reduce the effects of oil exploration and development activities on cultural resources. Prior to any undertaking (i.e., ground-disturbing activities such as the construction of buried pipelines) on federal lands, the NHPA would require that an archaeological resource survey be completed. If cultural resources were identified during such a survey, BLM guidelines and policy would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the SHPO.

4.5.11.4 Conclusion

Under Alternative C, the overall potential effects on cultural resources from management activities other than oil and gas exploration and development would be as previously described. Overall, the probability of the occurrence of effects would increase as compared to the No Action Alternative because of the increase in the amount of land that could potentially be affected.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). The density of cultural resource sites in the area north of Teshekpuk Lake is also presumed to be high, thus there is an increased risk of inadvertent damage to these sites under Alternative C. Activities that occur near these areas may have a greater likelihood of impacting cultural resources. In the most general terms, where surveys and inventories have been conducted, cultural sites have usually been found. Since surveys are required before any ground-disturbing activity can take place, the potential impacts to cultural resources from oil and gas exploration and development activities under the Alternative C would be minor.

In general, impacts to cultural resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area, and the potential for more oil and gas exploration and development activities, impacts to cultural resources under this alternative would be greater for oil and gas exploration and development activities, as compared to the No Action Alternative. Impacts could be greater, however, if oil and gas exploration and development activities occur in an area with a high concentration of cultural resources. These impacts would be effectively mitigated by lease stipulations and ROPs that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources, enforcement of lease stipulations and ROPs that prohibit collection of artifacts and require training of workers regarding avoidance of effects on cultural resources, and compliance with all federal laws, including the NHPA, requiring surveys for cultural resources in areas where ground-disturbing activities are proposed.

4.5.12 Subsistence

4.5.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities would be similar to those that would occur under the No Action Alternative, but would be greater in extent, duration, and magnitude given that lease sales could occur over the entire Planning Area.

Effects on Subsistence Species

Under Alternative C, non-oil and gas activities could affect subsistence species, including caribou, waterfowl, muskox, moose, wolf, wolverine, and fox. These activities could divert or deflect subsistence species from normal harvest areas; reduce populations as a result of stress; cause a change in or loss of habitat and forage; or result in the contamination of, as well as the subsistence users' perception of contamination of, subsistence species. Under Alternative C, the effects of aircraft and watercraft activities would be similar to those that would occur under the No Action Alternative, except that the frequency, extent, and duration of aircraft use would be greater. A greater level of aircraft activity could result in a greater amount of temporary and localized diversion, deflection, or disturbance of subsistence animals, relative to the No Action Alternative.

Under Alternative C, the types of effects from scientific research and data collection on subsistence species could be similar to those discussed the No Action Alternative. However, given that the extent, frequency, and duration of research and data collection activities would be greater under Alternative C, the temporary and localized diversion, deflection, or disturbance of subsistence species associated with research would also be greater under Alternative C. The effects of recreation would be the same under Alternative C as under the other alternatives. Recreation could temporarily divert, deflect, or disturb subsistence species in a localized area.

Solid and hazardous waste removal and remediation, which would involve monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing, independent of the amount of land open to leasing. Therefore, the effects of these activities would be the same under all alternatives. There could be a short-term and local deflection of subsistence species. Over the long term, these activities could benefit subsistence species by reducing the potential for contamination of subsistence species with the cleanup of hazardous waste sites.

Under Alternative C, there could be a greater number of overland moves than under the No Action Alternative, as camps at Inigok and elsewhere might need to support additional winter activities as additional lease sales occur. Similar to the No Action Alternative, overland moves would occur only by permit and would be subject to lease stipulations and ROPs. These moves would be rare, and would take place during the winter on frozen tundra, an adequate accumulation of snowpack, or on ice roads. However, overland moves could temporarily deflect local subsistence species when they did occur.

Effects on Subsistence Harvest Patterns

Under Alternative C, effects from non-oil and gas activities would be similar to those that would occur under the other alternatives, except they would have a greater extent, duration, and magnitude, given that the area open to leasing and year-round occupation would be greater. Non-oil and gas activities that could affect subsistence harvest patterns would include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. As discussed under the No Action Alternative, these activities could alter the availability of subsistence species in traditional harvest areas through direct interference with hunts. This direct interference could affect harvest patterns by requiring hunters to travel further because subsistence resources are more wary than normal following a disturbance or are deflected from traditional harvest areas following the presence of vehicles, vessels, and aircraft. Nuiqsut residents noted during development of the Alpine Satellite Development Plan EIS that aircraft have diverted subsistence resources away from areas where hunters were actively pursuing them, directly interfering with harvests or causing harvests to fail (USDOI BLM 2004C). Increased travel distances would result in greater expenditures for fuel and equipment, as wear and tear on snowmachines, outboards, and four-wheel vehicles could occur. Use of the Planning Area for non-oil and gas activities could interfere with subsistence uses, particularly if subsistence species were diverted or deflected from traditional harvest areas by exploration and development activities.

Under Alternative C, there would be greater use of aircraft than under the other alternatives, including air traffic necessary for sampling caribou and waterfowl in sensitive areas as part of wildlife monitoring. These activities could reduce subsistence harvests by diverting, deflecting, or disturbing subsistence species, such as migrating or insect-avoiding caribou, or seals, walrus, and whales. Given that a larger area would be open to leasing under Alternative C, these effects would occur over a larger area and for a longer duration than under the other alternatives. In addition, size of available and desirable subsistence use areas, and therefore the size of the subsistence harvest, could be reduced. It is possible that subsistence users would have to go farther to harvest subsistence foods, and would spend more time in pursuit of subsistence species, incur increased fuel cost, and face an increased risk of equipment failure and meat spoilage. Nuiqsut subsistence users have frequently stated during scoping meetings that aircraft traffic reduces harvest access and success, an issue that could affect Atqasuk and Barrow hunters if leasing were to open to the north and west of Teshekpuk Lake. The effects of watercraft on subsistence harvest patterns would likely be the same as under the other alternatives.

The amount of scientific research and data collection activity would likely be greater under Alternative C than under the other alternatives. Therefore, there would be a greater likelihood that these activities would affect the success of subsistence harvests. Research activities would predominantly take place during the summer months. Aircraft-based biological surveys would have the greatest likelihood of affecting subsistence harvest patterns because they cover large areas, last a long time relative to other research activities, and are known to elicit responses from caribou and waterfowl. Archaeological, paleontological, and geological activities, involving personnel walking on the tundra, would have some short-term effects on subsistence species. Research and data collection activities could divert, deflect, or disturb subsistence species, which could affect subsistence harvest patterns by causing a temporary and local reduction in resource availability at traditional use areas.

Similar to the other alternatives, recreational users would likely frequent waterways used by subsistence hunters during the summer months, potentially causing resource conflicts. The effects of these conflicts on subsistence harvest patterns would likely be localized and of short duration. Since the amount of recreation that would occur would be more or less the same under the other alternatives and Alternative C, effects to subsistence harvest patterns would also be much the same.

As discussed under the No Action Alternative, solid and hazardous waste removal and remediation activities would have localized effects that would last for the duration of the activity. Evaluation activities would have little effect on long-term harvest patterns. Site cleanup and remediation activities could temporarily divert or disturb caribou, muskox, and grizzly and polar bears, but would have little effect on long-term subsistence harvest patterns. Effects would be the same under Alternative C as under the other alternatives.

As compared to the other alternatives, the greater number of overland moves that would occur under Alternative C could result in greater deflection or diversion of caribou and disturbance to denned bears. Lease stipulations and ROPs would mandate procedures to protect denned bears and minimize impacts to caribou. Overall, the effects of overland moves on subsistence harvest patterns would likely be similar under all alternatives.

4.5.12.2 Oil and Gas Exploration and Development Activities

Allowing oil and gas activities to occur in areas that would not be available for leasing and year-round occupation under the No Action Alternative and Alternative B would increase the area potentially affected by these activities, increase the duration of those effects to approximately 40 years or longer, and spread those effects throughout the northern half of the Northeast National Petroleum Reserve – Alaska. This area was unavailable for leasing under the 1998 Northeast IAP/EIS ROD because it is a sensitive habitat that is important for calving caribou of the TLH and for molting, nesting, and fledgling waterfowl (USDOI BLM and MMS 1998). Under Alternative C, oil exploration would be ongoing and would involve seismic testing using low ground-pressure vehicle trains. A larger area would likely be exposed to drilling and temporary ice pads and roads than under the No Action Alternative. Oil and gas activities would likely occur at a great magnitude and at more frequent intervals than under the other alternatives.

Effects of Disturbances

Under Alternative C, disturbances associated with oil and gas activities would be similar to those discussed under the No Action Alternative; however, the effects on subsistence resources would be greater in geographic extent and duration, as a greater amount of potentially sensitive habitats would be open to leasing. In addition, areas that would be off limits to development under the No Action Alternative and Alternative B would be open to leasing and could be affected by oil and gas development.

Subsistence Species

As compared to the other alternatives, the extent, severity, and duration of effects would likely be greater under Alternative C, given that a larger area would be open for year-round occupation and development, which would include ecologically sensitive areas that would not be open under the other alternatives. The amount of habitat loss and degradation would be greater under Alternative C than under the other alternatives. It is possible that there would be some change in caribou and waterfowl populations and distribution because of oil and gas activity in this area, despite the protections granted by the lease stipulations and ROPs. Post-parturient caribou and calves could be deflected or diverted from preferred habitats in the vicinity of Teshekpuk Lake if development were to occur in that area (Murphy and Lawhead 2000). Migrating caribou could be delayed or deflected by vehicle and aircraft traffic, as well as other human activity, during development and construction; however, caribou would likely habituate to the new infrastructure and activity (except human presence) over time (Murphy and Lawhead 2000; USDOI BLM 2003). Waterfowl could be temporarily displaced from nesting areas, but would adapt quickly to most new activities during development and construction (Johnson 2000a, b; Ritchie and King 2000; Sedinger and Stickney 2000). Fox populations tend to increase in response to development, as gravel pads, food waste, and other human activity provide favorable habitat and energy inputs for these species (Burgess 2000). These predatory scavengers in turn cache waterfowl eggs and feed on fledgling and molting birds, thus reducing their breeding success and in some cases depleting local populations (Burgess 2000; Sedinger and Stickney 2000). Fish habitat should be protected adequately by lease stipulations and ROPs; however, development in freshwater lakes could cause changes in turbidity, salinity and dissolved oxygen levels, possibly reducing fish populations in those lakes. Given the larger area available for leasing, the effects of disturbance from oil and gas activities on subsistence species would be greater under Alternative C than under the other alternatives.

Subsistence Harvest Patterns

Under Alternative C, increased oil and gas activity occurring over a wider area could inhibit subsistence users from harvesting in their traditional use areas to a greater degree than under the No Action Alternative. Hunters from Barrow and Atqasuk would be directly affected by development north and west of Teshekpuk Lake, where numerous subsistence camps, cabins, and ice cellars are located. Until caribou became habituated to activity and infrastructure in the area, there could be reductions in subsistence harvest success or increased effort, time, risk, and expense involved in order to harvest adequate amounts of subsistence resources. Nuiqsut subsistence users could be affected by increased activity in the northeast portion of the Planning Area, should the Alpine Satellite Development proceed, and activity farther west could deflect migrating caribou away from other traditional harvest locations, reducing harvest access and success. If oil and gas activities were to divert or deflect the normal migration routes for the TLH caribou, Anaktuvuk Pass subsistence users could suffer a shortage of caribou, their main subsistence resource, until the normal migration route was resumed. A greater expenditure and risk on the part of the subsistence hunters from Anaktuvuk Pass would be required. In the past, when the herd has failed to pass near the community, hunters had to fly to more remote locations in search of subsistence food, increasing community stress and the time necessary for harvest success, as well as reducing the connection with traditional areas (SRBA 2003b).

As noted for the No Action Alternative, oil and gas development could inhibit subsistence harvesters' use of the traditional harvest areas, which could reduce harvest success, increase associated costs, efforts, and risks, and reduce the enjoyment of eating traditional foods. Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. In addition, 51 percent of the 1999-2000 harvests occurred greater than 16 miles, and 27 percent occurred 6 to 15 miles, from the Alpine oil field. Oil and gas development could divert subsistence users a distance of 5 to more than 25 miles from facilities. Given current high gasoline costs on the North Slope, this would add considerable cost to subsistence harvesters.

The areas that would be newly available for leasing under Alternative C are important caribou harvest areas for Barrow and Atqasuk. In addition, both of these communities fish in the vicinity of Teshekpuk Lake and along the Beaufort Sea coast between Atigaru Point and Smith Bay. As noted in the No Action Alternative, Nuiqsut residents are already excluded from utilizing traditional use areas east of the Colville River and delta, and planned development could inhibit subsistence use of the northeast corner of the Planning Area. Oil and gas development further to the west and south could negate Nuiqsut's strategy of using snowmachines and outboards to travel to more distant subsistence harvest locations and return in time to fulfill obligations in town. Alternative C would have a greater effect on subsistence harvest patterns than the other alternatives because of the increased area of potential activity, the longer duration of oil and gas activity in the area, and the greater extent of possible development.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following closure activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

The risk of oil spills under Alternative C would be similar to that under the No Action Alternative; however, a greater area of important caribou, waterfowl, and fish habitat would be subject to potential contamination by oil spills.

Subsistence Species

The potential effects of spills on subsistence species would be the same as those discussed under the other alternatives. As Alternative C would potentially increase oil and gas activity over a larger area in the Planning Area, however, there would be a greater likelihood that oil spills would affect subsistence species under Alternative C than under the other alternatives.

Subsistence Harvest Patterns

As compared to the No Action Alternative, Alternative C would put a greater area at risk for oil spill damage. The area surrounding Teshekpuk Lake and north to the Beaufort Sea, largely unavailable for leasing and/or year-round occupation under the No Action Alternative and partially unavailable under Alternative B, would be open for year-round development and operation under Alternative C. Subsistence users have stated that they prefer not to hunt in industrial areas, and the communities of Barrow, Atqasuk, and Nuiqsut have harvested resources in the area to be opened under Alternative C. The communities of Barrow, Atqasuk, and Nuiqsut rely greatly on the TLH caribou for subsistence. Large oil spills could affect subsistence patterns by reducing populations of subsistence species, contaminating subsistence species or their habitats, resulting in the resource being unfit to eat or polluted. These effects could reduce the amount of subsistence foods harvested, cause changes in traditional diets, increase risks and wear and tear on equipment if users were required to travel farther to find more suitable resources, and cause social stress due to the reduction or loss of preferred foods harvested in the traditional fashion. Effects on subsistence harvest patterns would be greater under Alternative C than under the other alternatives because oil and gas activity would likely occur over a larger and more ecologically sensitive area, and the likelihood of an oil spill occurring would be greater.

4.5.12.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs developed for Alternative B would also apply to Alternative C (see Section 4.4.12 [Subsistence] for an assessment of the effectiveness of the ROPs and lease stipulations). In theory, these protections would be equivalent to the prescriptive lease stipulations listed in the 1998 Northeast IAP/EIS ROD. Under Alternative C, no areas would be withdrawn from year-round occupation except the buffer zones around deepwater lakes, with the same exception clauses as the other alternatives. Under this alternative, oil exploration and development could occur over a wider area, in more sensitive areas and habitats, and in lakes; however, ROPs and lease stipulations would be included (e.g., ROPs H-1 and H-2) to effectively reduce conflicts between subsistence uses and oil and gas activities. As stated during scoping, subsistence users stated that the proposed revision to the 1998 Northeast IAP/EIS is a breach of faith and that opening up more areas in the Planning Area would have negative effects on subsistence users from Barrow and Nuiqsut (Ahmaogak 2003).

Local municipal government and tribal governments generally have few paid staff and limited funding. Local government official and tribal leaders feel they are overtaxed when asked to provide meaningful input to BLM on permitted activities. Many residents have stated during scoping that the change from the prescriptive lease stipulations in the 1998 Northeast IAP/EIS ROD to performance-based ROPs and lease stipulations places them in the position of having to defend subsistence interests because compliance is now defined in terms of meeting a management objective rather than meeting an absolute prescriptive standard. To effectively respond, they would have to further stretch their existing capabilities to review and comment on industry proposals and their impact on subsistence.

The BLM holds that performance-based lease stipulations and ROPs would provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on close, on-going monitoring to insure that these procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.5.12.4 Conclusion

Most impacts associated with oil and gas exploration and development would be localized and would not have substantial impacts on subsistence species. In addition, the ROPs and lease stipulations discussed above would protect subsistence species and would help to resolve conflicts between the oil and gas industry and local residents. It was apparent from public scoping testimony, however, that local residents are concerned about the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways, and their ability to be able to pass along these traditions to their children.

4.5.13 Sociocultural Systems

4.5.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, the effects of non-oil and gas activities (e.g., aircraft and watercraft use, scientific research and data collection, recreation, overland moves, and solid and hazardous waste removal and remediation) on sociocultural systems would be greater than those expected to occur under the other alternatives. There would be a greater amount of scientific research and data collection and associated aircraft use undertaken prior to lease sales and as part of federal land management responsibilities under Alternative C, as additional lands were opened to leasing, which could cause temporary and localized diversion or deflection of subsistence species. It is not expected that the amount of recreation and solid and hazardous waste removal and remediation would be greater under Alternative C, as compared to the other alternatives, but more overland moves could be required to support scientific and other activities in the additional areas available for leasing. Several families with members in Atqasuk, Barrow, and Nuiqsut use cabins, camps, caches, and other sites along the coast and inland to Teshekpuk Lake for subsistence activities. The use of these localities helps maintain family connections and a feeling of relatedness and stability, which could be reduced by increased activity in the areas formerly unavailable for leasing. In general, effects from non-oil and gas activities under Alternative C would be temporary and localized, and would be unlikely to affect overall sociocultural patterns.

4.5.13.2 Oil and Gas Exploration and Development Activities

Oil and gas exploration, development, and production in the areas formerly unavailable for leasing north of Teshekpuk Lake, outside the setbacks established in the lease stipulations and ROPs, would require, a seasonal network of ice roads, permanent gravel roads, pads, and runways, and a year-round corridor for pipelines and powerlines to each pad and production facility.

Effects of Disturbances

The effects on sociocultural patterns from disturbances caused by oil and gas activities under Alternative C would be the same as under the No Action Alternative, but would be greater in intensity, as compared to the other alternatives (refer to the No Action Alternative [Section 4.3.13] for further discussion of effects). Increases in the amount of area available for leasing and exploration would have a corresponding increase in the effects to subsistence harvests as compared to those for the No Action Alternative.

The development proposed for the Planning Area would require staging and overland travel during the winter, and in summer would require several aircraft for supplies, equipment, and crew changes. In all seasons, noise, lights, personnel, and traffic near oil and gas infrastructure could deflect or divert caribou in areas where activities were occurring; however, gravel pads could attract caribou during some seasons as insect-relief habitat. These effects could change the distribution, timing, and location of the caribou harvest, which could then require increased effort and expenditure on the part of subsistence hunters, resulting in increased stress and a decreased sense of well-being. Oil and gas development could divert subsistence users at distances from 5 to more than 25 miles from facilities. Given the high gasoline costs on the North Slope, this would add additional cost to subsistence harvests. Increased fuel costs and wear and tear on equipment would increase the need for wage labor to support subsistence pursuits and reduce the time available to pursue subsistence activities, which would result in sociocultural consequences, such as increased stress and a decreased sense of well being. Increases in the speed, range, and reliability of outboards and snowmachines have facilitated the mixed subsistence and wage economy, but are unable to compensate for impacts to subsistence activities from continued development and production activities in important subsistence harvest areas.

As discussed under the No Action Alternative, long-term change to sociocultural patterns would result from a weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under this amendment. These changes are already occurring to some degree on the North Slope because of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and increasing presence of television and the Internet. North Slope Borough institutions, such as the school district that promotes the teaching of Iñupiat language and culture, the Alaska Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and quite successfully to prevent the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and 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 unlikely to disrupt sociocultural systems or displace existing institutions (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would likely generate jobs for local residents for several years above the level that would exist during operations. However, after the production pads were shut down and closure activities were completed, jobs associated with them would cease. If local residents were to become substantially integrated into satellite operations and the community was to become substantially dependent on revenues associated with their operation, and if other oil fields were not active in the area to provide jobs and contribute economically to the local economy and government revenues, the community would face a time of adjustment. Subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities.

Effects of Oil Spills

The effects of oil spills would be the same as discussed in the No Action Alternative; however, under Alternative C there would be a greater likelihood that widespread damage would occur in sensitive habitats, as sensitive habitats that would be closed to leasing under the No Action Alternative would be open to oil and gas activity under Alternative C. Dispersion and contamination of important subsistence resources in these highly sensitive habitats could occur in the unlikely event of a large or very large spill. Effects would vary in severity depending upon the timing and location (i.e., terrestrial, riverine, lacustrine, or marine) of the spill event, but fish, waterfowl, and marine and terrestrial mammals could all be affected. Such a spill could result in contamination of subsistence resources and threaten the health and lifeways of the affected communities. If a large oil spill occurred in a traditional use area, then subsistence users would have to travel further to harvest uncontaminated resources, which would result in high effects to sociocultural patterns as long as the residents believed that the subsistence resources were contaminated.

4.5.13.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs proposed under Alternative C are the same as those proposed under Alternative B. As these mitigation measures have been in effect for only a short time in the Northwest National Petroleum Reserve – Alaska, their effectiveness cannot yet be empirically evaluated. The proposed performance-based lease stipulations and ROPs would provide equivalent or greater setbacks from rivers and lakes than under the No Action Alternative, but would allow drilling within lakes outside those setbacks. Other protections should be similar to those developed for the No Action Alternative.

The BLM proposes the new approach to mitigation measures in order to achieve equivalent protection as would occur under the No Action Alternative, while providing greater flexibility. The prescriptive approach adopted in 1998 gained legitimacy and credibility through the extended consultation leading to the final decision, while the new approach proposed for the final Preferred Alternative and Alternative B is not well known or understood, and some local residents doubt that the new approach would provide equivalent protection. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

4.5.13.4 Conclusion

New lease sales in the areas north of Teshekpuk Lake, which would be unavailable for leasing under the No Action Alternative, and to a lesser extent under Alternative B, could cause societal stress in Barrow, Nuiqsut, and Atqasuk. Construction and operation of oil facilities could discourage families from using and maintaining traditional camps, cabins, and caches in the affected areas, which could affect social organization and cultural values in these communities. Development in these areas could increase North Slope residents' concerns about encroachment; potential risks to subsistence resources in terms of access and availability; and contamination of caribou, fish, and waterfowl. Visits to traditional camps and cabins are a vehicle for transmitting traditional and family history and knowledge to younger generations, and the discontinuation of such visits would decrease social cohesion in these communities. In addition, as harvests decreased, resources would no longer be available in amounts suitable for sharing, resulting in changes in social organization and cultural values.

4.5.14 Environmental Justice

4.5.14.1 Activities Not Associated With Oil and Gas Exploration and Development

The non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. They could temporarily divert, deflect, or disturb subsistence species from their normal patterns. Non-oil and gas activities could alter the availability of subsistence species in traditional harvest areas, which could in turn affect harvest patterns by requiring hunters to travel further in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, and increased wear and tear on snowmachines, outboards, and four-wheel vehicles. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. Under Alternative C, these effects could be greater than under the other alternatives, but would still be minor, temporary, short term, and generally highly localized.

4.5.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under Alternative C, allowing oil and gas activities in areas formerly unavailable for leasing and year-round occupation could increase the amount of area affected by these activities, increase the duration of those effects, and spread the effects throughout the northern half of the Planning Area. Disturbances caused by Alternative C would be the same as those discussed under the other alternatives, but effects on subsistence caused by oil and gas development would be greater in magnitude, extent, and duration. For species unable to habituate to disturbances associated with oil and gas development, effects could potentially last for more than 40 years.

Alternative C could have long-term effects on several terrestrial mammal species. In particular, effects on caribou herds would likely be greater than under the other alternatives. It is expected that effects on waterfowl harvested for subsistence would be more frequent and more widespread than under the other alternatives, given the greater area available for petroleum leasing. Little or no effect on marine mammals would be expected from onshore activities under Alternative C, but noise and disturbance associated with offshore barge and vessel traffic could impact bowhead whale migration patterns. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under Alternative C, as under the other alternatives, could cause local effects on fish. It is believed that disruptions from Alternative C could affect caribou, waterfowl, and fish. All of these effects would be experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water and air quality, and noise. Once abandonment and rehabilitation were completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

As discussed elsewhere, the magnitude of effects of a crude oil spill on subsistence resources would depend on the context of the spill, the volume and area covered by spilled product, and the amount of time the product was loose before clean-up efforts commenced. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills (any size) directly into a water body, particularly in difficult to contain conditions such as breakup or broken ice, could spread widely and have long-term, population level effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

As compared to the other alternatives, a greater area would be at risk for oil spill damage under Alternative C. The area surrounding Teshekpuk Lake and north to the Beaufort Sea, largely unavailable for lease and/or year-round occupation under the No Action Alternative, would be open for year-round development and operation under Alternative C. Subsistence users have stated that they prefer not to hunt in industrial areas, and the communities of Barrow, Atqasuk, and Nuiqsut have harvested resources in the area to be opened under Alternative C.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). A major oil spill would result in effects that would impact Iñupiat subsistence users more than any other human group.

4.5.14.3 Effectiveness of Stipulations and Required Operating Procedures

Alternative C would utilize performance-based ROPs and lease stipulations patterned after those developed for Alternative B. The lease stipulations and ROPs would be highly effective in reducing conflicts between subsistence uses and oil and gas activities.

4.5.14.4 Conclusion

Several lease sales have already taken place in the Planning Area, and development in the northeastern portion of the Planning Area (Alpine Satellite Development) is undergoing permitting (USDOI BLM 2003a). Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating in the National Petroleum Reserve - Alaska (SRBA 2003a, b). These effects would continue under Alternative C, and would be somewhat greater than under the other alternatives. Most effects of disturbance would be greater in duration, extent, and magnitude. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse could have long-term, serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

4.5.15 Coastal Zone Management

4.5.15.1 Activities Not Associated With Oil and Gas Exploration and Development

As non-oil and gas activities are normal occurrences under existing BLM management practices, they would in most cases, be of limited duration and magnitude, and effects on neighboring uses primarily subsistence resources and harvest patterns of nearby communities would be limited to the immediate area of the activity. Coastal Zone Management regulations would be adhered to.

Under Alternative C, the effects of non-oil and gas activities on coastal resources would likely be slightly greater in duration, areal extent, and, perhaps magnitude than those that would occur under the other alternatives. Under Alternative C, aircraft and watercraft traffic could increase during the summer to support the increased scientific and other activity necessary prior to expanding lease areas. This additional traffic could result in increased effects on subsistence species and increased irritation of Native communities.

There would be more scientific research and data collection under Alternative C compared with the other alternatives, pursuant to greater exploration and development activities. As a result, effects on subsistence activities would be greater.

It is expected that the Planning Area would support similar amounts of recreation under Alternative C, compared to the other alternatives.

Solid and hazardous waste removal and remediation activities, such as monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing, independent of additional lease availability. The effects of solid and hazardous waste removal and remediation under Alternative C would likely have the same effects as the other alternatives.

Compared to the other alternatives, there could be a greater number of overland moves under Alternative C in order to stage research camps and activities. Overland moves would be permitted, subject to the lease stipulations and ROPs, similar to the prior alternatives.

4.5.15.2 Oil and Gas Exploration and Development Activities

Alternative C would involve ground-impacting management actions similar to those addressed for the other alternatives, but on a larger scale. As described in Section 4.3.15 (Coastal Zone Management) of this document, Section 307(c)(3)(B) of the CZMA requires applicants to certify that each of their activities that affects any land use or water use in the coastal zone complies with, and would be implemented consistent with, the state's coastal program. In the following discussion, ACMP standards for uses and activities are used to evaluate activities and effects that would occur under Alternative C. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

This analysis is not a consistency determination pursuant to the CZMA of 1972, as amended, nor should it be used as a local planning document. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale, affecting the accuracy of this assessment.

Effects of Disturbances

Coastal Development (11 AAC 112.200)

Water dependency is a prime criterion for development along the shoreline. The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine shores, lakeshores, and river waterfronts. Under Alternative C, the entire Beaufort Sea coast within the Planning Area would be open to leasing. Lease Stipulation K-6 would be highly effective in discouraging permanent oil and gas facilities within ¾ mile of the coast and other lease stipulations would address sensitive issues areas along parts of the coast and near deep water lakes and major creeks and rivers.

Natural Hazard Areas (11 AAC 112.210)

This statewide standard permits coastal districts and state agencies to identify and designate areas in which natural hazards are known to exist that may present a threat to life or property. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Flooding, earthquakes, active faults, tsunamis, landslides, volcanoes, storm surges, ice formations, snow avalanches, erosion, and beach processes in the Planning Area should be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). Actions that occur under Alternative C would be required to comply with this standard.

Coastal Access (11 AAC 112.220)

Districts and state agencies shall ensure that projects maintain and, where appropriate, increase public access to, from, and along coastal water. It is expected that Alternative C would be consistent with this standard, although, as under the final Preferred Alternative and Alternative B, the larger leasing area along the Beaufort coast could result in some conflicts with access opportunities, as compared to the No Action Alternative.

Energy Facilities (11 AAC 112.230)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent practicable, on 16 criteria within the energy facilities standard. Lease stipulations and ROPs in place under Alternative C would be effective in reducing conflicts, making the alternative consistent with the statewide standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained (11 AAC 112.230 (a) [3] and [14]). Under Alternative C, ROPs and lease stipulations would be effective in protecting many biologically sensitive areas, although leasing would be permitted in the 213,000-acre goose molting and caribou habitat areas that would be off-limits under alternatives A and B. The NSB CMP also requires that transportation facilities and utilities be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under Alternative C would also be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats; Air, Land, and Water Quality; and Historic, Prehistoric, and Archeological Resources.

Utility Routes and Facilities (11 AAC 112.240) and Transportation Routes and Facilities (11 AAC 112.280)

These statewide standards require that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. Utility routes and facilities along the coast must avoid, minimize, or mitigate alterations in drainage patterns, disruption in wildlife transit, and blockage of existing or traditional access.

The NSB CMP contains several additional policies related to transportation and utilities that would be relevant to this analysis. All but one are best-effort policies, and are subject to some flexibility. Transportation development, including pipelines, which would significantly obstruct wildlife migration, is subject to three conditions (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Interference with caribou movements would be short term under Alternative C; caribou migrations and overall distribution should not to be affected. Lease stipulations and ROPs in place under Alternative C would effectively reduce conflicts, making the alternative consistent with the statewide standard.

Transportation and utility facilities would 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), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires consolidation of transportation facilities and utilities. Lease stipulations and ROPs under Alternative C would effectively reduce conflicts, making this alternative consistent with the statewide standard.

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 water features associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. Lease Stipulation K-6, in particular, would be effective in ensuring compliance with this standard.

Sand and Gravel Extraction (11 AAC 112.260)

The ACMP statewide standards indicate sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no practicable noncoastal 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). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Substantially more gravel could be required under Alternative C than under the other alternatives, but ROPs and lease stipulations would be effective by placing restrictions on gravel mining locations and thus reducing conflicts to ensure compliance with this standard and the NSB policies.

Subsistence (11 AAC 112.270)

The statewide standard for subsistence indicates a project within a designated subsistence use area must avoid or minimize impacts to subsistence uses of coastal resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under Alternative C, the entire Beaufort Sea coast would be open to leasing. As a consequence, access to subsistence resources could be more limited, leading to a reduction in subsistence hunting and resource use, relative to the other alternatives. Disturbances and oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, and birds, and bowhead whales and other marine mammals.

The impacts would result in more difficult and somewhat reduced success at subsistence harvests for Barrow, Atqasuk and Nuiqsut hunters. Subsistence-hunter concerns about access to resources, resource disturbance, and resource contamination would be greater than for the other alternatives. Lease stipulations would offer protection to subsistence resources and activities. Surface, air, and foot traffic near the oil fields would be expected to increase more than under the other alternatives, and would potentially displace large numbers of caribou, moose, muskox, grizzly bears, wolves, and wolverines. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance from oil and gas activities on caribou, potential conflict with the subsistence policies would be greater under Alternative C than under the other alternatives. Although Alternative C would likely still comply with the statewide standard, the effects on subsistence resources and activities would depend to a great extent on the location(s) of well fields and facilities. For example, development in the caribou calving and insect-relief area north of Teshekpuk Lake would have a notably greater effect than would development in less sensitive areas.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies would be somewhat greater under Alternative C than under other alternatives.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities (offshore dredging, pipeline construction, structure placement and onshore pipelines, and construction of support bases, and roads).

The Alternative C development scenario predicts that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River potentially could affect subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or causing subsistence users to perceive them as tainted (Section 4.5.12; Subsistence). However, the number of sizable oil spills estimated for Alternative C would still be small. It is anticipated that the potential for effects from spills and associated clean-up activities would be greater under Alternative C than under the other alternatives, but that the impact on subsistence resources and harvest patterns would be minor.

Conflict with these policies would be possible during the exploration, development, and production phases but would more likely during development and production. Under Alternative C, ROPs and lease stipulations designed to protect subsistence resources and to establish procedures and advisory bodies to address subsistence concerns would effectively minimize policy conflicts. Therefore, Alternative C should be consistent with the statewide standard.

Habitats (11 AAC 112.300)

The statewide standard for habitats contains an overall standard policy, plus policies specific to nine habitat areas: offshore areas; estuaries; wetlands; tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes (including associated floodplains and riparian management areas); and important upland habitat. The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under Alternative C, no sensitive habitat areas in the Planning Area would be excluded from leasing, in contrast to the No Action Alternative, which would exclude 600,000 acres, Alternative B, which would exclude 213,000 acres, or the final Preferred Alternative, which would defer leasing on approximately 211,000 acres (Teshekpuk Lake) from oil and gas leasing. However, applicable ROPs and lease stipulations would provide effective protection for birds, terrestrial mammals, fish, and habitats. Therefore, conflicts with the ACMP standards would be minimized to the extent practicable, and activities under Alternative C would probably be consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to avoid, minimize, or mitigate significant adverse impacts to habitat resources. This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents substantial 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 lease stipulations placed on permits. Alternative C ROPs and lease stipulations would effectively reduce potential conflicts, and the activities would be consistent with the statewide standard, assuming the AO would be cognizant of the NSB requirements when determining the appropriate requirements of the performance-based lease stipulations and ROPs.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid, minimize, or mitigate significant adverse effects.

It is expected the caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of aircraft overflights, but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would be greater under Alternative C than under the other alternatives, and could displace some large mammals, though not enough to substantially affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to avoid, minimize, or mitigate significant adverse impacts to natural water flow; active floodplains; and natural vegetation within riparian management areas. Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in Section 11 AAC 112.260. The ROPs and lease stipulations in place under Alternative C would effectively reduce conflicts, and would be consistent with the statewide standard.

Air, Land, and Water Quality (11 AAC 112.310)

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. The NSB policies (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11) address water quality issues; development must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). Under Alternative C, there could be some short-term conflict with these policies due to potential oil spills, which would likely be more frequent under Alternative C than under the other alternatives. However, the ROPs and lease stipulations in place under Alternative C would effectively reduce conflicts, and the alternative would be consistent with the statewide standards.

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 these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA. The Alaska Oil and Gas Conservation Commission has primacy for this program. Some wastes are disposed through the annulus of producing wells, an activity is exempt from the Underground Injection Control program. However, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges of muds, cuttings, and drilling fluids are closely regulated, no conflict is anticipated with the statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. There would be no inherent conflict between the proposed activities of Alternative C and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (11 AAC 112.310, 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 C in Section 4.5.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Historic, Prehistoric, and Archaeological Resources (11 AAC 112.320)

The ACMP 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, including natural processes.

The NSB 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) also requires that development not disturb newly discovered historic or cultural sites prior to an archaeological investigation. It is likely that new cultural and paleontological sites would be discovered under Alternative C. No conflicts with these policies would be expected, however, since lease stipulations and ROPs would require an inventory of traditional use sites prior to conducting any activities. Therefore, Alternative C would be consistent with the statewide standard.

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 use sites. No conflict with these policies would be expected.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

Effects of Spills

Because of the interrelated nature of the ACMP and NSB CMP policies, the potential effects of spills were addressed with the effects of disturbances under each major policy area above.

It is expected that disturbances and oil spills associated with oil and gas activities would cause short-term and localized impacts from disturbance and oil spills to the TLH caribou and other terrestrial mammals, fish, and birds, and bowhead whales and other marine mammals. These impacts would likely be greater under Alternative C than under the other alternatives, as would subsistence hunter concerns about access to resources and resource contamination. The greater degree of impacts would result from opening additional area to leasing in caribou, waterfowl, and fishing areas, and because the expected level of development would be higher. Conflicts with ACMP and NSB CMP policies related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Implementation of ROPs and lease stipulations would therefore ensure that Alternative C would comply with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between Alternative C and the policies addressed in this section.

4.5.15.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above should be sufficient for Alternative C to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZM policy conflicts over the life of the alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but enforcement of applicable lease stipulations and ROPs should be effective in minimizing the conflicts and quickly return the development to compliance with policies and standards.

4.5.15.4 Conclusion

Under Alternative C, conflicts could occur with specific statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience significant overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. However, the ROPs and lease stipulations in place would be effective in reducing conflicts, and Alternative C would be consistent with ACMP standards.

In summary, it is expected that effects to terrestrial mammals would occur, but that there would not be high impacts to populations. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude oil and fuel spills, but populations would be expected to recover within 1 year. Arctic fish populations would experience minor effects. Disturbance and displacement effects and oil-spills risks would be expected for birds. Bowhead whales would be expected to experience short-term, nonlethal effects. Effects to seals and polar bears would be short term and localized, with no substantial effects to populations.

Because these effects would be spread over several decades, the biological analyses expect moderate overall effects on resource populations. Therefore, effects on subsistence harvest patterns in the communities of Barrow, Atqasuk, Anaktuvuk Pass, and Nuiqsut as a result of impacts from disturbance and oil spills should be moderate, and would not make any subsistence resource unavailable or undesirable for use, nor would overall population reductions be expected.

4.5.16 Recreational Resources

4.5.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts to recreation resources from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves would be very similar to those that would occur under the other alternatives. The level of activity would likely be slightly higher under Alternative C, lured by greater activity in the oil and gas arena and associated publicity.

Temporary structures, vehicles, noise from generators, aircraft, human presence, and associated activity would all have minimal short-term effects on the experience of solitude, naturalness, or primitive/unconfined recreation in the Planning Area. As under other alternatives, these short-term impacts would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction of the activity (500 acres). Approximately 2,000 to 3,000 acres would be affected at a time. All of the identified non-oil and gas activities would be transitory and short term; the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area would be small.

A longer lasting impact would be green trails resulting from overland moves. These trails would not necessarily develop over the entire route of an overland move, but where present would be detectable from the air for 2 to 5 years. They would be more difficult to recognize from the ground. Vegetation could also be damaged along these trails, with stems broken or the tops of tussocks scraped off. Because overland moves would be relatively constant from year to year, and would generally follow the same route(s), over several hundred miles of intermittent green trail in some phase of recovery would likely be visible from the air during any one summer season.

4.5.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, as under the other alternatives, seismic work would occur throughout most of the Planning Area. This work would primarily occur in winter using all-terrain ground vehicles supported by light aircraft, although some seismic work could occur in Teshekpuk Lake during summer. Mobile camps and their associated noise and activities would result in short-term effects to the primitive setting of the Planning Area, and a loss of solitude and naturalness. The effects would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction. As many as five seismic operations could take place in a season, temporarily affecting approximately 2,500 acres.

A longer-lasting impact of seismic survey operations would be green trails. Seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. Green trails would not necessarily develop over the entire survey route, but where visible, they would last for about 2 to 5 years. Assuming one or more operations per season for the first 5 to 10 years of the lease, the number of miles of intermittent green trails during any one summer season could peak at many hundred to several thousand miles. The number of miles of trail visible would decline as the preliminary phase of exploration slowed. Though green trails would last a short time, their linear nature would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

A total of 12 to 122 (91) exploration and delineation wells are anticipated under Alternative C. However, due to the limited number of drill rigs available, it is anticipated that no more than six wells would be drilled at any one time. Drilling would occur over several seasons, primarily using ice pads, roads, and airstrips. Temporary on-site location of structures (e.g., drill rigs); noise from sources such as generators, vehicles, aircraft; human presence; and associated activity would all have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences. Effects would be expected to be greatest within a 2-mile radius of the drill site, or an area of approximately 8,000 acres per site. Accordingly, under Alternative C, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 8,000 to 48,000 (32,000) acres during any given year, which would be equivalent to about 0.2 to 1 (0.7) percent of the Planning Area. The potential effects on recreation opportunities and experience would be minor.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating 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 would be 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 noticeable from the air for 2 to 5 years and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken, especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, and that half of the sites are vacated, approximately 300 to 3,050 (2,275) acres would be in various states of recovery.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

It is anticipated that there would be two to 20 (14) production pads and 110 to 330 (220) miles of pipeline under Alternative C. While the intensity of impacts would be greatest during construction and development of these facilities, remaining structures, human presence, and associated activity and noise would all have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years or more, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad site (an area of about 8,000 acres).

Pipelines, which would be elevated a minimum of 7 feet above the ground surface, would also impact recreation values. There would be little, if any, on-the-ground activity associated with pipelines, except during construction and repair. Long-term impacts to recreation values from pipelines should be minimal beyond about ½ mile, which equates to 640 acres impacted per mile of pipeline. Impacts to recreation values from a pump station and staging base would be similar to those resulting from a production pad and its facilities, impacting about 8,000 acres per staging base. Accordingly, at $25 per bbl of oil, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of up to 268,800 acres (i.e., [8,000 acres/pad x 14 pads] + [8,000 acres/base x 2 staging bases] + [640 acres/mile x 220 miles of pipeline]), or approximately 6 percent of the Planning Area. Short-term, routine/daily inspection flights would impact solitude and naturalness along the length of all pipelines for as long as they were in use.

Out of all the oil and gas activities, development activities would be most likely to have an effect on recreation opportunities and experience because they would take place year-round and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nevertheless, the effects would be expected to be minor because they would impact only a small portion of the Planning Area and because the Planning Area supports a very small amount of recreation. The actual effects would depend greatly on where development fields were located relative to major water courses and the Beaufort Sea coast, and how widely spread out they would be. Under Alternative C, the area subject to recreation effect from development would be approximately 2.4 times the area that would be affected under the No Action Alternative, 1.1 times the area that would be affected under Alternative B, and 1.3 times the area that would be affected under the final Preferred Alternative, if oil prices averaged $25 per bbl.

The potential for future formal wilderness or wild and scenic river designation would likely be reduced in areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills would be confined to a pad, and the remainder would usually be confined to the area immediately around the pad or pipeline. Therefore, effects on solitude, naturalness, or primitive/unconfined recreation opportunities resulting from small spills would likely be confined to an area of the same size as described above under Effects of Development.

A large spill that would reach a river, especially the Colville River, and move rapidly downstream would have high short-term (and possibly long-term) impacts on recreation values. Under Alternative C, outstandingly remarkable river values along the Colville River would not receive any special protection under the WSRA, although buffer areas are included in applicable ROPs for other reasons. As such, activity near the Colville River, and other major watercourses, would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any major impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to prevent wilderness or wild and scenic river designations in major portions of the Planning Area in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 8 percent of the Planning Area under Alternative C, about 2.4 times the area that would be similarly affected under the No Action Alternative, 1.1 times the area that would be affected under Alternative B, and 1.3 times the area that would be affected under the final Preferred Alternative, if oil prices averaged $25 per bbl. In addition, portions of the area could be explored unsuccessfully, resulting in lesser residual effects that would reduce wilderness values. Despite the lost values, over 4.2 million acres, almost 92 percent, of the Planning Area, would likely retain substantial wilderness values. The Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The “outstandingly remarkable values” that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology, and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with Alternative C, primarily from an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near the pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river’s outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable lease stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite “free flowing” nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the “outstandingly remarkable values” noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.5.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the lease stipulations and ROPs do not specifically address recreation activities, and there is no intent by the BLM to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the performance-based lease stipulations and ROPs required for development under Alternative C would serve to protect recreation values in the area. For example, certain areas would be excluded from leasing or surface development, and several ROPs and lease stipulations address protection of subsistence values and wildlife in the Planning Area. Buffer requirements would help to minimize potentially damaging activity in and near creeks, rivers, and lakes. Since wildlife viewing, big game hunting, and boating are the primary activities that attract recreationists to the Planning Area, these lease stipulations and ROPs would also help protect and preserve recreation values.

4.5.16.4 Conclusion

Under Alternative C, management activities other than oil and gas exploration and development would impact recreation values on 2,000 to 3,000 acres at a time. These impacts would be minimal and temporary.

In addition, impacts to recreation would result from oil and gas exploration and development activities. At any one time, exploratory/delineation drilling and seismic operations could result in short-term effects to solitude, naturalness, and primitive/unconfined recreation opportunities over an area of approximately 32,000 acres. More lasting effects (2 to 3 years) would result from a vegetative greening phenomenon caused by compacted snow and dead vegetative matter. As many as 2,275 acres of green pads, roads, and airstrips and several hundred to thousand miles of intermittent green trails could be visible from the air, and somewhat discernible at ground level, at any one time. Development, production pads, and connecting pipelines would result in long-term loss of solitude, naturalness, and primitive/unconfined recreation opportunities over 268,800 (or 6 percent of the Planning Area) if oil prices average $25 per bbl. In general, impacts from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped.

4.5.17 Visual Resources

4.5.17.1 Activities Not Associated With Oil and Gas Exploration and Development

Under Alternative C, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Between 20 and 60 trains comprised of one to six vehicles and attached sleds could engage in overland travel each year. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than introducing something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

4.5.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under Alternative C, the impacts from exploration would generally be the same as those under Alternative B, except that more exploration and delineation wells would likely be drilled. The number of exploration and delineation wells would range from 12 to 122 (91), and the number of drilling rigs that could be operating in the Planning Area at any one time would range from one to six. Therefore, the area of long-term disturbance associated with the new wells would range from 120 to 1,220 (910) acres (a 10-acre footprint per well). Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow covered landscape. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails—a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a “ring effect” around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, from 600 to 6,100 (4,550) acres (50 acres per site) would be in various states of recovery from greening and ring effects under Alternative C. Because greening and ring effects visually modify the existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would also leave behind a marker pipe, which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from a distance of several hundred feet.

Effects of Development

Production rigs (up to 11 with an average height of 208 feet under the No Action Alternative) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also introduce strong contrast to the natural browns landforms and greens of the vegetation. In addition, burn-off flares and general work lighting would contrast against the dark night sky. Drill rigs, because of their height and color, could be seen and dominate the attention of the casual observer if they were located within the Foreground-Middleground Zone.

It is estimated that long-term surface disturbance from staging bases, pads, roads, airstrips, gravel pits, and CPFs would range from 190 to 1,975 (1,380) acres. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

An estimated 110 to 330 (220) miles of pipeline, impacting 660 to 1,980 (1,320) acres (5 to 6 acres per mile), would be constructed under this alternative. There would be no on-the-ground activity associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 7 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, pipelines would attract and dominate the attention of the casual observer if located within the Foreground-Middleground Zone.

Other facilities associated with development would include gravel mine sites, bridges, roads, airstrips, and communications towers. Disturbance associated with gravel mine sites would generally occur below the ground surface, with only stockpiled materials being visible aboveground. While these sites could be large in size or footprint, very little material would remain as stockpile at any one time. If located within the Foreground-Middleground Zone, only bridges, because of their contrast with smooth water bodies, and communications towers, because of vertical height above the horizon, would be likely to attract the attention of a casual observer.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.5.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no ROPs or lease stipulations specific to visual resources, ROPs and lease stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under Alternative C.

4.5.17.4 Conclusion

Under Alternative C, visual impacts would be greater than those under the other alternatives, because no areas within the Planning Area would be closed to leasing, and there would be more overall exploration and development. Several thousand miles of seismic lines and up to 6,100 acres associated with exploratory drilling would be in various states of recovery from greening and ring effect. An additional 120 to 1,220 (910) acres of disturbance would be associated with drilling sites each winter. It is anticipated that as many as 330 miles of pipeline would be constructed under this alternative, causing surface disturbance of approximately 1,980 acres. There could also be approximately 190 to 1,975 (1,380) acres of disturbance associated with staging bases, pads, gravel pits, roads, and CPFs.

4.5.18 Economy

4.5.18.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the Alternative C, there would be recreational employment that would generate approximately 30, 1-week long float trips per year. This is equivalent to one person working for 8 months.

4.5.18.2 Oil and Gas Exploration and Development Activities

As explained in Section 4.2.1.2 (Oil and Gas Exploration and Development Activities), scenarios were developed based on the assumption that oil prices would range between $20 and $30 per bbl (in constant dollars), with a more likely long-term average of $25 per bbl of oil. Revenues and employment are estimated based on these three scenarios. At $25 per bbl of oil, peak annual oil production is projected to be 82 million barrels (Table 4-5).

The number of workers needed to operate the oil and gas infrastructure would be determined by the scale of the oil and gas infrastructure rather than the amount of oil and gas produced. A wide range of production volume would be handled by a given level of infrastructure. Under Alternative C, once the infrastructure was in place, the number of workers needed to operate it would be independent of the amount of product flowing through it. The economic effects of oil and gas activities would include employment generated by exploration, development, and production. State and NSB property-tax revenues would be directly proportional to the value of onshore facilities. State royalty income and state severance tax would be proportional to production.

Effects on Revenues

Tables 4-16, 4-17, and 4-18 show projected property tax revenues for the NSB and State of Alaska, royalties for the NSB, State of Alaska, and the federal government, and severance taxes for State of Alaska at $20, $25, and $30 per bbl of oil, respectively. Potential revenues would be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist.

The State of Alaska depends heavily upon oil royalties and taxes to fund its annual operating budget. Approximately 80 percent of the State of Alaska's general fund unrestricted revenues are derived from petroleum revenue, and 35 percent or more of all state revenues are derived from the oil industry (ADR 2003b). Royalty tax payments from within the National Petroleum Reserve – Alaska are treated differently than those from other state or federal lands. Federal law establishes a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska.

The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough and is subject to local property tax limitations. The 2002 property tax rate for the NSB was 18.5 mills (ACDED 2003), leaving the state portion of the property tax at 1.5 mills. The NSB faces a declining property tax base because of depreciation of petroleum production facilities that comprise most of the assessed valuation. Alternative C would help expand assessed property valuation and resultant taxes to the NSB.

An estimate of the potential property tax revenues that would be generated under Alternative C can be calculated using a unit factor estimate of $0.50 per barrel of oil (ADR 2003b). The estimated property taxes using the per barrel unit factor for $20, $25, and $30 per bbl of oil are shown in Tables 4-16, 4-17, and 4-18.

The estimated royalties and severance payments are based on currently available information on the tax structure for the National Petroleum Reserve – Alaska.[2] The model incorporates the projected production schedule for oil, and the assumed wellhead values under Alternative C.

Effects on Employment

Under Alternative C, the gains in direct employment would be greater than under the other alternatives, and would include jobs in petroleum exploration, development, and production, and related activities. Tables 4-19, 4-20, and 4-21 show the employment effects by place of residence at $20, $25, and $30 per bbl of oil, respectively. Employment is expressed as annual average jobs by place of residence for each phase of activity.

The employment effects were calculated using a model developed by Northern Economics, Inc. The model incorporates exploration, development, and production activities and expenditures associated with Alternative C at the different oil price scenarios. Employment multipliers were derived using an input-output model of the state

[2] Federal Royalty Rate: 16.67 percent; Oil Severance Tax Rate: 12.5 percent for the first 5 years and 15 percent for later years; Gas Severance Tax Rate: 10 percent.

economy. The employment effects shown in the table represent the number of potential direct, indirect, and induced jobs that would be held by NSB residents and resident workers from the rest of Alaska (does not include out-of-state workers). The regional breakdown of employment by place of residence was based on the Northwest IAP/EIS.

Table 4-16. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $20 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$5.088	$0.413	$6.638	$6.638	$13.276	$19.910
2	$7.863	$0.638	$10.259	$10.259	$20.517	$30.770
3	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
4	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
5	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
6	$10.175	$0.825	$13.276	$13.276	$26.552	$39.820
7	$9.250	$0.750	$12.069	$12.069	$24.138	$36.200
8	$8.325	$0.675	$10.862	$10.862	$21.724	$32.580
9	$6.938	$0.563	$9.052	$9.052	$18.104	$27.150
10	$6.475	$0.525	$8.448	$8.448	$16.897	$25.340
11	$5.550	$0.450	$7.241	$7.241	$14.483	$21.720
12	$5.088	$0.413	$6.638	$6.638	$13.276	$19.910
13	$4.163	$0.338	$5.431	$5.431	$10.862	$16.290
14	$3.700	$0.300	$4.828	$4.828	$9.655	$14.480
15	$3.700	$0.300	$4.828	$4.828	$9.655	$14.480
16	$3.238	$0.263	$4.224	$4.224	$8.448	$12.670
17	$2.775	$0.225	$3.621	$3.621	$7.241	$10.860
18	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
19	$2.313	$0.188	$3.017	$3.017	$6.035	$9.050
20	$1.850	$0.150	$2.414	$2.414	$4.828	$7.240
21	$1.388	$0.113	$1.810	$1.810	$3.621	$5.430
Total	$120.713	$9.788	$157.501	$157.501	$315.003	$472.410

"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 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 jobs generated by this spending are referred to as "induced employment."

During the exploration phase, the potential number of direct, indirect, and induced jobs generated for North Slope residents would be 6 jobs at $20 per bbl, 42 jobs at $25 per bbl, and 54 jobs at $30 per bbl of oil. The number of potential jobs for the rest of Alaska during the exploration phase would range from 111 at $20 per bbl to 1,067 at $30 per bbl of oil.

Total NSB resident jobs during the development phase would range from potentially 156 jobs at $20 per bbl to 638 jobs at $30 per bbl of oil. For the rest of the state, there would be potential of 2,219 jobs at $20 per bbl, 5,798 jobs at $25 per bbl, and 9,090 jobs at $30 per bbl of oil.

Fewer jobs would be generated during the production phase than during the development phase. During the production phase, the potential number of jobs for NSB residents would range from 17 jobs at $20 per bbl to 79 jobs at $30 per bbl of oil. For the rest of Alaska the production phase would potentially generate 793 jobs at $20 per bbl, 2,386 jobs at $25 per bbl, and 3,657 jobs at $30 per bbl of oil.

Table 4-17. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $25 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$5.550	$0.450	$9.742	$9.742	$19.484	$29.220
2	$7.863	$0.638	$13.801	$13.801	$27.602	$41.395
3	$15.725	$1.275	$27.602	$27.602	$55.204	$82.790
4	$26.283	$2.131	$35.814	$35.814	$71.628	$104.929
5	$41.745	$3.385	$56.916	$56.916	$113.831	$166.764
6	$51.840	$4.203	$70.683	$70.683	$141.367	$207.105
7	$53.841	$4.366	$73.428	$73.428	$146.856	$215.152
8	$55.205	$4.476	$75.273	$75.273	$150.545	$220.552
9	$51.840	$4.203	$70.683	$70.683	$141.367	$207.105
10	$47.111	$3.820	$64.250	$64.250	$128.499	$188.258
11	$43.746	$3.547	$59.660	$59.660	$119.321	$174.811
12	$39.017	$3.164	$53.226	$53.226	$106.453	$155.964
13	$33.651	$2.728	$45.893	$45.893	$91.785	$134.470
14	$30.286	$2.456	$41.303	$41.303	$82.607	$121.023
15	$26.921	$2.183	$36.714	$36.714	$73.428	$107.576
16	$23.556	$1.910	$32.125	$32.125	$64.250	$94.129
17	$21.554	$1.748	$29.380	$29.380	$58.760	$86.082
18	$18.827	$1.527	$25.691	$25.691	$51.382	$75.282
19	$16.825	$1.364	$22.946	$22.946	$45.893	$67.235
20	$14.824	$1.202	$20.202	$20.202	$40.403	$59.188
21	$13.460	$1.091	$18.357	$18.357	$36.714	$53.788
22	$9.457	$0.767	$12.868	$12.868	$25.735	$37.694
23	$8.732	$0.708	$11.923	$11.923	$23.846	$34.941
24	$5.367	$0.435	$7.334	$7.334	$14.668	$21.494
25	$4.729	$0.383	$6.434	$6.434	$12.868	$18.847
26	$3.078	$0.250	$3.866	$3.866	$7.732	$11.224
27	$2.440	$0.198	$2.966	$2.966	$5.931	$8.577
28	$0.877	$0.071	$0.442	$0.442	$0.884	$1.060
29	$0.614	$0.050	$0.309	$0.309	$0.618	$0.742
Total	$674.963	$54.727	$929.829	$929.829	$1,859.659	$2,727.397

In terms of total statewide effects on employment, Alternative C could generate 3,301 jobs at $20 per bbl, 9,524 jobs at $25 per bbl, and 14,595 jobs at $30 per bbl of oil.

Because of the development of facilities or the continued use of facilities taxable by the NSB, the NSB would receive additional revenues, which would most likely be used for ongoing infrastructure construction and operations. In turn, NSB-government jobs would be generated.

4.5.18.3 Effectiveness of Stipulations and Required Operating Procedures

No lease stipulations or ROPs were developed to address economic concerns.

4.5.18.4 Conclusion

It is anticipated that under Alternative C, annual NSB resident employment would increase in the range of 156 to 638 jobs during the peak of development and 17 to 79 jobs during production. During development, this would be a four to 14-fold gain over employment levels under the No Action Alternative and up to a 4-fold increase during production. The annual employment of Alaska residents (excluding residents of the NSB) would increase in the range of 2,219 to 9,090 jobs in the peak of development, and 793 to 3,657 jobs during production, about five times the number of jobs created under the No Action Alternative.

Table 4-18. Estimated Property Taxes, Royalties, and Severance Taxes for Alternative C at $30 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$7.400	$0.600	$16.323	$16.323	$32.647	$48.960
2	$10.638	$0.863	$23.465	$23.465	$46.929	$70.380
3	$21.738	$1.763	$47.950	$47.950	$95.899	$143.820
4	$36.290	$2.942	$64.607	$64.607	$129.213	$188.073
5	$53.092	$4.305	$93.886	$93.886	$187.773	$273.018
6	$57.206	$4.638	$101.765	$101.765	$203.531	$296.208
7	$72.756	$5.899	$129.361	$129.361	$258.722	$376.500
8	$74.032	$6.003	$131.696	$131.696	$263.393	$383.328
9	$74.670	$6.054	$132.864	$132.864	$265.728	$386.742
10	$72.756	$5.899	$129.361	$129.361	$258.722	$376.500
11	$65.213	$5.288	$116.073	$116.073	$232.146	$337.884
12	$60.572	$4.911	$107.752	$107.752	$215.503	$313.632
13	$53.841	$4.366	$95.779	$95.779	$191.558	$278.784
14	$46.473	$3.768	$82.639	$82.639	$165.278	$240.522
15	$41.657	$3.378	$74.170	$74.170	$148.340	$215.916
16	$37.016	$3.001	$65.848	$65.848	$131.696	$191.664
17	$32.375	$2.625	$57.527	$57.527	$115.053	$167.412
18	$29.010	$2.352	$51.540	$51.540	$103.081	$149.988
19	$26.283	$2.131	$46.722	$46.722	$93.444	$135.978
20	$22.918	$1.858	$40.736	$40.736	$81.471	$118.554
21	$20.191	$1.637	$35.917	$35.917	$71.834	$104.544
22	$18.101	$1.468	$32.266	$32.266	$64.533	$93.948
23	$13.460	$1.091	$23.945	$23.945	$47.890	$69.696
24	$12.184	$0.988	$21.609	$21.609	$43.219	$62.868
25	$7.368	$0.597	$13.140	$13.140	$26.280	$38.262
26	$6.730	$0.546	$11.972	$11.972	$23.945	$34.848
27	$3.365	$0.273	$5.986	$5.986	$11.972	$17.424
28	$2.727	$0.221	$4.818	$4.818	$9.637	$14.010
29	$2.089	$0.169	$3.651	$3.651	$7.301	$10.596
Total:	$982.151	$79.634	$1,763.369	$1,763.369	$3,526.738	$5,140.059

Table 4-19. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $20 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	2	3	6
Development phase	93	63	156
Production phase	9	8	17
Rest of Alaska			
Exploration/delineation phase	28	84	111
Development phase	957	1,261	2,219
Production phase	349	444	793
Total Statewide Effects			
Total exploration/delineation	30	87	117
Total development	1,050	1,324	2,374
Total production	358	452	810

Table 4-20. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $25 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	16	26	42
Development phase	242	165	407
Production phase	28	24	52
Rest of Alaska			
Exploration/delineation phase	209	630	839
Development phase	2,502	3,296	5,798
Production phase	1,050	1,336	2,386
Total Statewide Effects			
Total exploration/delineation	225	656	881
Total development	2,744	3,461	6,205
Total production	1,078	1,360	2,438

Table 4-21. Effects on Employment (Expressed as Annual Average Jobs) for Alternative C at $30 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	21	33	54
Development phase	380	258	638
Production phase	43	37	79
Rest of Alaska			
Exploration/delineation phase	280	797	1,067
Development phase	3,923	5,167	9,090
Production phase	1,610	2,047	3,657
Total Statewide Effects			
Total exploration/delineation	301	830	1,131
Total development	4,302	5,426	9,728
Total production	1,652	2,084	3,736

The combined average annual property taxes to the NSB and State of Alaska could range from $6 to $37 million depending on the price of oil and gas and the resulting infrastructure development. This would be a two to eight-fold increase in annual property taxes paid as compared to the No Action Alternative. The annual average royalty paid to government is expected to be twice the amounts estimated to be paid under the No Action Alternative. The royalty is estimated to range from $15 million to $122 million for the federal government and $15 to $122 million for the state and the NSB combined, depending on the price of oil and resulting infrastructure development.

The estimated average annual state severance tax would range from $22 million to $177 million, depending on the price of oil and gas. This is twice the amount that would occur under the No Action Alternative and would be similar to the amount that would occur under the final Preferred Alternative and Alternative B.

The proximity of Nuiqsut to the area of interest (northeast NPRA) enhances the community's opportunities to benefit from development and production activities associated with Alternative C. These opportunities could extend to community businesses that might provide goods and services, as well as residents who might obtain work as a result of the development and production activities.

4.6 Alternative D (Final Preferred Alternative)

Alternative D (final Preferred Alternative) was developed based on public comments on the Draft Amended IAP/EIS. The final Preferred Alternative makes approximately 95 percent (4.4 million acres) of the Planning Area available for oil and gas leasing (Map 2-4); Teshekpuk Lake would be deferred from leasing from oil and gas leasing after signing of the ROD if this alternative was chosen by the decision-maker. Under the final Preferred Alternative D, performance-based lease stipulations and ROPs very similar to those developed for alternatives B and C would be used to mitigate the impacts of energy exploration and development on surface resources. In addition, three new lease stipulations are proposed for the final Preferred Alternative, and additions, deletions, and edits have been made to the proposed performance-based mitigations designed for alternatives B and C that would apply to the final Preferred Alternative and would increase protection to surface resources throughout the planning area. The additional lease stipulations and changes would prohibit permanent oil and gas facilities (No Surface Occupancy; NSO), on approximately 374,000 acres, although pipelines and publicly-funded community roads would be allowed in this area. Exploration activities would be allowed within this NSO, including seismic acquisition and exploratory drilling. These lease stipulations would protect calving, post-calving, insect-relief, and migration habitat for caribou and molting habitat for geese. Finally, a new site-specific stipulation would establish a maximum limit of 300 acres of permanent surface disturbance from oil and gas activities within each of seven lease tracts identified north of Teshekpuk Lake. Theses seven lease tracts range in size from approximately 46,000 acres to 59,000 acres.

A comparison of these lease stipulations with those developed for the No Action Alternative and alternatives B and C is provided in Table 2-2. Additional seasonal and spatial lease stipulations would be applied to provide protection of environmentally sensitive areas. These areas, which are described in Section 2.2.1 (Areas with Additional Stipulations) and in the lease stipulations outlined in Section 2.6 (Lease Stipulations and Required Operating Procedures), include:

- Rivers Area
- Deep Water Lakes
- Teshekpuk Lake
- Goose Molting Area
- Teshekpuk Lake Caribou Habitat Area
- Coastal Area
- Colville River Special Area
- Pik Dunes
- Caribou Movement Corridor Area (see Lease Stipulation K-9)
- Southern Caribou Calving Area (see Lease Stipulation K-10)
- Lease Tracts Area (see Lease Stipulation K-11)

For the resources discussed in the following section, a single value, or a range of values, are given to describe the amount of area that could be impacted by oil exploration and development. If a range of values is given, it represents the level of oil exploration and development, and associated resource impacts, for oil prices of $20 per bbl and $30 per bbl. The range of values better describes the types of impacts that could occur if oil prices are higher, or lower, than predicted to occur during the life of the amendment. If a single value is given, or a value is enclosed in parentheses after a range of values, it represents the level of oil activity, and associated resource impacts, projected to occur if oil prices average $25 per bbl during the life of the amendment.

4.6.1 Air Quality

4.6.1.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, the ground-impacting-management activities that would affect air quality would be the same as those under No Action Alternative. Impacts to air quality would result from emissions. Emissions from non-oil and gas activities would be extremely limited and would generally be associated with activities of the small resident population and their habitation and transportation activities. The impacts of these activities would be the same as those under the No Action Alternative.

4.6.1.2 Oil and Gas Exploration and Development Activities

Effects of Routine Emissions

The entire National Petroleum Reserve – Alaska is a PSD Class II Area, which allows a moderate incremental decrease in the air quality of the area. Baseline concentrations of PSD pollutants and the portions of the PSD increments already consumed are established for each location by the USEPA 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 (acid rain) and freshwater bodies, or effects on plants.

Under the State Implementation Plan, the ADEC has jurisdiction for regulating and permitting air quality emissions within the Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including obtaining construction and operating permits. Construction air quality permits include applicable PSD requirements.

Exploration

During the exploration phase, emissions would be produced by: 1) vehicles used to gather seismic and other geological and geophysical data; 2) diesel-powered generating equipment required for drilling exploratory and delineation wells; 3) vehicles and aircraft used in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Criteria pollutants generated would primarily consist of NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10}.

If permanent facilities, such as gravel airstrips, storage pads, and connecting roads were built, fugitive dust emissions would occur. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations.

For all these operations, controls would be applied under the ADEC and USEPA air quality regulations. The main emissions would be NO_2, with lesser amounts of SO_2, CO, and PM_{10}.

Development

During the construction and drilling phases, the primary emission sources would be 1) piston-driven engines or turbines used to provide power for drilling, 2) heavy construction equipment used to install modules and pipelines, and 3) various vehicles and aircraft. The principal development-phase emissions would consist of NO_2, with lesser amounts of SO_2, CO, and PM. Based on assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) are projected as follows for construction: NO_x (17.7), SO_2 (1.3), CO (4.2), and PM_{10} (1.3). Emissions for drilling would be: NO_2 (26.7), SO_2 (3.0), CO (5.9), and PM_{10} (1.3). These projections assume that the typical development in the Planning Area would be similar in size to the proposed Alpine Satellite Development and that only one development would be under construction at a time.

Aircraft would bring materials and crews to the development sites. Based on assumptions developed for the Alpine Satellite Development Plan, an estimated 40 to 70 one-way aircraft flights each month would be needed initially to service a CPF and associated satellite fields (USDOI BLM 2004C). The number of flights occurring each month could increase to as many as 340 and 90, at the peak of construction and drilling activities, respectively. A similar number of flights would be expected to service a development in the Planning Area. These flights could generate up to 1.2 tons of CO, 0.14 tons of NO_x, 0.9 tons of VOCs and other hydrocarbons, and 0.03 tons of SO_x annually.

During the production phase, the primary source of emissions would be turbines for power generation and gas compression, and power generation for heating, oil pumping, and water injection. The emissions would consist mainly of NO_2, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOCs) from oil/water separators, 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 VOCs 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 VOCs. However, flaring would burn up any emissions of VOCs, 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 minor (but never completely absent). Based on the assumptions developed for the Alpine Satellite Development Plan, maximum annual emissions (in tons) during production are projected as follows: NO_x (1,020), SO_2 (13.4), CO (293, and PM_{10} (10; USDOI BLM 2004C). These projections assume that eight fields would be in production at the same time.

It is estimated that up to 190 flights would occur monthly during the operations phase for the final Preferred Alternative, based on flight estimates developed for the Alpine Satellite Development Plan. At peak flight activity, 0.4 tons of CO, 0.1 tons NO_x, 0.3 tons of VOCs and other hydrocarbons, and 0.02 tons of SO_x would be generated annually, assuming eight fields would be in production at the same time.

Construction and production activities can produce fugitive dust emissions. Fugitive dust occurs primarily during the summer months and is most often caused by trucks driving on unpaved roads. Vehicles can also track out fine material from gravel mining operations in the winter as well as during the summer months. Excessive fugitive dust can adversely affect human health and the environment; fugitive dust concentrations are controlled by state and USEPA air quality standards. Control measures include posting speed limits and watering road surfaces.

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 as equipment and personnel are brought into the area to remove equipment. The effects on air quality, however, would be 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 not include activities that would affect air quality more than previously discussed, these operations would cause limited effects to air quality.

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

Table IV.B.12-1 of the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS* lists estimated uncontrolled pollutant emissions for the peak-exploration, peak-development, and peak-production years from that sale proposal (USDOI MMS 1996c). The EIS also has additional relevant discussion, especially in the last paragraph of Section IV.B.12.(1). Information from the Beaufort Sea Sale 144 Final EIS is relevant for the Planning Area because the Sale 144 EIS analysis included the area immediately offshore of the National Petroleum Reserve – Alaska and analyzed effects from a scenario that included greater projected oil development than is projected in this amendment. Emissions analyzed for the Beaufort Sea also included some emission sources not applicable to operations on land in the National Petroleum Reserve – Alaska. Emissions from expected Planning Area operations would not include major emission sources not analyzed for the Beaufort Sea. Therefore, effects analyzed and pollutants modeled for the Beaufort Sea Sale 144 EIS are greater than those that would be expected for the Planning Area. Modeling discussed in the Sale 144 EIS showed that the concentration of NO_2 was the highest out of all the modeled pollutants, but that all pollutant contributions would be well within the PSD increments and federal ambient air quality standards.

Air quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a typical field that might be developed in the Planning Area), 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 because of 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 the final Preferred Alternative should have air emissions that are similar to or less than 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.

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 OCS averaged 3.3 per 1,000 wells drilled from 1956 through 1982, and the blowouts were comprised mostly of gas and water (Fleury 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Statistical information from OCS blowouts is relevant for this amendment because of possible activity in offshore coastal waters from leasing in the National Petroleum Reserve – Alaska. The statistical information for the OCS is recent enough that it may assist readers in becoming aware of how relatively infrequent such blowouts have been in recent years. Please see Section 4.2.2 (Oil Spills) and Appendix K of this amendment for a detailed discussion of oil spills. Typical emissions from such accidents consist of hydrocarbons (VOCs); only fires associated with blowouts produce other pollutants, such as NO_x, CO, SO_2, and PM. Accidental emissions likely would have a minor 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 VOCs. It is estimated that the probability of experiencing one or more blowouts while drilling the wells projected for the final Preferred Alternative would be minor. 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 VOCs. Since 1974, 60 percent of the blowouts have lasted less than 1 day; and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. In addition, in-situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill contingency plans. For catastrophic oil blowouts, in-situ burning may be the only effective technique for spill control. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by over 99 percent and slightly increase emissions, relative to quantities in other oil and gas industrial operations, of other pollutants. 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 45 miles off the coast of Africa locally deposited oily residue in a rainfall 30 to 50 miles 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 could occur on the North Slope would not cause noticeable fallout problems. Along the TAPS, 500 bbl of a spill 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 would be the major, though not the only, potential air quality risk. Recent examination of PAHs in crude oil and smoke from burning crude oil indicated that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater 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).

Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only). Visibility can 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 used the VISCREEN model and found noticeable effects on only a very limited number of days with the most restrictive meteorological conditions. No effects were simulated during average conditions. Those results would be expected to be typical of development projects in the Planning Area.

A substantial increase in ozone concentration would not be likely to result from exploration, development, or production scenarios associated with the final Preferred Alternative. Photochemical pollutants such as ozone are not emitted directly, but form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the National Petroleum Reserve – Alaska during the summer, temperatures remain relatively minor (Brower et al. 1988). Also, activities that would occur as a result of field development would be 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 oil fields, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05 to 0.07 parts per million (ppm), which is well within the existing maximum 1-hour-average ozone standard of 0.12 ppm (Table 3-1). 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 USEPA cannot enforce the standard until the legal issues are resolved.) Because the projected ozone precursor emissions from the final Preferred Alternative 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 SO_2 concentration as low as 12 µg/m^3 for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 µg/m^3. In addition, the sensitivity of lichens 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, it is assumed that the ambient concentrations at most locations would be near the lower limits of detectability. Because of atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under the final Preferred Alternative is expected to be minor. For the proposed Liberty development project, BPXA determined that maximum-modeled pollutant concentrations were well below levels that can damage lichens, according to laboratory studies. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants on vascular plants or lichens (Kohut et al. 1994). That research was conducted in areas typical of much of the North Slope area. Monitoring the vascular plant and lichen communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

4.6.1.3 Effectiveness of Stipulations and Required Operating Procedures

None of the lease stipulations or ROPs is particularly applicable to air quality impacts. Mitigation of air quality impacts would result from operators' use of the best available technology to control air emissions.

4.6.1.4 Conclusion

Effects on air quality from emissions would likely only constitute 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 moderate effect on air quality with respect to standards. Because of the atmospheric dispersion of emissions, the other effects of air pollutant concentrations caused by 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. Air emissions associated with exploration and development under the final Preferred Alternative would be approximately 2 to 3 times the level for the No Action Alternative based on the number of fields likely to be developed under this alternative, but would be less than under any other action alternatives considered.

A large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (VOCs) as a result of evaporation from the spill. The VOC concentrations would be very minor and normally limited to only ½ to 1 square mile surrounding the point of emission. Moderate or stronger winds would further reduce the VOC concentrations in the air.

4.6.2 Paleontological Resources

4.6.2.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, the types of non-oil and gas activities would be the same as those described for the No Action Alternative; however, there would be likely be an increase in the level of aircraft and survey activity associated with environmental studies and monitoring. Despite increased activity, the impact to paleontological resources, which are deeply buried, would still be minor.

4.6.2.2 Oil and Gas Exploration and Development Activities

Under the final Preferred Alternative, the level of seismic activity is expected to increase beyond that of the No Action Alternative because an additional 389,000 acres would be available for leasing, and these additional acres would be in an area with high oil and gas potential. While the types of impacts to paleontological resources would remain the same, the increased level of seismic activity would increase the potential for impacts to occur. Any impacts associated with the increased seismic activity are expected to be minor.

Paleontological resources are not ubiquitous in the Planning Area as are wildlife and habitat, and their locations are much less predictable. As a result, it is possible that oil and gas exploration or development activities would not impact paleontological resources.

Effects of Disturbances

Under the final Preferred Alternative, the level of activity in the Planning Area would increase. However, because most of the activity would occur during the winter months, the potential for impacts to paleontological resources is extremely minor. The likelihood of impacting surface paleontological material also is minor due to their isolated and rare occurrence.

The drilling of exploration wells and delineation wells would occur during winter, except from current production pads and platforms sited within a lake body from May 20 through August 20 in the Teshekpuk Lake Caribou Habitat Area. Because of the limited availability of drill rigs, it is expected that no more than a few wells would be drilled at any one time. Drill pads, camp pads, roads, and airstrips made of ice and snow would be used, but permanent pads, roads, or airstrips could also be constructed; therefore, ground disturbance could occur and buried paleontological material could be impacted. The other substantial subsurface disturbance that would occur as a result of the actual drilling would be the making of the drill hole itself. If scientifically important paleontological material were present at the site of the borehole, these resources could be impacted by the drilling practice. However, the likelihood of such an occurrence is minor.

Surface disturbance from development could impact from 130 to 1,300 (920) acres, but there would be limited subsurface impacts associated with these activities. The primary impact to paleontological resources would result from the excavation of material for construction of the permanent facilities. Extraction of the terrestrial materials could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining operations on the North Slope. It is anticipated that a pipeline would not have associated all-weather roads or pads and would be constructed during the winter months from ice roads and/or pads. Therefore, the only substantial impact resulting from pipeline construction would be associated with the placement of VSMs. Depending on the depth at which the VSMs were set it is possible, though highly unlikely, that paleontological resources would be impacted. Overall, ground disturbance from development would have a minor impact on paleontological resources.

It is unlikely that paleontological resources would be impacted by abandonment activities, as these areas would have been previously disturbed by construction and development activities.

Effects of Spills

Under the final Preferred Alternative, the effects of spills to paleontogical resources would be the same as discussed under the No Action Alternative. If present, surface paleontological material could be impacted; however since the occurrence of paleontological remains is rare, the probability of an impact is minor.

4.6.2.3 Effectiveness of Stipulations and Required Operating Procedures

As discussed under Alternative B, the ROPs and lease stipulations under the final Preferred Alternative would be highly effective in protecting known and previously unknown paleontological resources and preserving their research potential and, ensuring that impacts to paleontological resources would be minor.

4.6.2.4 Conclusion

The types of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to what was described for the No Action Alternative. The potential impacts to paleontological resources from oil and gas exploration and development could increase about 3-fold from levels associated with the No Action Alternative, based on area of surface disturbance. Impacts could be greater if exploration and development occurred in an area with abundant paleontological resources. However, the ROPs and lease stipulations proposed to protect paleontological resources under this alternative, which are the same as those proposed for the No Action Alternative, would be highly effective.

4.6.3 Soil Resources

4.6.3.1 Activities Not Associated With Oil and Gas Exploration and Development

Various types of activities not related to oil and gas leasing and development, including private or commercial air traffic, summer research camps, use of OHVs, recreational camps, paleontological and archaeological excavations, and overland moves could affect soil in the Planning Area under the final Preferred Alternative.

Under the final Preferred Alternative, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would be little affected by the increased availability of land for oil and gas leasing. There could be some increase in the use of OHVs in the Planning Area, if development occurred, because of a greater amount of roads within the area. However, impacts to soil from this increase would be minor.

4.6.3.2 Oil and Gas Exploration and Development Activities

During oil and gas exploration and development, various activities could cause impacts to soil in the Planning Area. These activities include seismic activities, construction and use of gravel pads, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates.

Effects of Disturbances

Seismic Surveys

Seismic surveys to collect geological data and exploration drilling activities would mostly occur during the winter months. Under the final Preferred Alternative, impacts to soil resulting from seismic exploration, and the amount of area surveyed, would be similar to those for the No Action Alternative and alternatives B and C, although much of the survey focus would be on lands near Teshekpuk Lake. The same analysis, as the other alternatives, was used for the two-dimensional survey areas. The total area impacted by 2-D seismic surveys would be approximately 6,600 acres.

It is assumed that each 3-D seismic operation would also cover a total area of 600 mi^2 (384,000 acres). However, the number of miles (5,280) covered in that area would be much greater than for 2-D surveys. Thus, the tundra area impacted by seismic lines would be about 49,440 acres (82.4 acres per mi^2). For 3-D seismic surveys, this figure is a maximum, because a vehicle would not overrun all of the area between survey lines. For 3-D surveys, the length of camp move trails would be similar in length to those covered by 2-D surveys. Camp move trails would impact about 500 acres of tundra per survey. It is anticipated that two to five 3-D surveys would occur in the Planning Area during a 25-year period, impacting 1,000 to 2,500 acres by camp move vehicles and 98,880 to 247,200 acres by seismic lines. In general, 3-D seismic surveys have the potential to cause greater impacts to soils than 2-D seismic surveys, since tighter turns by heavy equipment are required. Thus, moderate and high-level disturbances would likely be more frequent with 3-D surveys.

Seismic activities could alter the thermal balance of the soil, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, making surface travel more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible.

Exploration

Under the final Preferred Alternative, impacts to soil from activities associated with oil and gas exploration would be similar to those described for the other alternatives. The drilling of exploration and delineation wells would result in impacts to soil resulting from the construction of well collars and both multi- and single-year ice pads (500 feet by 500 feet; 6 acres). In addition, up to 50 miles of ice road would be constructed annually.

Under the final Preferred Alternative, it is assumed 6 to 48 (34) exploration wells and 4 to 35 (26) delineation wells, or a total of 10 to 83 (60) wells, would be drilled from ice pads in the Planning Area. Impacts to soils would occur on 60 to 498 (360) acres over a period of about 25 years.

Placement of Gravel Fill

Construction of CPFs and associated satellite pads, roads, and airstrips would result in the loss of soil productivity in the areas of gravel placement. The development scenario under the final Preferred Alternative assumes gravel placement on 100 acres for the average field during construction. Under this alternative, 1 to 12 (8) fields would be developed, resulting in a total of 110 to 990 (730) acres of soil productivity lost by gravel placement. In addition, an additional 0 to 100 (50) acres of soil productivity could be lost by gravel placement for staging areas.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts would be exacerbated by dust deposition and by the formation of impoundments. These factors could combine to warm the soil, deepen thaw, and cause thermokarst adjacent to roads and other gravel structures (NRC 2003). In general, most changes around gravel structures would occur within 164 feet of the structure (Woodward-Clyde Consultants 1983). If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 200 to 2,400 (1,600) acres under the final Preferred Alternative.

Material Sites

Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that one to six (four) gravel mine sites would be necessary, resulting in a total of 20 to 210 (140) acres impacted, depending on the actual number of sites required. Excavation of the gravel mine and stockpiling of overburden would remove soil and impact soil productivity at these sites. Presumably, the likelihood of new gravel sites within the Planning Area would be greater under the final Preferred Alternative than under the No Action Alternative.

Pipelines

Under the final Preferred Alternative, impacts from pipeline construction would be similar to those described for the other alternatives. The extent of impacts associated with buried pipeline could be similar to alternatives B and C. Melting of ice in the soils would result, and the filled area, normally mounded immediately after placement of fill, which would level over time as melt water migrated to lower areas.

Effects of Oil and Gas Development on Permafrost

As discussed under the No Action Alternative, structures must be designed to avoid thawing their own foundations. Roadways and buildings must be elevated on thick gravel berms or pads, or on pilings. Gravel berms for roads can be as high as 6 feet above the tundra surface to ensure that the subgrade remains frozen. These roads have visual impacts on the landscape, and can intercept natural drainage and create ponds that thicken the active layer and initiate thermokarst (Walker 1996). Pipelines generally must be built on VSMs to ensure that the heat from the transmission of warm fluids does not thaw the surrounding permafrost, causing differential settlement. Heated buildings can also thaw the permafrost, leading to thaw settlement, if they are not elevated on pilings or their foundations insulated and refrigerated. On pads with closely spaced wells, extensive refrigeration with passive heat pipes and insulation is required to ensure that the heat from fluids does not melt the permafrost.

Abandonment and Rehabilitation

Removal of aboveground facilities, pipelines, bridges, and power poles during the winter would have a negligible impact on soils and permafrost. Soils and permafrost would remain unaffected for as long as pads and roads were maintained. Once maintenance of the roads and pads ceased, thaw subsidence in ice-rich areas would result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process.

Effects of Spills

Under the final Preferred Alternative, impacts to soils from activities associated with oil spills would be similar to those described for the other alternatives.

4.6.3.3 Effectiveness of Stipulations and Required Operating Procedures

Development in the Planning Area would result in impacts to soils. Lease stipulations and ROPs developed to protect soil under the final Preferred Alternative would provide similar protection to those developed for the other alternatives.

Similar to the other alternatives, many of the lease stipulations and ROPs developed under the final Preferred Alternative would directly or indirectly limit potential impacts to soils in the Planning Area. These ROPs and lease stipulations would provide similar protection as those provided for the No Action Alternative.

4.6.3.4 Conclusion

Under the final Preferred Alternative, impacts to soils from activities other than oil and gas development would include minor impacts 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 would vary from 1 year to decades.

Impacts from oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time from impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. Oil and gas development and operation would affect soils by disrupting soils under gravel pads, roads, and airstrips, excavating material sites, constructing of VSMs, and spilling oil and other chemicals. These impacts would be permanent except for those associated with spills, which would be cleaned up immediately, allowing recovery within a few years to several decades.

Short-term impacts would occur on up to 6,600 and 250,000 acres of soil from 2-D and 3-D seismic surveys, respectively, during a 25-year period. Another 30 to 250 (180) acres could be impacted by exploration and delineation wells.

Impacts to soil resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to soil resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Long-term impacts would occur on an estimated 310 to 3,490 (2,380) acres of soil from field and staging area development, and 20 to

210 (140) acres from gravel extraction activities. These activities could result in long-term impacts to approximately 0.007 to 0.1 (0.06) percent of the Planning Area, or approximately 0 to 2,590 more acres (3-fold increase) than under the No Action Alternative. The overall impact to soil in the Planning Area would be minor. The placement of pipelines underground could disturb an additional 1.5 acres per pipeline mile. Although all soil map units identified on Map 3-6 could be impacted during oil and gas exploration and development, soil associated with map unit IQ6 (see Section 3.2.7; Soil Resources) would likely be most affected since it is located in the area having high oil potential.

Lease stipulations and ROPs developed for the final Preferred Alternative would provide protection similar to that offered by lease stipulations developed for the No Action Alternative.

4.6.4 Water Resources

4.6.4.1 Surface Water and Groundwater Resources

Under the final Preferred Alternative, approximately 95 percent of the acreage in the Planning Area (approximately 4.39 million acres) would be open for leasing. Because this is substantially more acreage than under the No Action Alternative, more surface water could be impacted by oil and gas activities under this alternative. However, most of the lease stipulations that govern water resources under the No Action Alternative would also apply to this final Preferred Alternative. Setbacks from rivers, streams, and fish-bearing lakes would be in the range of ½ to 3 miles. The main difference between this alternative and the No Action Alternative pertaining to water resources is that the final Preferred Alternative allows for drilling near Teshekpuk Lake and within the Teshekpuk Lake Special Area, whereas the No Action Alternative does not allow for drilling near the lake. This greatly increases the likelihood of exploration or development activities impacting water resources and quality in the lake.

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas exploration and development that could occur in the Planning Area under the final Preferred Alternative include aircraft use, watercraft use, collection and excavation for scientific research, hunting camps, recreational use of the area, and use of the area by local natives for subsistence. These activities would be expected to occur at the same frequency and intensity as under the No Action Alternative. All of these activities have the potential to impact water resources, as discussed in Section 4.4.4 (Water Resources). However, all of these activities have also been ongoing for many years with minimal impact to water resources.

Oil and Gas Exploration and Development Activities

Under the final Preferred Alternative, exploratory and developmental drilling would be allowed near Teshekpuk Lake, subject to the restrictions listed in Lease Stipulations K-4, and K-9 through K-11 (see Section 2.6.4.2; Lease Stipulations that Apply to Biologically Sensitive Areas). Although these lease stipulations and the other lease stipulations in K-3 are generally protective of the water quality in Teshekpuk Lake, drilling near the lake greatly increases the risk for an oil spill that could affect this lake. Teshekpuk Lake itself would be deferred from leasing under this alternative.

Seismic surveys. Seismic surveys have the greatest potential for thermokarst because they involve vehicles that cross the tundra during the winter months. Upon removing the organic mat, soils are exposed to transport by wind and water. These forces could deposit sediment into water bodies. Seismic equipment and vehicles used today employ low-ground-pressure equipment and designs and have much less impact to the tundra than older equipment, but camp moves can still impact the tundra and cause thermokarst (WesternGeco 2003). Observations by the BLM and others (NRC 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting land seismic surveys to snow covered areas would greatly reduce the potential for thermokarst and long-term impacts to the tundra.

Important lease stipulations for thermokarst would be the restriction on bulldozing of trails, the requirement that snow and frost cover be at sufficient depths to protect the tundra before overland activities could commence, and the lease stipulation that trails could not be used repeatedly, to avoid formation of ruts. These lease stipulations, along with the low impact of modern seismic equipment, should be highly effective in minimizing thermokarst erosion of the tundra and transport of soil to water bodies. Under the final Preferred Alternative, seismic surveys would be allowed in the Teshekpuk Lake Special Area.

Effects of Disturbances from Exploration and Development

Ice Road and Pad Construction. Under the final Preferred Alternative, the potential impacts of ice roads on water resources would be greater than under the No Action Alternative because more of the Planning Area would be open for leasing, and more ice pad and road construction would be likely to occur. Ice roads would be offset from year to year by at least the width of the road to minimize damage to the tundra. Ice road use would be limited to the winter season, with the months during which ice roads are allowed set each year by the AO. Similarly, ice pads would be limited seasonally and subject to approval by the AO. Impacts to the tundra under this alternative should be minimal and limited mainly to the spring when the ice roads and pads would melt and add somewhat saline water to the shallow tundra pools. This impact would be temporary in nature, and it is expected that long-term impacts to surface water quality would be negligible.

Water Withdrawal from Lakes. The only source of water during the winter months in the Planning Area is unfrozen water that lies beneath the ice caps of both shallow and deep lakes. This water is somewhat saline because of the exclusion of ions during the freezing of the upper part of the lake. Fish-bearing lakes often have fish living in the water beneath the ice cap during the winter months. Withdrawal of water from streams and riverine pools is not allowed by the AO in the Planning Area under any of the alternatives during the winter months. Under the final Preferred Alternative, more of the Planning Area would be subject to withdrawal of water from lakes than under the No Action and other alternatives because more of the Planning Area would be available for leasing.

Ice Road/Pad Water Use. Under the final Preferred Alternative, water from lakes could be used for ice roads and pads and for drilling water and potable water at drilling facilities, but the volume of water taken from an individual lake would depend on the depth of the lake and the depth of unfrozen water in the lake. As under the No Action Alternative, water withdrawal from fish-bearing lakes would be limited to a maximum of 15 percent of the under-ice volume of the water for lakes 7 feet deep or deeper. No water would be taken from lakes less than 7 feet in depth if known to be fish-bearing or connected to a fish-bearing stream; water could be removed from lakes that are 5 to 7 feet deep if they contain only ninespine stickleback or Alaska blackfish. The AO could authorize water withdrawal from lakes less than 7 feet deep that are not connected to a fish-bearing stream. Water from streams would not be used for ice roads or ice pads. Under the final Preferred Alternative, more water would be expected to be used for ice roads and pads than under the No Action Alternative because of the greater acreage of the Planning Area available for leasing.

Drilling Water Use. Drilling requires water for making drill mud slurries, for general lubrication of the drill bits, and for waterflooding. Potable water is also used for drinking and other domestic uses in the camp that accompany drill rigs. For example, a 10,000-foot drill test would require about 850,000 gallons of water for drilling and about 100 gallons/day per person (50 to 60 persons per camp) for the drill camp (USDOI BLM 1998b). Under the final Preferred Alternative, water use would be about twice that of the No Action Alternative. Under the final Preferred Alternative, water withdrawal from lakes for drilling water would be governed by the same lease stipulations as those for ice roads and pads. Therefore, it is expected that impacts to surface water resources would be minor because of lease stipulations governing the amount of drawdown allowed in the lakes, and which lakes could be used as water sources.

Because more of the Planning Area would be open to leasing under the final Preferred Alternative, more lakes could potentially by impacted be water withdrawal during the winter months than under the No Action Alternative. Lease Stipulations K-1 (Rivers Area) and K-2 (Deep Water Lakes) would be protective of water resources in streams and fish-bearing lakes, but given the greater number of lakes, the final Preferred Alternative could potentially have more impact on lakes, especially non-fish bearing lakes, than the No Action Alternative.

Snow Compaction. Removal or compaction of snow can increase the depth of freezing on lakes, often by a foot or more. As a result, the water quantity available in a lake during the winter months is greatly reduced, and the salinity of the water beneath the ice can be increased. Snow removal and compaction by oil and gas operations would be prohibited over fish-bearing water bodies.

Under the final Preferred Alternative, snow compaction would be prohibited on fish-bearing lakes, except at ice road crossings. Therefore, this alternative would be protective of lakes and streams. No impacts to ice thickness on fish-bearing lakes are expected as a result of oil and gas exploration and development activities. However, lakes without fish could be subject to impacts due to snow compaction if this activity were authorized by the AO.

Because a greater number of lakes could be affected by winter activities, including snow compaction, under the final Preferred Alternative, impacts to lakes could be greater under this alternative than under the No Action Alternative.

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 in areas with low flow capacity, especially culverts blocked by snow and ice, can result in seasonal and sometimes permanent impoundments (NRC 2003). The resulting inundation can affect tundra vegetation and possibly lead to thermokarst (Walker et al. 1987a, b). Diverting stream or lake flow can also lead to increased bank or shoreline erosion and sedimentation. Proper siting and adequate capacity design of culverts, bridges, pipelines, and other surface structures are needed to minimize drainage problems during the spring snowmelt.

Under the final Preferred Alternative, drainages would be protected by performance-based ROPs and lease stipulations. These ROPs and lease stipulations require setbacks from specified rivers, require bridges rather than culverts for crossing major rivers, and require that culverts used for small drainages have ample capacity to handle the flow of the drainage during spring breakup to avoid ice jams. Thus, this alternative would minimize impacts to drainages from construction of permanent and temporary facilities related to crossing the drainage. Overall, impacts to drainages should be minor under this alternative as a result of these lease stipulations.

Because a greater portion of the Planning Area would be open to oil and gas leasing under the final Preferred Alternative, there could potentially be more disruption of drainages than under the No Action Alternative. However, if the lease stipulations and ROPs listed for this alternative are followed, this potential increase in impacts should be minor.

Channel Erosion and Sedimentation. Any surface activities that disturb streambeds and stream banks or remove protective shoreline vegetation can lead to channel erosion, formation of meltwater gullies, and formation of alluvial fans in streams and lakes (Lawson 1986). Inadequate design or placement of structures, culverts, or bridges can alter natural sedimentation patterns, creating scour channels and channel bars in streams. Improper placement of gravel pads or fill can result in erosion from the pads or roads and transport of gravel to streams and lakes. Blockages or diversions caused by insufficient flow capacity of structures over streams can lead to washouts during spring breakup flooding. Activities that can minimize erosion and sedimentation include limiting construction and transport activities to winter or periods of low water and keeping culverts free of snow and ice (Walker et al. 1987a, b).

Lease stipulations and ROPs developed for the final Preferred Alternative to mitigate for disturbances to drainages, streams, and rivers by exploration and production activities would be similar to those developed for the No Action Alternative. These lease stipulations and ROPs regulate bridges, culverts, winter crossings, removal of ice bridges, and any temporary facilities constructed near rivers. They also include setbacks for specified rivers. These ROPs and lease stipulations should be effective in minimizing impacts to stream channels.

Because more of the Planning Area would be open to oil and gas leasing under the final Preferred Alternative, there would potentially be more channel erosion and sedimentation under this alternative than under the No Action Alternative. If the lease stipulations and ROPs developed for this alternative were followed, this potential increased impact to stream channels should be minor.

Gravel Removal. Removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics and lake shoreline flow patterns, erosion and sedimentation, ice damming, and aufeis formation (NRC 2003). Locating gravel pits at a safe distance from streams and lakes should minimize these impacts.

Under the final Preferred Alternative, gravel mining sites would not be permitted in the active floodplain of a river, stream, or lake unless authorized by the AO. Gravel mining sites would also be kept to a minimum in the Planning Area, and, where possible, be designed so that fish and wildlife could use them after mining was completed. These measures would protect streams, rivers, and lakes and keep impacts to floodplains to a minimum.

Because more of the Planning Area would be open to oil and gas leasing under the final Preferred Alternative, there would potentially be more gravel removal under this alternative than under the No Action Alternative. Lease stipulations and ROPs developed for the final Preferred Alternative would be effective in reducing impacts to streams and lakes.

Pipelines. Pipelines have their greatest impact on water resources during the construction phase, primarily from temporary impoundments, diversions, and sedimentation changes in streams. Roads are necessary for access to construction equipment, and construction activities associated with installing and testing pipelines can have considerable impact on surface water resources during the summer months. After the construction phase, elevated pipelines are expected to have a minimal impact on water resources. Leaks from elevated pipelines have been relatively minor in the North Slope. Buried pipelines, which are less commonly used on the North Slope, could have potential thermokarst, subsidence, and erosion problems beyond the construction phase.

The lease stipulations and ROPs developed for the final Preferred Alternative require that pipelines be designed to minimize leaks and that operators have spill prevention and clean-up plans and equipment in place. These measures are designed to reduce impacts to water resources from pipeline leaks. Leaks would generally be small. Therefore, impacts to water resources from pipeline leaks should be minor under the final Preferred Alternative.

Effects of Spills

Surface Oil Spills. The behavior of oil spills would likely be similar in fresh and marine waters. Because marine waters can have strong currents, the dispersal of the oil spill by currents would be rapid. Given the cold temperatures in the Arctic, oil spills in fresh water should not spread rapidly, unless they are driven by strong winds. Shallow, marshy, ponded or flooded tundra during the summer months can reach temperatures of about 64 °F (Miller et al. 1980), which would allow for a lower viscosity of the oil and a spreading of the oil spill. Spills into water bodies with broken ice would spread between the ice floes into any gaps greater than 3 to 6 inches (Free et al. 1982).

Oil spilled into streams would be driven and dispersed by stream currents. The oil would be driven downstream, likely accumulating in quiet pools and along natural and man-made structures that impede or redirect flow in the stream. The oil slick would move fastest along the centerline of the stream channel, where currents are the highest, leading to a dispersed oil slick elongated downstream. In near-bank areas, the oil slick would tend to accumulate, bind with sediments and vegetation, and become difficult to remediate (Overstreet and Galt 1995). This oil along the banks could be released at a later date and re-enter the main flow of the stream.

Under-Ice Oil Spills. Oil spills under an ice cap have the added problem of the oil binding to the ice. Studies by Glaeser and Vance (1971), NORCOR Engineering and Research (1975), and Comfort et al (1983) have shown that the oil rises to the under-ice surface and spreads laterally, accumulating in under-ice cavities. Spills that occur when the ice sheet is growing become encapsulated in the ice. In the spring, as the ice melts, the oil rises to the surface in brine channels within the ice.

Lease stipulations and ROPs developed for the final Preferred Alternative restrict exploration drilling and production drilling near and within water bodies in the Planning Area. These lease stipulations require a setback of 500 feet or more from any fish-bearing, and 100 feet or more from any non-fish-bearing water body to protect these water bodies from possible oil spills. The AO has final decision authority on the location of drilling platforms. Lakes that are non-fish bearing are not regulated with setbacks; however setbacks from all major streams and rivers are required. These measures are considered to be protective of streams, rivers, and fish-bearing lakes.

The lease stipulations and ROPs for oil and gas drilling, especially the setbacks from streams and lakes, are similar to those for the No Action Alternative. Therefore, the final Preferred Alternative should provide protection similar to that of the No Action Alternative when potential oil spills are considered. However, because more of the Planning Area would be open to oil and gas leasing under the final Preferred Alternative, a greater area of the Planning Area could be subject to oil spills from drilling operations. If protective measures were followed, impacts to water resources from oil spills should be minor under all alternatives.

4.6.4.2 Surface Water and Groundwater Quality

Activities Not Associated With Oil and Gas Exploration and Development

The only types of non-oil and gas activities in the Planning Area that could affect freshwater quality would be ongoing subsistence and recreational activities, primarily along rivers and lakes in the ACP, and use of lakes by floatplanes and watercraft. These activities have been ongoing for sometime, and impacts to freshwater quality appear to have been negligible. Impacts under the final Preferred Alternative would be expected to be similar to those that would occur under the No Action Alternative.

Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the final Preferred Alternative, exploration activities that could affect water quality within the Planning Area include seismic survey activities, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Spills of crude oil or produced waters would be attributed predominantly to development activities.

Damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al. 1987a, b). Thermokarst erosion and associated effects on water quality could occur in high impact areas if damage to the vegetative mat was persistent. Recovery of a vegetative mat damaged during seismic activities, which would be necessary to improve water quality impacts, could take from a few years to decades. Exploration in the TLSA could lead to local areas of thermokarst erosion and thus affect water quality locally.

While the NRC (2003) and others have indicated that short-term impacts, such as compaction of the vegetative mat, water diversions from seismic vehicle tracks, and ponding, can be estimated at about 1 percent of the acreage impacted by seismic lines per season, use of newer low-ground-pressure equipment would reduce impacts substantially, to a total of about 75 acres for each 2-D survey, and 495 acres for each 3-D survey, under the final Preferred Alternative. If it is assumed that 1 percent of the persistent high damage area would result in thermokarst erosion, up to 26 acres (assumes 250 miles of 2-D seismic surveys and five 3-D seismic surveys) could be affected long term during a 25-year period.

As discussed for the No Action Alternative, use of water for ice-road construction could affect water quality through a change in water chemistry in lakes from which water was drawn; through restrictions on water circulation in shallow lakes that would impact the oxygen content of the water; through changes in water chemistry along the roadbed during and after meltout; and through modification of the local hydrology along the ice road. As discussed under the No Action Alternative, studies in other areas of the North Slope have shown that withdrawal of water from lakes for ice roads and ice pads has not affected water quality. Thus, use of water for ice roads during exploration under the final Preferred Alternative should not affect water quality.

Effects of Development

Construction of gravel pads, within-field roads, an airstrip, and staging areas would impact approximately 110 to 1,090 (780) acres for the 1 to 12 (8) fields that could occur under the final Preferred Alternative. The preferred sources for gravel would be 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). 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 affected by this dredging activity (Walker 1994). Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 (35) acres per site, or from 20 to 210 (140) acres total under the final Preferred Alternative. Because gravel is a scarce commodity, construction technology could be refined to lessen gravel use and associated impacts, although such alternatives are not assumed in this analysis.

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by thermal effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity/suspended-sediment concentrations, as discussed under the No Action Alternative. 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, it is anticipated that gravel construction would result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or from 200 to 2,400 (1,600) acres for the development assumptions made under this alternative.

The primary effect on water quality from construction and placement of gravel structures would be upslope impoundment and thermokarst erosion (Walker et al. 1987a, b). Thermokarst erosion, which would be caused in part by the effects of dust blown off the gravel and onto the tundra, could result in water features with high turbidity and suspended-sediment concentrations, as discussed under the No Action Alternative. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downflow of thermokarst features. Under the final Preferred Alternative, more gravel structures would be expected than under the No Action Alternative.

If buried oil pipelines resulted from development under the final Preferred Alternative, they could range from 110 to 190 (180) miles in length and affect from up to 165 to 285 (270) acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction was complete, impacts from elevated pipelines should be minimal. If underground pipelines were also constructed, potential impacts during construction could double, also through temporary impoundments, diversions, and sedimentation during construction. Buried lines could also result in thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines was done during winter, these impacts would be greatly reduced.

Effects of Abandonment and Rehabilitation

Removal of facilities, particularly roads, bridges, and culverts, would likely cause increased sedimentation and erosion immediately after removal. Leaving pads, airstrips, roads, bridges, and culverts in place, particularly without future maintenance, however, would result in longer term, higher levels of erosion, sedimentation, and upslope impoundment. Leaving the roads in place, but removing bridges and culverts and breaching the roads where culverts had been placed, would reduce upslope impoundment. Ponds would be formed from melting of ice wedges or other ice underlying the gravel facilities. Because more of the Planning Area would be available for development under the final Preferred Alternative, the impact of facility removal on water quality would be expected to be greater than under the No Action Alternative.

Effects of Spills

Dissolved-oxygen concentrations in tundra waters could be affected by oil spills in the summer. 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 would be negligible. In addition, sediment respiration has even less effect in the thicker water column of lakes deep enough to not freeze solid in winter.

The primary effect of a small spill on tundra water quality, however, would be direct toxicity rather than oxygen depletion or other secondary effects. Long-term toxicity could result from a small spill, as shown in a National Petroleum Reserve – Alaska experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years (Miller et al. 1978; Barsdate et al. 1980; Hobbie 1982).

As noted in the 1998 Northeast IAP/EIS, an oil spill reaching Teshekpuk Lake would likely have a minor effect on water quality (USDOI BLM and MMS 1998). 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 percent of the lake surface) could be considered an effect on water quality. This effect would persist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline. Similar effects would be expected if an oil spill were to reach any of the lakes in the Planning Area.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are locally and marginally at toxic levels. Effects of spills less than 1,000 bbl can be considered negligible. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area of a 100,00 acres or larger. Concentrations above the 1.5-ppm State of Alaska acute criterion could occur over 10,000 acres or more during the first several days of such a spill.

Under the final Preferred Alternative, more construction of gravel structures, gravel roads, ice roads and pads, and more drilling in environmentally sensitive areas, would be expected. Thus, impacts to surface water quality would be greater under this alternative than under other alternatives.

4.6.4.3 Effectiveness of Stipulations and Required Operating Procedures

Under the final Preferred Alternative, the lease stipulations and ROPs listed are expected to be effective in protecting water resources because they would require setbacks from rivers and fish-bearing lakes for oil and gas activities, place limits on the withdrawal of water from fish-bearing lakes, and regulate the construction of gravel roads, ice roads and pads, and pipelines. Also, oil spill prevention and response procedures would be outlined, as would oil spill clean-up procedures. Refueling would be regulated and thereby kept away from rivers and lakes, particularly fish-bearing lakes. The required snowpack would be present on the tundra before seismic equipment would be allowed to make overland moves during winter. Drilling would not be allowed in streams, rivers, or fish-bearing lakes. The “K” lease stipulations for the final Preferred Alternative would be somewhat more protective of water resources than the lease stipulations for the No Action Alternative, because they would provided more specific setback requirements for streams, rivers, and lakes.

Lease stipulations and ROPs would protect water quality under the final Preferred Alternative. Required Operating Procedures A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and clean-up plans. Required Operating Procedure B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. Required Operating Procedure’s C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. Lease Stipulation D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there was no feasible or prudent alternative. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there was no feasible or prudent alternative. Lease Stipulation G-1 may require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Lease Stipulation K-1 should protect aquatic, floodplain, and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Lease Stipulation K-2 would protect aquatic and riparian areas adjacent to deep-water lakes, but would allow exceptions if there were no feasible or prudent alternative. Lease Stipulation K-4 would protect the Goose Molting Area north of Teshekpuk Lake, while Lease Stipulations K-9 through K-11 would protect the area around Teshekpuk Lake.

4.6.4.4 Conclusion

Under the final Preferred Alternative, the impacts of activities other than oil and gas exploration and development would likely be similar to those under the No Action Alternative. The most likely impacts on the water resources in the Planning Area would be from gravel roads, pads, and structures, and would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways, which would disrupt drainage patterns.

Impacts to water resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to water sources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. The potential short-term impacts from exploration and delineation would be water removal from lakes, and, during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 25 acres. Both aboveground oil pipelines (not including infield lines) and buried pipelines could add up to an additional 1.5 acres per pipeline mile. After construction was complete, impacts from elevated pipelines should be minimal. Buried gas lines would have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on gravel roads, pads, and pipelines were done during the winter impacts could be reduced. While any surface-disturbing activity could affect water resources, the lease stipulations and ROPs under the final Preferred Alternative would protect most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools. Thus, the lease stipulations and ROPs for the final Preferred Alternative are expected to protect water resources in the expanded part of the Planning Area open for exploration and development under this alternative.

4.6.5 Vegetation

4.6.5.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area, and at more or less the same frequency and intensity as under the other alternatives. There could be some increased use of off-road vehicles in the Planning Area due to an increase in the amount of roads associated with development when compared to the No Action Alternative. However, additional impacts to vegetation from this increase would likely be small.

4.6.5.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Under the final Preferred Alternative, impacts to vegetation from activities associated with oil and gas exploration would be similar to those that would occur under the other alternatives, except that the frequency and total number of seismic surveys would differ somewhat. It is anticipated that under the final Preferred Alternative there would be a greater number of exploration and delineation wells drilled than would occur under the No Action Alternative, but fewer than would be drilled under alternatives B and C. This would increase the impacts of well collar construction and the impacts of both multi-year and single-year ice pads when compared to the No Action Alternative, but would decrease the area of impact when compared to alternatives B and C. The 50-mile estimate for ice roads used for the other alternatives would probably be an upper end for the number of ice road miles within the Planning Area per year under this alternative. This is identical to the other alternatives and would impact about 212 acres of vegetation, with recovery expected within a few years.

The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Based on earlier studies discussed for Alternative B, there should be no long-term impacts to vegetation from seismic lines, but camp move trails could impact approximately 200 acres (assuming 250 miles of 2-D and five 3-D camp move trails over a 25-year period).

The area of vegetation impacted around the perimeter of a typical multi-year ice pad (500 feet by 500 feet) would be approximately 6 acres. Under the final Preferred Alternative, it is assumed that 6 to 48 (34) exploration wells and 4 to 35 (26) delineation wells, or a total of 10 to 83 (60) wells, would be drilled from ice pads in the Planning Area. Assuming that half the pads would be multi-year ice pads, these impacts may occur on 30 to 250 (180) acres spread among 5 to 41 (30) different sites over a period of about 10 years. This would be about 17 percent less impact than for the Alternative B, 32 percent less impact than Alternative C, and 2 times the area that would be impacted under the No Action Alternative.

The construction of well collars during exploration requires the digging of hole that destroys vegetation on approximately 16 square feet (0.006 acres) of ground. Thermokarst associated with the disruption of the thermal regime in the surrounding soil can also change the vegetation type around the well collar to a wetter vegetation type. These impacts could result in 0.06 to 0.50 (0.36) acres of vegetation being destroyed under the final Preferred Alternative, assuming construction of 10 to 83 (60) well collars.

Development and Production

During oil and gas development and production, various activities could cause impacts to vegetation in the Planning Area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Placement of Gravel Fill. Construction of CPFs and associated satellite pads, roads, staging areas, and airstrips would result in the destruction of vegetation in the areas of gravel placement. Under this alternative, one to 12 (8) fields would be developed, resulting in a total of 110 to 1,090 (780) acres of vegetation destroyed by gravel placement. This is about 3 times more area than would be impacted by gravel placement under Alternative A, about 25 percent less area than would be impacted under Alternative B, and about 30 percent less area than would be impacted under Alternative C.

Under the final Preferred Alternative, a larger area would be impacted by dust than under the No Action Alternative. However, impacts from dust would be less than would occur under alternatives B and C, both of which would potentially have more production facilities constructed. Assuming that each field would have an average of 5 miles of some combination of roads, pads, and airstrips, with a potential for a 10-mile perimeter, dust would impact up to 36 acres of vegetation per field. Assuming development of 1 to 12 (8) fields, the total area of potential impact by dust would be 36 to 432 (288) acres under the final Preferred Alternative.

Construction of gravel pads, roads, and airstrips could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures increase the wintertime soil surface temperature and increase thaw depth in soils near the structures. These impacts are exacerbated by dust deposition (described above) and by the formation of impoundments (described below). These factors could combine to warm the soil, deepen thaw, and produce thermokarst adjacent to roads and other gravel structures (NRC 2003). Additionally, these changes could alter the species composition of the plant community near gravel structures. In general, most changes in the plant community around gravel structures would occur within 164 feet of the structure. If all effects were to occur within this zone, approximately 200 acres per developed field would be impacted, or a total of 200 to 2,400 (1,600) acres under the final Preferred Alternative.

Material Sites. Gravel required for development in the Planning Area could be mined from existing sites east of the Planning Area or could be extracted from new sites developed within the Planning Area. Investigations to identify gravel sources in the Planning Area have not been conducted, but presumably would be initiated if discoveries of recoverable oil or gas were made. It is possible that one to six (four) gravel production sites would be necessary, resulting in a total of 20 to 210 (140) acres impacted, depending on the actual number of sites required. Excavation of gravel and stockpiling of overburden would destroy vegetation at these sites.

Pipelines. Under the final Preferred Alternative, impacts from pipeline construction would be similar in nature to those described for the other alternatives. The total area disturbed by each VSM would be about 14 square feet. Overall, 0.03 acres of vegetation would be disturbed by VSMs per pipeline mile, resulting in approximately 3 to 6 (5) acres of disturbance.

Impacts associated with buried pipeline could be greater under the final Preferred Alternative than the No Action Alternative, but would be less than for alternatives B and C, given the potential numbers of fields that may be developed. With an increase in the number of fields developed, the likelihood of river crossings that would require segments of buried pipeline would also increase.

Air Pollution. The potential for impacts to vegetation from air pollution would be slightly greater under the final Preferred Alternative than under the No Action Alternative, given the potential for additional oil and gas fields and processing facilities. Similarly, the potential impacts would be less under this alternative than for alternatives B and C. However, it is unlikely that impacts to vegetation from pollutants would substantially alter the plant communities in the Planning Area.

Effects of Spills

The greater amount of leasing, development, and production of oil that would occur under the final Preferred Alternative, relative to the No Action Alternative, would result in a greater number of small spills of crude and refined oil in the Planning Area. The chance of a large oil spill occurring would also be greater under the final

Preferred Alternative; however it would still be a very rare event. Impacts from spills would be less likely under the final Preferred Alternative than under alternatives B and C.

Most oil spills cover less than 500 square feet (<0.01 acres), though a pressured aerial mist may cover substantially more area (Ott 1997). The average spill would cover 0.1 acre; about 107 acres could be impacted during the lifetime of development in the Planning Area under the final Preferred Alternative, and about three times the amount that would be impacted under the No Action Alternative. Overall, past spills on Alaska's North Slope have resulted in minor ecological damage and ecosystems have shown good potential for recovery (Jorgenson 1997).

Abandonment and Rehabilitation

During abandonment activities, vegetation and wetlands would be impacted by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and power lines, and by disturbance to vegetation adjacent to VSMs and power line poles during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts would be less if the gravel were to be left in place. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, water impoundment would occur, and could alter plant communities as described for the construction period. It is also likely that the unmaintained roads would have occasional washouts, where tundra vegetation would be covered with washed-out gravel. Roads and pads, if left in place, would likely need to be revegetated with plants native to gravel bars and ridges in the Arctic (i.e., different from the plant communities surrounding the facilities). Revegetation activities could take several years, as initial attempts are not always successful. Removal of gravel from pads, roads, and airstrips could be mandated. Partial or complete removal of gravel can result in faster reestablishment of native plant growth, although establishment can take many years (more than a decade). In addition, thaw subsidence is difficult to predict, and complete restoration to preexisting conditions is improbable. In general, impacts from abandonment and rehabilitation for the final Preferred Alternative would be greater than what would occur under the No Action Alternative and less than what would occur under alternatives B and C given the numbers of fields likely to be developed under each of these alternatives.

4.6.5.3 Effectiveness of Stipulations and Required Operating Procedures

The final Preferred Alternative would have the same lease stipulations and ROPs as those outlined under alternatives B and C. Development in the Planning Area would result in impacts to vegetation and plant communities. The ROPs and lease stipulations associated with the final Preferred Alternative would provide protections to limit impacts, and should be effective in minimizing destruction of vegetation and alteration of plant communities. The final Preferred Alternative also has several additional lease stipulations that limit surface occupancy in portions of the Planning Area. These lease stipulations would prevent surface occupancy in areas north and east of Teshekpuk Lake in the Goose Molting Area and in caribou calving and migration areas to the south and east of Teshekpuk Lake. These additional lease stipulations would also protect vegetation in these areas.

4.6.5.4 Conclusion

Under the final Preferred Alternative, impacts to vegetation from activities other than oil and gas development would include minor impacts from aircraft landings, archaeological and paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery would vary from 1 to several years. The amount of impact from these activities would be similar for all alternatives.

Impacts associated with oil and gas development would occur from seismic work and construction of well collars during exploratory drilling. The duration and recovery time for impacts associated with seismic work would be similar to those for overland moves. Effects of well collar construction would be permanent. The effects of oil and gas development and operation would include destruction of vegetation during the construction of gravel pads, roads, and airstrips; excavation of material sites; construction of VSMs; and spills of oil and other chemicals.

These impacts would be permanent except for those associated with spills, which would be cleaned up, allowing for recovery within a few years to several decades. Plant communities could also be altered by dust deposition, salinity from gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. These indirect impacts would not be permanent but would persist for an extended period depending on the level of rehabilitation following abandonment. An estimated 365 to 4,130 (2,810) acres would be directly and indirectly impacted from development. This is approximately 0 to 2,915 more acres than for Alternative A, 245 to 745 fewer acres than Alternative B, and 295 to 1,855 fewer acres than for Alternative C; vegetation impacted by oil spills could comprise another 107 acres.

It is assumed that impacts to vegetation types or communities would occur in proportion to their occurrence within the Planning Area. However, the final Preferred Alternative also has several additional lease stipulations that limit surface occupancy in portions of the Planning Area. These lease stipulations would prevent surface occupancy in areas north and east of Teshekpuk Lake in the Goose Molting Area and in caribou calving areas to the south and east of Teshekpuk Lake. These additional lease stipulations would protect vegetation in these areas, which have a higher percentage of wet vegetation communities.

Under the final Preferred Alternative, development would be unlikely to substantially affect any plant species or communities. However, if development facilities were constructed in an area containing a population of a rare plant species, the impacts to that species could be severe. Three rare North Slope plant species are known to occur in the Planning Area, and four other rare species are known to occur on the North Slope but have not been documented in the Northeast National Petroleum Reserve – Alaska. Sabine grass is an aquatic grass that rarely occurs between the pendent grass and sedge zones in lakes and ponds. This species is known from a few locations north and northeast of Teshekpuk Lake, which would be protected from development under the alternatives A and B, but would not be protected under Alternative C. Although some development would be allowed in the area north of Teshekpuk Lake under the final Preferred Alternative, most areas where Sabine grass could be found would be protected by the additional lease stipulations associated with this alternative. Stipulated cinquefoil has been found at Umiat. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. This species would be protected by setbacks along rivers in the Planning Area and by the designation of the Colville River Special Area. Muir’s fleabane, Drummond’s bluebell, and Hartz’s bluegrass all occur in dry habitats associated with bluffs, floodplains, river terraces, sand dunes, rocky outcrops and fellfields. These habitats are the primary sources of gravel fill used during construction and development (NRC 2003) and could be impacted by development in these areas.

Impacts to vegetation from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to vegetation from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.6.6 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 the Planning Area that are considered to have the function and value of wetlands, as described in Section 3.3.2 (Wetlands and Floodplains).

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. Assuming that impacts would be distributed across all vegetation types equally based on their occurrence in the Planning Area, most of the acreage that would be impacted by development activities in the Northeast National Petroleum Reserve – Alaska would be wetlands. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. All of the Northeast National Petroleum Reserve – Alaska, except Teshekpuk Lake, would be open to oil and gas leasing under the final Preferred Alternative. However, three additional lease stipulations would provide additional protection in the Teshekpuk Lake Special Area by prohibiting permanent oil and gas facilities, excluding major right-of-ways (i.e., pipelines and major roads), on approximately 374,000 acres north, northeast, and east of Teshekpuk Lake. Exploration activities would be allowed within this NSO, including seismic acquisition and exploratory drilling. This area encompasses much of the Goose Molting Area, which contains a large percentage of the wetland vegetation types preferred by waterfowl, including aquatic vegetation dominated by water sedge and pendent grass. Under the final Preferred Alternative, this area would be less likely to be developed and these vegetation classes would be less likely to be impacted than under Alternative C.

Resources included in the overview discussion below are classified as having the function and value of wetlands and floodplains on the North Slope. In general, impacts to wetlands and floodplains from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to wetlands and floodplains from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.6.6.1 Soils

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. Impacts from winter exploration and well drilling would also be minor. Development would cause the loss or disturbance of 315 to 3,510 (2,395) acres of wetland 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. 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.

4.6.6.2 Water Resources

Water Resources

Seismic impacts should be minimal. Construction of gravel roads, pads, and structures associated with oil and gas development could cause impacts to water resources in the Planning Area. The potential long-term impacts from exploration and delineation would occur from water impoundments, diversions, thermokarst erosion and sedimentation on approximately 24 acres of wetlands. Long-term impacts from development of gravel roads, pads, and pits could directly and indirectly impact 315 to 3,510 (2,395) acres of wetlands.

Water Quality

Seismic and exploratory activity would have short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water. Gravel construction of pads, within-field roads, and field airstrips, and gravel removal would impact about 875 acres of wetlands for the eight fields proposed. Gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long term (decade-or-more) effects from development of gravel roads, pads, and pits could occur on 315 to 3,510 (2,395) acres of wetlands. Oil spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes, and could cause ponds or small lakes to remain toxic to sensitive species for several years.

4.6.6.3 Vegetation

Impacts from activities, other than oil exploration and development, would involve disturbance or destruction of vegetation on a small fraction of the Planning Area, and overall impacts would be minor.

Impacts from oil exploration would include vegetation disturbance on 6,270 and 45,125 acres of wetlands per survey from 2-D and 3-D seismic surveys, respectively. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines, and 95 percent for camp trails, resulting in approximately 190 acres of long-term impacts to wetlands. Ice road construction would have impacts on up to 200 acres, and ice pads on 29 to 237 (171) acres, of wetlands per year. Exploration activities would cause permanent, minor destruction and alteration of vegetation from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of staging areas, gravel pads, roads, airstrips, pipelines, pump stations, and the excavation of material sites, would cause the destruction of vegetation on 125 to 1,230 (875) acres of wetlands and the alteration in plant species composition on an additional 225 to 2,280 (1,520) acres. These impacts would be permanent assuming that gravel pads would remain after production ended, although some plant species would be able to grow on the pads (McKendrick 2000). This would represent about 0.1 percent of the Planning Area, and, as such, no plant species or community would likely be affected. If a development facility were to be placed over a rare plant population, the effects on that population could be high. However, careful siting of facilities after site-specific environmental analysis should avoid and protect rare plant species.

Lease stipulations and ROPs would be effective in limiting the amount and type of development that could occur within active floodplains in the Planning Area. However, impacts to floodplains could occur from river channel crossings by pipelines and roads, which could destroy vegetation where bridge pilings or VSMs were required for the crossing. Construction of a buried pipeline under the river channel would also have impacts to floodplain vegetation.

Much of the gravel used for construction of roads, pads, and airstrips on the North Slope in the past has been obtained from deposits in river floodplains. Impacts from these activities include habitat modifications, caused by increased braiding and spreading of flows (Woodward-Clyde Consultants 1980). Established guidelines have largely restricted gravel mining to deep mining in upland pits, which can be flooded on abandonment to create aquatic habitat, including fish overwintering areas (NRC 2003). Approximately 20 to 200 acres of wetland vegetation are likely to be disturbed by the establishment of gravel extraction sites in the Northeast National Petroleum Reserve – Alaska under the final Preferred Alternative.

4.6.6.4 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations identified above for soil, water, and vegetation resources would apply to wetlands. These lease stipulations would be effective in minimizing impacts to wetlands from waste discharges and spills, and from direct and indirect surface impacts associated with non-oil and gas and oil and gas activities. The setbacks outlined in lease stipulations associated with development near rivers and lakes would be effective at minimizing impacts in high value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats.

4.6.6.5 Conclusion

Approximately 95 percent of the Planning Area would be considered wetlands, according to established criteria for determining wetland status. In general, the northern portion of the Planning Area has the greatest percentage of wetlands and is thought to be the area with the greatest oil and gas potential. Under the final Preferred Alternative, Teshekpuk Lake would be deferred from leasing, and approximately 374,000 acres to the north and east of the lake would be protected with NSO restrictions on permanent facilities, although road and pipeline ROWs would be allowed within most of the NSO area.

Impacts from oil exploration would include disturbance on up to 6,980 (2-D) and 47,500 (3-D) acres of wetlands from each seismic survey. About 25 percent of the disturbance would be at a moderate to high level, and, after 9 years, recovery would be about 100 percent for seismic lines and 95 percent for camp trails, resulting in about 180 acres of long-term impacts to wetland vegetation over a 25-year period. Ice road construction would impact about

205 acres annually, and ice pad construction would impact about 340 acres of wetlands during the life of the project.

The combined effect of development activities, such as the construction of staging areas, gravel pads, roads, airstrips, pipelines, pump stations, and the excavation of material sites, would cause the destruction of vegetation on 125 to 1,230 (875) acres of wetlands and the alteration in plant species composition on an additional 225 to 2,280 (1,520) acres. These impacts would be permanent assuming that gravel pads would remain after production ended, although some plant species would be able to grow on the pads (McKendrick 2000). This would represent about 0.1 percent of the Planning Area, and, as such, no plant species or community would likely be affected. If a development facility were to be placed over a rare plant population, the effects on that population could be high. However, careful siting of facilities after site-specific environmental analysis should avoid and protect rare plant species.

4.6.7 Fish

4.6.7.1 Freshwater and Anadromous/Amphidromous Fish

Activities Not Associated With Oil and Gas Exploration and Development

Actions and impacts associated with the final Preferred Alternative that could cause disturbance to fish are expected to be similar to those described under the No Action Alternative.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Effects from Seismic Surveys. Extrapolation of current 2D and 3D seismic data gathering techniques suggests that the entire area could be covered by a level of effort similar to that described for alternatives B and C. There would be 250 miles of additional 2-D surveys and two to five additional 3-D surveys relative to the No Action Alternative. As a result, seismic activities associated with the final Preferred Alternative would be expected to have the same overall effect on fish as discussed for the other alternatives—no measurable effect on Arctic fish populations. Because of the larger potential scope of development under the final Preferred Alternative relative to the no Action Alternative, the number of fuel spills is expected to be higher. However, the amount of fuel entering fish habitat is not expected to increase significantly since spills are expected to be small (< 5 gallons) and are likely to occur on developed pads. Fuel spills associated with the final Preferred Alternative 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).

Effects from Seismic Surveys in Teshekpuk Lake. Under the final Preferred Alternative, Teshekpuk Lake would be deferred from leasing. The deferral would preclude exploratory drilling and pipeline construction, but would allow seismic exploration. Under the final Preferred Alternative, seismic exploration in Teshekpuk Lake could occur during the summer open water period using airgun arrays and explosives (although the use of explosives is unlikely). Impacts from Vibroseis and airgun arrays under the final Preferred Alternative would be similar to those for Alternative B.

Pressure pulses from airguns have long rise times and cause relatively little injury to fish. In comparison, explosives have shorter rise times and are generally more detrimental to fish (Wright and Hopky 1998). The received impulse depends on the mass of the charge, the depth of the charge, the distance from the charge to fish, and the depth of the fish. The peak pressure generated by an airgun array is less than that produced by a small charge of explosives. Most blast injuries to fish involve damage to air or gas-containing organs (Yelverton 1981). All of the species of fish present in Teshekpuk Lake have swim bladders and would be vulnerable to explosives. During exposure to shock waves, the swim bladder oscillates and may rupture, causing hemorrhages in nearby organs. In extreme cases the oscillating swim bladder may rupture the body wall of the fish. The use of explosives in Teshekpuk Lake would likely result in the mortality of some fish present in the lake. The number of fish impacted would depend on the frequency and size of the charge used and the location of charges relative to fish in the lake.

Effects from Water Demand. Construction-related activities that could affect Arctic fish include water withdrawal needed for the construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling. Under the final Preferred Alternative, it is anticipated that 6 to 48 exploratory wells and 4 to 35 delineation wells would be drilled (Table 4-5), for a total of 10 to 83 wells on ice pads. Assuming that the average ice pad is 500 feet by 500 feet (5.7 acres), water needs equate to approximately 2 million gallons per drill pad, for a total of 20 to 166 million gallons. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that zero to two ice roads, 25 to 50 miles long, would be built each season for a maximum annual water requirement of 150 million gallons (same as Alternative B). Water needed for the maximum of four drilling rigs, associated camps and airstrips, and maintenance of roads, pads and airstrips would add another 119 million gallons to the annual water use budget. The total annual maximum water would be on the order of 435 million gallons, or about a 13 percent increase over the No Action Alternative (384 million gallons).

Assuming that the Authorizing Officer follows the common practices when approving water withdrawals, lake water withdrawals associated with the final Preferred Alternative may kill small numbers of fish, but would not be expected to have a measurable effect on arctic fish populations throughout the Planning Area.

Effects from Exploratory Drilling. Under the final Preferred Alternative, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be similar to those developed for the No Action Alternative and Alternative B. The number of exploratory wells could increase under the final Preferred Alternative relative to the No Action Alternative, but the prohibition of drilling in rivers and streams should provide fish with adequate protection. Therefore, exploratory drilling activities associated with the final Preferred Alternative should not have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area.

Effects from Gravel Extraction. Required Operating Procedure E-8 is synonymous with Lease Stipulation 40 of the No Action Alternative. Both are intended to minimize the effects of gravel mining on fish by limiting gravel mine sites within the active floodplain of any river, stream, or lake unless the action enhances fish habitat. Gravel deposits are limited within the Planning Area and importation from outside sources could further reduce mining activities. Equivalent protection is provided for fish and fish habitat under both the No Action Alternative and the final Preferred Alternative. Neither alternative is expected to have a measurable effect on freshwater, anadromous, and amphidromous fish populations in and adjacent to the Planning Area, and may have a positive effect by creating new overwintering areas.

Effects from Pad, Road, and Pipeline Construction. Impacts from sedimentation and altered flow patterns associated with the construction of drill pads, roadways and airstrips are similar to those described for the No Action Alternative. Impacts from erosion would be short term. The proper placement and design of bridges and culverts, in combination with adequate and properly sited drainage systems, should minimize impacts to anadromous/amphidromous and freshwater fish.

Effects from Causeways. The BLM discourages the use of solid-fill causeways, instead preferring alternatives including onshore directional drilling, elevated structures, or buried pipelines. Lease Stipulation 30 prohibits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas, and artificial gravel islands and bottom-founded structures in active stream channels, unless otherwise approved by the AO on a site-specific basis. Overall, the construction of causeways under the final Preferred Alternative is not expected to have a measurable effect on anadromous and amphidromous fish populations in and adjacent to the Planning Area.

Effects from Waterflooding. Under the final Preferred Alternative, oil fields in the northern portion of the Planning Area are likely to receive seawater from facilities already serving fields in the Prudhoe Bay/Kuparuk area. These facilities have been operational for years and have been shown to have no serious adverse affect on fish migrating or foraging in the intake area (see Alternative A, Effects from Waterflooding). If seawater intake facilities are constructed in the future to enhance supply to oil fields in the Planning Area, it is assumed that the same design safeguards would be incorporated to prevent the entrainment and impingement of fish. Waterflooding under the final Preferred Alternative is not expected to have a measurable effect on anadromous and amphidromous fish population within the Planning Area.

Effects of Abandonment and Rehabilitation

Water withdrawal and removal of bridges, culverts, and bridge approaches could have impacts on fish similar to those described for construction activities. Additional fish habitat could be created by allowing gravel pits to be colonized by fish from nearby streams.

Effects of Spills

Under the final Preferred Alternative, the general level of protection to fish and fish habitat offered by ROPs and lease stipulations would be nearly identical to those discussed under the other alternatives. However, designation of NSO areas by Lease Stipulations K-4(h), K-9, K-10, and K-11 would help protect fish in lakes and streams in those areas from potential impacts of oil spills. Under the final Preferred Alternative, the number of small spills is approximately 3 times greater than the number of spills projected to occur under the No Action Alternative, and one of these spills could be large (>500 bbl). Rigorous adherence to oil spill safety protocols and clean-up policies would effectively protect critical fish habitat. Therefore, oil spills would not be expected to have a measurable effect on freshwater, anadromous, or amphidromous fish populations within and adjacent to the Planning Area under the final Preferred Alternative.

Effectiveness of Stipulations and Required Operating Procedures

Required Operating Procedures B-2h, C-2a, C-2b, C-3, and C-4 limit the extent of winter activities that could harm fish and fish overwintering habitat. Required Operating Procedures B-1 and B-2 protect overwintering fish and their habitat by limiting the withdrawal of water from rivers and streams during winter. Required Operating Procedure D-1 prohibits exploratory drilling in rivers, stream, and lake beds. Required Operating Procedure E-8 protects fish habitat by prohibiting the mining of gravel within the active floodplain of any river, stream, or lake unless the AO determines that there is no other alternative. Mining might also be approved if it can be demonstrated that the site would ultimately enhance fish habitat. Required Operating Procedures E-6 states that bridges rather than culverts be used for road crossings on all major rivers and that if culverts are necessary on smaller stream, that they be large enough to avoid the restriction of fish passage or adversely affect natural stream flow. Required Operating Procedures E-12 requires extensive ecological mapping of proposed development sites in order to assess and minimize impacts to sensitive wildlife and fish habitats. Required Operating Procedure E-2, which prohibits the construction of all permanent oil and gas facilities, roadways, airstrips, and pipelines within 500 feet of any active floodplain unless otherwise permitted by the AO, also established a buffer zone to protect fish habitat from unplanned spills or discharges and sedimentation from gravel-based structures. Required Operating Procedure E-3 limits the construction of causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths and deltas, and artificial gravel islands and bottom-founded structures in active stream channels. Required Operating Procedures A-2d, A-3, A-4, A-5, A-6, A-7a, and E-4 provide increased protection to fish and fish habitat from oil spills and during fueling use, handling, and storage of refined oil products.

Conclusion

Construction of pads, roads, airstrips, and fuel spills associated with the final Preferred Alternative might kill a small number of individual fish, but these activities are not expected to have a measurable effect on Arctic fish populations. Higher water demand relative to the No Action Alternative would potentially place greater numbers of fish at risk, although limits on withdrawal and monitoring of water quality should minimize concerns. The greater extent of exploration activity under the final Preferred Alternative (as compared to the No Action Alternative) represents a correspondingly higher water budget. Gravel extractions within the Planning Area are likely to be minimal and, if they did occur under the proper siting and design criteria, could lead to habitat enhancement under certain situations. Seismic surveys, non-oil and gas activity, causeways, and seawater spills associated with the final Preferred Alternative are not expected to have a measurable effect on Arctic fish populations in the Planning Area over the production life of the field.

4.6.7.2 Marine Fish

Under the final Preferred Alternative, lagoons and estuaries along the western coast of the Planning Area, including the 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 in either the Dease Inlet/Admiralty Bay area or Elson Lagoon, and oil and gas exploration and development activities adjacent to these areas would be subject to issue/area-based lease stipulations. Exclusion of marine construction from these coastal areas would reduce the probability that oil and gas activities associated with the final Preferred Alternative would have a measurable effect on marine fish populations. The activities and events most likely to have some effect on marine fishes in the final Preferred Alternative would be seismic surveys, and oil or diesel fuel spills.

Activities Not Associated With Oil and Gas Exploration and Development

Activities not related to oil and gas development are not likely to have a measurable effect on marine fishes.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

Disturbance, including seismic surveys, under the final Preferred Alternative is not expected to have any measurable effect on marine fish.

Effects of Spills

The exclusion of permanent facilities from coastal waters of the Planning Area would reduce the probability that an oil or diesel spill associated with the final Preferred Alternative would adversely affect marine fish.

Effectiveness of Stipulations and Required Operating Procedures

Waste prevention, handling, and disposal and spills Lease Stipulations A-1 through A-3 and ROPs A-3 through A-8 reduce the potential for introducing fuel and oil spills into environments inhabited by marine fish. Lease Stipulation K-6 would provide increased protection to marine water bodies within and adjacent to the Planning Area. Required Operating Procedure E-12 requires extensive ecological mapping of proposed development sites in order to access and minimize impacts to sensitive wildlife and fish habitats.

Conclusion

Based on the assumptions discussed in the text, exploration and development activities under the final Preferred Alternative are not expected to have a measurable affect on marine fish. In the event that an oil spill did reach nearshore coastal waters, marine fish could be adversely affected. However, the impact would likely be localized and affect only a small percentage of the marine fish population in the Planning Area.

The most likely activities that might affect marine fish as a result of oil and gas exploration and development are seismic surveys, fuel spills, and oil spills. Such events would be infrequent and if they did occur would be localized affecting only a very small proportion of marine species. Seismic surveys, which are conducted in winter, would have no affect on marine fish unless they occurred outside the bottom-fast ice zone. Overall, seismic surveys associated with the final Preferred Alternative are expected to have the same effect on marine fish as for the No Action Alternative.

4.6.7.3 Essential Fish Habitat

For the reasons discussed for the No Action Alternative, Essential Fish Habitat (EFH) is likely to be largely unaffected under the final Preferred Alternative. Potential impacts to the relatively few salmon that inhabit the Planning Area would be the same as described for other fish. Consequently, impacts to salmon, as part of EFH, are evaluated in the general fish analysis for the final Preferred Alternative.

4.6.7.4 Subsistence Harvest

Activities Not Associated With Oil and Gas Exploration and Development

Subsistence harvests could be indirectly affected by non-oil and gas activities if those activities were to jeopardize the fish species upon which the fisheries depend. It is not expected that non-oil and gas activities would have a measurable effect on fish populations, or on subsistence fisheries, within and adjacent to the Planning Area.

Oil and Gas Exploration and Development Activities

Oil and gas activities should not have a measurable effect on subsistence fisheries within and adjacent to the Planning Area under the final Preferred Alternative. Under the final Preferred Alternative, the general level of protection to freshwater, anadromous, and amphidromous fish and fish habitat offered by lease stipulations and ROPs would be identical to that discussed under Alternative B.

Effectiveness of Stipulations and Required Operating Procedures

Protections provided by the performance-based ROPs and lease stipulations under the final Preferred Alternative are similar to prescriptive-based lease stipulations developed for the No Action Alternative. The Tingmiaksiqvik River is afforded protection under Alternative B and the final Preferred Alternative, but not under Alternative C or the No Action Alternative. Oil and gas development would be allowed in Teshekpuk Lake under Alternative C; this area would be closed to leasing under the final Preferred Alternative and No Action Alternative.

Conclusion

It is not expected that a measurable effect to subsistence fisheries within and adjacent to the Planning Area would occur under the final Preferred Alternative. Lease stipulations developed for all alternatives afford similar levels of protection.

4.6.8 Birds

This section discusses the potential effects to bird species, which are not threatened or endangered, that could result from management actions in the Planning Area under the final Preferred Alternative. The final Preferred Alternative and Alternative B are similar in that they provide a level of protection for birds in the areas of high bird use in the Goose Molting Area north of Teshekpuk Lake that is intermediate between that of alternatives A and C. Birds in the Goose Molting Area are provided with the greatest amount of protection under the No Action Alternative and the least amount of protection under Alternative C. Most of the discussion of comparisons in this section concentrates on the differences between the final Preferred Alternative and Alternative B. A discussion of effects to threatened and endangered bird species is given in Section 4.4.10 (Threatened and Endangered Species). Activities that could affect birds in the Planning Area include oil and gas exploration and development, subsistence hunting, recreational use, and activities associated with scientific survey and research camps. These activities could result in: 1) temporary or permanent habitat loss; 2) various types of disturbance that could result in displacement from foraging, nesting or brood-rearing habitats; 3) increased predation pressure from predators attracted to areas of human activity; and 4) mortality resulting from collisions with vehicles or structures, or exposure to contaminants, including oil spills.

4.6.8.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, activities not related to oil and gas exploration and development that could affect birds in the Planning Area would be the same as those described under the other alternatives: private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. The potential for disturbance, displacement, or mortality from non-oil and gas related activities, would likely be similar under the various alternatives. Lease stipulations to protect waterfowl, shorebirds, raptors, and other birds and their habitats would help to mitigate the potential effects of non-oil and gas activities on birds under the final Preferred Alternative.

4.6.8.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Exploration

Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when birds are mostly absent from the Planning Area. Under the final Preferred Alternative, the types of effects of winter exploration activities on the bird species present in the Planning Area during the winter would be the same as those discussed under the other alternatives. Although impacts associated with winter exploration would likely be minor under any alternative, exploration could occur in the central portion of the Goose Molting Area under the final Preferred Alternative that is closed to development under the No Action Alternative and Alternative B. Conversely, small portions of the western and southeastern Goose Molting Area that are not protected under Alternative B would receive some protection under the final Preferred Alternative. The direct effects of exploration would likely include the temporary displacement of a small number of birds from preferred feeding or roosting areas.

During winter exploration activities, indirect impacts to birds could result from the construction of ice roads and ice pads and the associated water withdrawal. The types of effects that could result from ice road and ice pad construction under the final Preferred Alternative would be the same as those described under the other alternatives, and would primarily involve the temporary alteration of tundra habitats. Water withdrawal for ice road construction could also temporarily alter habitats adjacent to water source lakes, which could affect nesting or brood-rearing loons and waterfowl. Rolligons and track vehicles used during winter exploration could also temporarily affect tundra vegetation, resulting in minor impacts to tundra-nesting birds. Although exploration could occur in portions of the Goose Molting Area that are closed to oil and gas leasing under the No Action Alternative and Alternative B, other portions of the Goose Molting Area that are open to development under Alternative B would receive some protection under the final Preferred Alternative.

The use of airguns for seismic work in Teshekpuk Lake during the summer could temporarily displace loons and waterfowl from preferred feeding habitats while surveys were being conducted. Because setbacks around the perimeter of the lake presumably would eliminate the potential for disturbance to bird nesting near the lakeshore, only birds using open water habitats in lake would potentially be disturbed. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting support activities after the completion of the nesting and brood-rearing periods would eliminate the potential for nest abandonment and loss of productivity. Under the final Preferred Alternative, exploration activities in Teshekpuk Lake would be deferred, thus delaying the potential for seismic exploration activities to impact birds.

Predators, such as glaucous gulls, ravens, and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under the final Preferred Alternative, the potential effects of increased predation would be mitigated by ROPs A-2 and E-9, and the overall effects to birds would likely be similar under the various alternatives.

Oil and Gas Development

Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic; routine maintenance activities; heavy equipment use; and oil spill clean-up activities could cause disturbances that would affect tundra-nesting birds. Under the final Preferred Alternative, these types of disturbances to birds would be the same as those discussed under the other alternatives. These disturbances could result in temporary displacement from preferred foraging, nesting, and/or brood-rearing habitats; decreased nest attendance or nest abandonment; and increased energy expenditures that could affect physiological condition, rate of survival, and productivity of birds. The likelihood for impacts to tundra-nesting birds would depend on the location of the disturbance, the bird species and the number of individuals in the area, and the time of year. The greatest potential for impacts from disturbance would most likely occur in habitats with high bird concentrations, such as the Teshekpuk Lake Goose Molting Area, or if species with low or declining populations, such as buff-breasted sandpiper or yellow-billed loon, were disturbed.

The potential for disturbance to birds from activities on roads and pads would likely be greater under the final Preferred Alternative, as compared to Alternative B, because under the final Preferred Alternative roads would be permitted throughout most of the Goose Molting Area and pads would be permitted in portions of the Goose Molting Area that were closed to development under Alternative B. Under the final Preferred Alternative, no surface occupancy, including the construction of roads and pipelines, would be permitted in the caribou migration corridor between Teshekpuk Lake and the Kogru Inlet. This would provide birds in this area with a greater level of protection from disturbance on pads under the final Preferred Alternative compared to Alternative B. An NSO area would also be established south/southeast of Teshekpuk Lake covering 141,000 acres identified as an important caribou calving area. Restricting surface occupancy in this area would also protect birds using the area. Some disturbance in this area would be possible, since road and pipeline right-of-ways would be allowed in the area.

The final Preferred Alternative would likely increase the risk of disturbance to internationally significant populations of molting geese, particularly brant that use the Goose Molting Area when compared to alternatives A and B. The reduction in protection under the final Preferred Alternative could also affect white-fronted and Canada geese. Disturbance that resulted in a reduction in the breeding success of geese and other waterfowl could also impact the success of subsistence and sport hunters in Alaska, the lower 48 states, Canada, Russia, and Mexico. Disturbance effects could also impact shorebirds if development occurred in areas of high shorebird concentration located north of Teshekpuk Lake. Lease Stipulation K-6 would establish a ¾-mile buffer inland from the coast, within which oil and gas facilities would be prohibited to the extent practicable to minimize hindrance or alteration of caribou movement within caribou coastal insect-relief areas. This lease stipulation could also help to reduce the potential impacts to waterfowl and their habitats in coastal areas.

Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the perimeter of any fish-bearing lake in the Deep Water Lakes Area south of Teshekpuk Lake. Under the final Preferred Alternative, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish-bearing lakes in the Deep Water Lakes Area could result in disturbance to yellow-billed loons and waterfowl near the facilities and access roads. However, other bird groups could also be disturbed if facilities were located outside the ¼-mile buffer. The extent of effects to birds from activities on roads and pads would depend on the species and numbers of individuals occurring in areas adjacent to the development. Although Lease Stipulation K-2 has been designed primarily to provide mitigation for deepwater fish habitat, it would also provide protection for birds using habitats near these lakes.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of disturbance effects to waterfowl and other bird groups from aircraft would be the same under the final Preferred Alternative as those discussed under the other alternatives, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some birds could habituate to aircraft activity and either remain in habitats located near aircraft activities, or move to nearby habitats. This may not be the case for brant, as they apparently do not habituate well to aircraft traffic (Derksen et al. 1992). Aircraft disturbance to brant may cause behavioral and physiological responses that could increase energy expenditures and reduce foraging time, which could increase the duration of the flightless period and susceptibility to predation. Birds could be displaced from optimal to sub-optimal habitats, causing birds to spend more time foraging to meet nutrient needs (Derksen et al. 1992).

Under the final Preferred Alternative, there would be the potential for a greater amount of disturbance to birds from aircraft activity in most of the Goose Molting Area as compared to Alternative B. This is due to the potential for placement of facilities in the central portion of the Goose Molting Area, which is not open to oil and gas leasing and development under Alternative B. Under the final Preferred Alternative, however, development would not be permitted in portions of the western, southeastern, and north coastal Goose Molting Area that are open to development under Alternative B, which could reduce the potential for aircraft disturbance to birds in these areas. Confounding the issue is the potential for pipeline construction throughout most of the Goose Molting Area, which would result in the potential for helicopter surveillance for pipeline inspection.

Although set-backs from the goose molting lakes would provide a buffer within which facilities could not be located, continual aircraft flights into facilities located between buffer zones would have the potential to disturb molting geese. Aircraft disturbance could have moderate impacts on tundra nesting waterfowl and shorebirds under the final Preferred Alternative. Impacts may be greater on brant that apparently do not habituate well to some types of aircraft traffic. Helicopter traffic during pipeline surveys or other activities may result in greater impacts to brant than other types of aircraft traffic. If all of the development in the Goose Molting Area is connected by a road system and individual fields are supplied from staging areas located on coast, it is possible that individual fields could be supplied via the road system and aircraft disturbance could be minimized. The level of impacts would depend on the final development scenario, the number and location of fields, and whether construction and production activities were conducted primarily with air or road support.

If a CPF were located within the ¼-mile buffer around deep-water lakes the potential effects of aircraft disturbance would be similar under the action alternatives and would increase from that of the No Action Alternative. The degree of effects to birds would depend on the number of birds present and which species of birds were using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this lease stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to birds.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting and staging waterfowl, could occur in offshore waters of the Planning Area from mid-July through October. These impacts would likely be minor. Displaced waterfowl would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact waterfowl. There may be a greater likelihood for disturbance to waterfowl under the final Preferred Alternative as compared to Alternative B, because of the increased potential for development in the Goose Molting Area that may require increased barge support at coastal staging areas. Under the final Preferred Alternative and Alternatives B, the potential for barge and vessel traffic to disturb birds would be greater than for the No Action Alternative, and less for Alternative C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer. Disturbance from watercraft activity along rivers could affect birds such as ruddy turnstones, semipalmated plovers, and Baird’s sandpipers that use gravel bars. The results of disturbance may include failure to nest or nest abandonment (Rodgers and Smith 1995). The potential for these activities to disturb waterfowl and shorebirds under the final Preferred Alternative would likely be increased compared to Alternative B because there would be a greater likelihood that facilities would be located in areas of high bird use within the Goose Molting Area, and a road system through the area would allow access to goose molting lakes. However, wildlife resource surveys would be conducted prior to development to identify suitable areas for spill response training activities.

Habitat Losses and Alteration

Permanent Habitat Loss. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in the loss of tundra-nesting bird habitat. As much as 1,090 acres of tundra could be covered by gravel placement under the final Preferred Alternative and up to 210 acres could be impacted by gravel mining. During the construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites would be lost as nesting, brood-rearing, and foraging habitat for birds. The potential effects of habitat loss under any alternative would likely have moderate impacts to tundra-nesting birds and would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. The impacts of permanent habitat loss on tundra-nesting birds under the final Preferred Alternative may be reduced compared to Alternative B due to the reduced amount of tundra covered by gravel for construction of facilities under the final Preferred Alternative. Loss of habitat in areas of high bird use in the Goose Molting Area, however, could cause greater impacts to birds under the final Preferred Alternative compared to Alternative B. In addition, the potential for roads to be constructed throughout the Goose Molting Area under the final Preferred Alternative would further increase the potential for habitat loss in areas of high bird use. Birds that use drier habitats may be more affected by habitat loss than those that use wet habitats, because less dry habitat is available in the National Petroleum Reserve – Alaska. Loss of dry habitat could be especially important for buff-breasted sandpiper, which is a species of concern with low population numbers that uses dry habitats. As under Alternative B, there would be an increased potential for birds to be affected by a functional loss of habitat under the final Preferred Alternative in areas near roads and pads if development-related disturbances precluded birds from utilizing these habitats. The potential for habitat loss to impact tundra-nesting waterfowl and shorebirds would be greater under alternatives B and D as compared to the No Action Alternative, but would be less than would occur under Alternative C.

Temporary Habitat Loss. In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. Water withdrawal from lakes during ice-road construction could temporarily affect birds in adjacent habitats if the lakes did not have adequate recharge capabilities. Under the final Preferred Alternative, the types of effects to birds resulting from temporary habitat loss would be the same as those discussed under the other alternatives. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by bird populations. Temporary habitat loss under the final Preferred Alternative could potentially have a reduced impact on tundra-nesting birds, compared to Alternative B, because of the reduced amount of habitat that would be affected. The potential for locating facilities and a road system in the Goose Molting Area under the final Preferred Alternative, however, would increase the potential for impacts to birds as compared to Alternative B. The potential for temporary habitat loss to impact birds under the final Preferred Alternative and Alternative B would be greater than those under the No Action Alternative, but less than would occur under Alternative C.

Mortality

Bird mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment is discussed under the No Action Alternative. The potential impacts to bird populations as a result of collisions in areas of oil and gas development would likely be minor. Without knowing specific locations of potential developments, it is difficult to compare potential impacts among alternatives. However, there may be an increased risk of bird collision with offshore barge and vessel traffic under the final Preferred Alternative compared to the No Action Alternative and Alternative B because facilities could be constructed in portions of the Goose Molting Area that would be unavailable for leasing under Alternative B. These facilities could be accessed by roads from staging areas on the coast which could result in increased barge and vessel traffic under the final Preferred Alternative. Under the action alternatives, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of bird collisions with oil field infrastructure could still be greater under the action alternatives because the potential benefits of illumination of facilities may not be adequate to mitigate for the presence of facilities within or near areas of high bird use. The potential for bird mortality to result from collisions with vessel traffic and oil field facilities and equipment depends on facility location and on the species and numbers of birds in developed areas.

Some predators, such as ravens, gulls, Arctic fox, and bears, could be attracted to areas of human activity where anthropogenic sources of food and denning or nesting sites were present. The potential impacts of increased numbers of predators on birds are discussed under the other alternatives. Increased predation pressure could have moderate impacts on tundra-nesting birds. Under the final Preferred Alternative, the types of effects to bird populations would be the same as those discussed under the other alternatives. Under the final Preferred Alternative, there may be the potential for greater bird mortality due to predation than under Alternative B if predators were attracted to development in areas of high bird use that are closed to leasing under Alternative B. Under Alternative B and the final Preferred Alternative, the potential for bird mortality to result from increased levels of predation would be greater compared to the No Action Alternative and less compared to Alternative C. Although all alternatives have ROPs or lease stipulations in place to eliminate attraction of predators to anthropogenic sources of food, the action alternatives would require the lessee to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. Still, it may be difficult to totally exclude ravens from nesting on oil field structures. There would be no equivalent lease stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

The impacts of abandonment and rehabilitation on birds would be similar in many respects to those incurred by construction activity. Activities occurring in the winter would cause little disturbance or displacement, because most species would be absent from the area. However, the melting of ice roads could be delayed, compared to surrounding tundra, causing the formation of impoundments. Delay in the melting of ice roads could also cause the complete loss of nesting habitat for a season, or cause compaction of vegetation, which would reduce the quality of the nesting habitat for a nesting season. Such impacts would only affect nesting in the summer following ice road use, and would be minor. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to birds that would be similar to, and at the same levels as, those caused by traffic during construction and production. If pads, roads, and airstrips were not revegetated, their value to birds would be lessened. If they were revegetated without removing the gravel, the habitat would not return to its current utility for most birds of the area. If gravel was removed, habitat similar to that existing in the area at the time of disturbance could be created and used by birds, though the precise mix of habitat types would likely not be the same as what originally occurred. Foam insulating materials used in pad construction could be broken up in the course of removal. Fine particles of foam not removed from the environment could be ingested by some birds incidentally; depending on the material’s toxicity and the amount ingested, ingestion of foam could cause sickness or mortality, though the numbers of birds harmed or killed would be very small.

Effects of Spills

Oil spills would have similar types of effects to tundra-nesting birds under all alternatives. There may be an increased risk of an offshore spill occurring under the final Preferred Alternative compared to Alternative B, because of the potential for increased barge traffic needed to supply facilities in the Goose Molting Area. Offshore spills would have the potential to spread through the action of wind and currents, and could affect molting waterfowl along the coastline or in Harrison and Smith bays, as well as shorebirds feeding in littoral habitats in the Colville River Delta. The potential for an offshore spill to impact birds under Alternative B and final Preferred Alternative would be greater compared to the No Action Alternative, but less compared to Alternative C.

Under the final Preferred Alternative, the potential for a terrestrial oil spill in the Goose Molting Area would be greater compared to Alternative B because of the potential to construct facilities and pipelines in the central portion of the Goose Molting Area under the final Preferred Alternative. A pipeline leak or other spill on terrestrial habitats could affect greater numbers of waterfowl and shorebirds because of the high concentration of nesting and molting birds found in this area. The potential for a terrestrial spill to impact birds under Alternatives B and the final Preferred Alternative would be greater compared to the No Action Alternative, and less compared to Alternative C.

Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe. Waterfowl along the shoreline or in marine habitats and shorebirds in the littoral areas of the Colville River Delta could be impacted during the fall molting and staging period. Under the final Preferred Alternative, the potential that an oil spill would enter a major river or stream would be minimized by the setbacks from goose molting lakes associated with this alternative, although pipelines would not necessarily be prohibited in some of these areas. The other alternatives have lease stipulations with similar levels of protection.

4.6.8.3 Effectiveness of Stipulations

The final Preferred Alternative incorporates many of the "K" lease stipulations and establishes buffers around important goose molting lakes in the 213,000 acre portion of the Goose Molting Area that was unavailable to oil and gas leasing under Alternative B. In addition, the final Preferred Alternative establishes buffers around goose molting lakes located outside of the area protected under Alternative B. These buffers are established to protect important habitat for caribou and molting geese, and medium to high-density concentrations of white-fronted goose which are found on 85 percent of this area (Map 3-14). However, other bird species would also benefit from protection of this area. For example, medium to high-density concentrations of pintails and shorebirds are found on 86 and 84 percent of this area, respectively (Maps 3-16 and 3-19). Approximately half the area contains medium to high densities of tundra swans and Pacific loons (Maps 3-10 and 3-13).

Several new lease stipulations are added under the final Preferred Alternative. Lease Stipulation K-4(h) creates an NSO area of approximately 217,000 acres using buffer areas around the Goose Molting Lakes as the boundary. This allows areas of potential development within the Goose Molting Lakes habitat that were previously off limits to development and potentially compromises much of the protection provided by the NSO for waterfowl using the area. Additionally the lease stipulation allows pipelines and roads to be constructed within the NSO which also compromises the benefits of the NSO designation. Lease Stipulations K-9 and K-10 cover habitat important to caribou migration and calving but would also protect birds using these areas. Lease Stipulation K-11 delineates the area North of Teshekpuk Lake into seven large lease tracts and limits development within each tract to no more than 300 acres of disturbance. While surface disturbance is limited in these areas, the tracts effectively open areas of land within the Goose Molting Area that was off limits to development under the No Action Alternative and Alternative B.

Numerous lease stipulations and ROPs were developed to protect birds and their habitat within the Planning Area. The "A" ROPs would be effective in ensuring that solid, liquid, and hazardous wastes did not impact birds or their habitats, and in reducing the potential for garbage to attract animals that may prey upon birds in exploration and development sites. The "B" ROPs would be effective in ensuring that water withdrawals do not impact lakes, or lake habitats, used by molting geese, while the "C" ROPs would govern seismic ground operations during spring and summer to prevent seismic activity-related disturbance to geese during the nesting and molting periods. Disturbances caused by aircraft are controlled within the Goose Molting Area and raptor sites under ROP "F." Several of the "K" lease stipulations would be effective in protecting birds and their habitats, including habitats associated with rivers and lakes, the Goose Molting Area, and Coastal Area.

4.6.8.4 Conclusion

Under the final Preferred Alternative, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be similar to those described under the other alternatives. The potential for these disturbances to impact birds may be greater under the final Preferred Alternative compared to Alternative B, because of a greater potential for development to occur in portions of the area of high bird use in the Goose Molting Area. Although the level of development would be reduced under the final Preferred Alternative compared to Alternative B, disturbance to birds could be greater due to the potential to locate facilities in the Goose Molting Area. This is due in part to the potential for the construction of roads throughout the entire Goose Molting Area. The overall effects of disturbance under the final Preferred Alternative and Alternative B would be greater than for the No Action Alternative, but less than those that would occur under Alternative C. The potential for habitat loss and alteration to affect tundra-nesting birds may be greater under the final Preferred Alternative compared to Alternative B, although the amount of tundra habitat that would be lost to gravel infrastructure would be less. Under the final Preferred Alternative, there would be a higher potential for infrastructure to be located in areas of high bird use in the Goose Molting Area. The potential for bird mortality resulting from collisions with vehicles or infrastructure and marine vessel traffic may be greater under the final Preferred Alternative because of the increased potential for development that may require offshore barge support. The potential for an oil spill to impact tundra-nesting birds would also be greater under the final Preferred Alternative, as compared to Alternative B, because of the increased potential for an off shore spill from a barge and the potential for a pipeline spill in the Goose Molting Area. The impacts from any alternative would depend on the location and size of the developments and the species and numbers of birds located in developed areas.

In general, impacts to birds from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to birds from exploration and development activities would also be additive. However, once exploration and development/production ceased in an area, bird populations could recover from the effects of disturbance reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Based on the reduced area of disturbance under the final Preferred Alternative compared to Alternative B, impacts to birds could be reduced. However, because more development could occur in areas of high bird use in the Goose Molting Area under the final Preferred Alternative compared to Alternative B, there may also be greater potential for bird disturbance to occur under the final Preferred Alternative. Because of the larger disturbance area and the potential for more oil and gas exploration and development activities, the potential impacts to birds under the final Preferred Alternative would be less than under alternatives B and C, but would be 4 times greater than those that would occur under the No Action Alternative. The level of impacts, however, would also be dependant on the location of facilities and development in the Goose Molting Area, which under the final Preferred Alternative, could increase the effects of development on sensitive species, such a brant. Potential impacts may be greater for brant than for other species due to their apparent inability to habituate to some types of disturbance (Derksen et al. 1992), their decreasing population size, and the potential for as much as 30 percent of the Pacific flyway population of brant to use the Goose Lake Molting Area. Impacts could be even greater if oil and gas activities occurred in areas with high bird concentrations, with high quality habitat, or used by species of concern.

4.6.9 Mammals

4.6.9.1 Terrestrial Mammals

Activities Not Associated With Oil and Gas Exploration and Development

The types of impacts to terrestrial mammals under the final Preferred Alternative would be similar to those that would occur under the other alternatives, but could be more frequent, greater in extent, or longer in duration than those occurring under the No Action Alternative. 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 the camps and along aerial survey routes. The disturbance reactions of caribou and other terrestrial mammals would likely be brief, lasting for a few minutes to an 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. Impacts from recreation and overland moves would be the same as under the No Action Alternative. Current management practices and lease stipulations addressing land use authorizations for temporary facilities, overland moves, and recreation permits would effectively mitigate impacts from these activities on terrestrial mammals.

Oil and Gas Exploration and Development Activities

Under the final Preferred Alternative, oil and gas leasing and exploration would be allowed in the Planning Area, but lease stipulations would limit surface occupancy in the Goose Molting Area northeast of Teshekpuk Lake (approximately 217,000 acres), in the caribou calving area south and southeast of Teshekpuk Lake (approximately 141,000 acres), and in the caribou travel corridor between Teshekpuk Lake and the Kogru River (approximately 16,000 acres) (Figure 2-4). In addition, lease stipulations would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, could potentially be greater under the final Preferred Alternative than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and the overall scale of development would likely be greater under the final Preferred Alternative. Exposure of terrestrial mammals to oil and gas activities under the final Preferred Alternative would be reduced compared to alternatives B and C because of the additional lease stipulations provided under this alternative.

Effects of Disturbances

Seismic. Impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative but would be greater in frequency and extent, given the greater number of 3-D seismic surveys and the larger area open to surveys. A larger 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. It is expected that the reactions of caribou and other terrestrial mammals to disturbance would be brief, although large numbers of wintering TLH caribou could be encountered, depending on the location of exploration activities. Some caribou and other large mammals would likely be displaced from the general area of the seismic work. Some terrestrial mammals would avoid seismic camps, while others, such as foxes, could be attracted to the camps by food odors. The potential for disturbance to hibernating bears would be greater under the final Preferred Alternative, compared to the No Action Alternative, because of the increased level of seismic activity occurring in the Planning Area. Bears, however, are only present at low densities in the Planning Area. Muskox and moose would most likely be present in their greatest numbers in the southern portion of the Planning Area, so impacts would be similar to those presented under the No Action Alternative, although the greater number of surveys would likely result in greater impacts. A greater number of lemmings and voles could be killed or disturbed by surface vehicles. The frequency and extent of seismic surveys would be similar to that proposed for Alternative B and less than that proposed for Alternative C.

The use of airguns for seismic work in Teshekpuk Lake during the summer would likely cause only temporary displacement of terrestrial mammals near the lake. Displacement would occur primarily from the support activity associated with the surveys, such as helicopter flights to bring equipment to the lake. Once surveys were finished, mammals would move back into the area around the lake. However, Teshekpuk Lake would be deferred from leasing under the final Preferred Alternative, which would likely limit seismic activity in the lake.

Exploratory Drilling. Under the final Preferred Alternative, it is projected that the number of exploration wells and delineation wells drilled would be greater than for the No Action Alternative and less than for Alternatives B and C. Types of impacts to terrestrial mammals would be similar to those discussed under the No Action Alternative, but somewhat greater in extent and frequency, as more exploration would occur, particularly in the area to the northwest, south, and east of Teshekpuk Lake, which would be excluded from leasing under the No Action Alternative. Exploratory drilling would be conducted during the winter, when wildlife are largely absent, although wintering TLH caribou could be present in large numbers if more exploration activity occurred in the southern portion of the Planning Area. Exploratory drilling could also occur from pads and platforms in lakes in the TLCH Area during summer, potentially disturbing mammals found near this activity. Moose, muskox, and grizzly bears would experience a greater level of impacts than under the No Action Alternative.

The implementation of lease stipulations and ROPs should ensure minimal impacts to terrestrial mammals. These lease stipulations and ROPs would include provisions to avoid known grizzly bear dens by ½ mile, methods to avoid attracting wildlife to food and garbage, provisions to protect stream banks from damage during overland moves, provisions to minimize the effect of low-lying aircraft on wildlife (particularly over caribou winter ranges), and provisions to minimize the disturbance and hindrance of caribou in the TLCH Area.

Oil Development. Approximately 95 percent of the Planning Area would be made available for leasing under the final Preferred Alternative. Leasing would be allowed throughout the Planning Area. However, additional lease stipulations would limit development in the 217,000-acre region northeast of Teshekpuk Lake and would protect the caribou calving area south and southeast of Teshekpuk Lake (approximately 114,000 acres), and the caribou travel corridor between Teshekpuk Lake and the Kogru River (approximately 16,000 acres) by creating NSO areas.

The primary effects of oil and gas development on terrestrial mammals would be similar to those outlined under the No Action Alternative, and would result 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 habitat alteration associated with gravel mining and construction. The greatest potential for impacts to caribou would be through disruption of calving areas and interference in the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas. These impacts would likely be greater under the final Preferred Alternative than under the No Action Alternative, given the larger development scenario that would affect approximately 0 to 2,915 additional acres of habitat (includes acres that could be indirectly lost due to alteration of plant species composition). Functional loss of habitat would be greater than the number of acres indicated, which is the actual development footprint plus indirect losses. Wolfe (2000) suggested that when caribou in the CAH avoided areas within 2.5 miles of roads and pipelines, the functional habitat loss increased from 2 percent (the immediate footprint of roads and gravel pads) to 29 percent.

Construction of permanent roads within the Planning Area would increase access to the area and could increase public and subsistence hunting of terrestrial mammals. Caribou would be most impacted by increased access for hunting, but other species (moose in particular) may also be impacted depending on the location of permanent roads. The overall number of animals taken would be unlikely to increase dramatically since most hunting would be for subsistence, but roads could focus hunts in particular portions of the Planning Area. Hunting pressure and harvests have increased for many wildlife species near the TAPS since its construction, but have not produced adverse population effects (TAPSO 2001). It is unlikely that the more remote roads associated with oil and gas development in the Planning Area would have as great an effect on wildlife populations as occurred along the TAPS corridor.

<u>Caribou</u>

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. If a field were developed in the area surrounding Teshekpuk Lake (excluding the portion unavailable to leasing), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH caribou for calving, insect relief, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH caribou, impacts to caribou could be greater under the final Preferred Alternative than under the No Action Alternative. Overall, the level of impact would be dependent on the specific location of any oil field—a field in the central or southern portion of the Planning Area would not impact the TLH caribou calving grounds, although such a development could still affect migratory movements of TLH and WAH caribou as well as activities on their wintering ground.

Development in the TLH caribou calving grounds could displace some calving animals within 2½ miles of roads. Movements of some cows and calves across roads would also likely be reduced, and cow caribou might avoid crossing the roads during the calving season. Lease Stipulation K-4(h) would limit development north of

Teshekpuk Lake and would help protect caribou calving areas in that region. Additionally, Lease Stipulation K-10 creates an NSO area south/southeast of Teshekpuk Lake (141,000 acres). This area in addition to the areas north of Teshekpuk Lake is important to caribou calving. These lease stipulations prohibit permanent oil and gas facilities excluding major right-of-ways such as pipelines and roads within this area. Lease Stipulation K-11 would delineate the area north of Teshekpuk Lake into seven large lease tracts and limits development to a maximum of 300 acres of permanent surface disturbance resulting from oil and gas development in each tract.

Some TLH caribou movements during the insect-relief season (late June to August 15) would likely be affected by pipelines and road traffic. The critical part of the movement to the coastal insect-relief area is through the narrow corridor between Teshekpuk Lake and the Kogru River. Caribou must pass through these corridors to get to and from insect-relief areas. The area to the east of Teshekpuk Lake is a particular problem, because nearly all of the parturient cows pass through this area either shortly before or after calving (Carroll Pers. comm.). Any development that occurs on the limited amount of habitat that is used by caribou migrating through this corridor would likely affect caribou movements. Lease Stipulation K-9 designates an NSO area extending from the eastern shore of Teshekpuk Lake approximately 4 miles eastward towards the Kogru Inlet (approximately 16,000 acres). The NSO designation prohibits permanent oil and gas facilities including major right-of-ways such as pipelines and roads. This lease stipulation should protect enough land to allow caribou use of this major migration corridor. However, pipelines could be allowed in the NSO area north of Teshekpuk Lake and south/southeast of the lake. Careful siting of pipeline and road right-of-ways would still be required to prevent affects on caribou use of this corridor. Additionally, the areas that would be excluded from surface occupancy do not extend to the coast, suggesting that there could be some development along the coastline. While a set-back from the coast is stipulated (Lease Stipulation K-6), development in the coastal area would likely impact caribou use of insect-relief areas near the coast, though the number of developments would be restricted by Lease Stipulation K-11.

Traffic associated with hauling gravel from outside of the Planning Area could result in local disturbance and displacement of caribou within about 1 mile of the operations. A pipeline linking oil fields in the Planning Area with facilities at the Alpine and Kuparuk River fields would result in the disturbance and displacement of some caribou during winter construction, due to vehicle traffic along ice roads and air traffic. It is expected that these disturbances would be short term and occur within about 1 mile of the pipeline corridor.

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 3-27). Unless an oil field were to be developed in the southern portion of the Planning Area, development would be unlikely to impact moose. Under the final Preferred Alternative, impacts to moose would be similar to those discussed under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario under the final Preferred Alternative.

If gravel were mined from the southern portion of the Planning Area, a temporary displacement and disturbance of moose could occur. Borrow pit operations could potentially destroy or degrade 20 to 210 acres of moose habitat if gravel borrow operations occur in the southern portion of the Planning Area.

Muskox

Muskox occur in low densities in the Planning Area, although they may be present year-round. 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 placement of gravel at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities. Under the final Preferred Alternative, impacts would be similar to those under the No Action Alternative, although they could be greater in duration and area, given the larger overall development scenario. Impacts would be greatest if development were to occur in the southern portion of the Planning Area.

Grizzly Bears

Major sources of noise include construction of roads, installation of crude oil pipelines, pump stations, gravel mining, and drilling operations. These activities could disturb grizzly bears within a few miles of the noise sources. Industrial activities and human presence could also cause potentially serious disturbances to denning bears. Under the final Preferred Alternative, impacts to grizzly bears would be similar to those that would occur under the No Action Alternative, although the extent and duration of impacts could be greater because of the larger overall development scenario, depending on the location of the field development. Grizzly bears are present at low densities in the northern portion of the Planning Area, but could be attracted to some activities. It is likely that the greatest number of bears would be encountered during development activities in the southern portion of the Planning Area, since the greatest amount of suitable habitat is located in this area.

Wolves

Under the final Preferred Alternative, oil and gas development would have a minimal impact on wolves, similar to the No Action Alternative. Potential effects to wolves would 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 associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be affected. However, wolves are generally not abundant in the Planning Area.

Wolverines

The potential effects of oil and gas development on wolverines under the final Preferred Alternative 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 could be sensitive to oil exploration and development activities and abandon habitat areas near oil development. If caribou abundance was affected by oil development, wolverines could be affected in turn. Alteration of riparian habitats through gravel excavation or pipeline construction could affect wolverines, especially during the winter, when these habitats provide cover and important hunting areas. Wolverines are present at low density in the Planning Area and sightings have been infrequent. Documented sightings and harvest locations suggest that wolverines could be encountered along rivers and in the vicinity of Teshekpuk Lake. Under the final Preferred Alternative, some wolverines could be displaced near (within a few miles) oil field facilities. Impacts under this alternative are likely to be similar to, or slightly greater than, those that would occur under the No Action Alternative, given the larger overall development scenario.

Foxes

Under the final Preferred Alternative, impacts to Arctic foxes would be similar to those discussed under the No Action Alternative, although they could be greater in duration and extent. Oil and gas development activities could affect Arctic foxes by increasing the availability of food and shelter. An increase in the fox population associated with oil development could 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 were to occur in the Arctic foothills or mountains, similar impacts to red foxes could occur.

Other Mammals

Small rodents and their predators would be affected locally (i.e., through 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 could increase local densities of ground squirrels. Under the final Preferred Alternative, impacts to small mammals would be similar to slightly greater than those that would occur under the No Action Alternative, given the larger overall scale of the development scenario.

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would disturb and displace terrestrial mammals in a manner similar to that associated with construction. The intensity of the disturbance would be less than during construction, however, because it is likely that caribou, muskox, and other terrestrial mammals would have become habituated to road and air traffic over the course of construction and operation of the facilities. Some individuals could be killed by collisions with road traffic. If roads were left in place and maintained in useable condition upon abandonment, they could continue to provide improved access to hunting areas, with consequent hunting pressure on caribou and other subsistence species. Revegetation of the roads, pads, and the airstrip left in place would facilitate restoration of habitat. Plant communities on these raised gravel structures would likely be different from those that prevail in adjacent areas. Pads, roads, and the airstrip could provide some insect-relief habitat for caribou, if left in place. If gravel fill was removed and the pad revegetated with vegetation similar to the surrounding plant communities, caribou, and possibly other terrestrial mammals, would use the area. Foam insulating materials that could be used in pad construction could be broken up in the course of removal and used by fox as denning material. Depending on the material's toxicity and the amount ingested by fox, this could cause mortality, though the numbers of fox killed would likely be very small.

Effects of Spills

The impacts of oil spills on terrestrial mammals are described under the No Action Alternative (Section 4.3.9; Mammals). Compared to the No Action Alternative, the risk of oil spills would be greater, but still small, under the final Preferred Alternative, given the greater extent of development. Activities occurring in the vicinity of Teshekpuk Lake could increase the likelihood that a spill would reach the lake under the final Preferred Alternative. The majority of impacts to terrestrial mammals would result from disturbance associated with spill clean-up activities rather than direct oiling.

Effectiveness of Stipulations

Numerous lease stipulations and ROPs were developed to protect mammals. These include the "A" ROPs, which have been developed to reduce the potential for direct mortality due to oiling, ingestion of toxic materials, or contamination of habitat, prey species, and forage species, and to reduce the attractiveness of industrial sites to predators that could result in elevated predator populations.

Lease Stipulation D-1 would prohibit exploratory drilling in lakes, streams, lakebeds, and active floodplains unless impacts to wildlife were minimal, while Lease Stipulation D-2 would be effective in minimizing surface impacts from exploratory drilling by limiting exploratory drilling to temporary facilities such as ice pads, ice roads, ice airstrips, and temporary platforms, unless the lessee were to demonstrate that construction of permanent facilities was environmentally preferable.

Required Operating Procedure E-1 would be effective in protecting wildlife resources by requiring that all roads be designed, constructed, maintained, and operated to create minimal environmental impacts, while ROP E-7 would require that pipelines and roads be designed to facilitate caribou passage by elevating all aboveground pipelines at least 7 feet above the ground, burying pipelines, or providing ramps to facilitate caribou movements. In addition, ROP E-7(c) would require that a minimum distance of 500 feet separate pipelines and roads, when feasible. If fully implemented, these ROPs would be effective in reducing, but not eliminating, the 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.

Required Operating Procedure F-1 would minimize the effects of low-flying aircraft on terrestrial mammals by requiring an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges, limiting the number of takeoffs and landings in support of operations, and requiring aircraft altitudes of at least 2,000 feet AGL (except for takeoffs and landings) over the TLCH Area from May 20 through August 20. Assuming that aircraft operators were aware of the potential effects of aircraft on wildlife and took the appropriate actions to minimize those effects, disturbance impacts to terrestrial mammals could be effectively reduced.

Lease Stipulations K-5 and K-6 would require that the operator minimize disturbance and hindrance of caribou, or alteration of caribou movements through portions of the TLCH Area and the Coastal Area that are essential for all season use, including calving and rearing, insect relief, and migration. These lease stipulations would require studies of caribou movement, would restrict exploratory drilling, would protect major land corridors, would require field design that takes caribou movements into account, and would require various ground and air traffic controls. New lease stipulations associated with the final Preferred Alternative also provide protection for terrestrial mammals. Lease Stipulation K-4(h) creates an NSO in the Goose Molting Area north and east of Teshekpuk Lake (approximately 217,000 acres). This lease stipulation would provide protection for caribou calving and insect-relief areas located in this region and should effectively limit impacts to caribou associated with development. However, the NSO in this area would allow major right-of-ways for pipelines and roads, which could still potentially impact caribou calving areas and insect-relief habitat as well as caribou movements depending upon their location.

Lease Stipulation K-9 would designate an NSO area extending from the eastern shore of Teshekpuk Lake approximately 4 miles eastward towards the Kogru Inlet (approximately 116,000 acres). The NSO designation prohibits permanent oil and gas facilities including major right-of-ways such as pipelines and major roads. This lease stipulation should protect enough land to allow caribou use of this major migration corridor.

Lease Stipulation K-11 would delineate the area north of Teshekpuk Lake into seven large lease tracts and limits development to a maximum of 300 acres of permanent surface disturbance resulting from oil and gas development in each tract. This lease stipulation, along with Lease Stipulation K-4(h), would limit the amount of surface disturbance within the area north and east of Teshekpuk Lake and would help to minimize impacts to caribou calving and insect relief habitat and movements of caribou within the area. However, potential impacts would depend on the actual location of any developments within this area.

Conclusion

Under the final Preferred Alternative, oil and gas leasing and exploration would be allowed anywhere in the Planning Area, except where lease stipulations prohibit permanent oil and gas facilities in the area north and east of Teshekpuk Lake, south/southwest of Teshekpuk Lake and in the migration corridor between Teshekpuk Lake and the Kogru Inlet. In addition, lease stipulations and ROPs would provide seasonal and spatial protection to certain environmentally sensitive areas, including Rivers Area, Deep Water Lakes, Goose Molting Area, Teshekpuk Lake Caribou Habitat Area, Pik Dunes, Colville River Special Area, Coastal Area, and Teshekpuk Lake. The exposure of terrestrial mammals to oil and gas activities, and therefore the level of associated impact, would be greater under the final Preferred Alternative than under the No Action Alternative, given that leasing of lands adjacent to Teshekpuk Lake could occur and that the overall scale of development would likely be greater under the final Preferred Alternative. However, exposure of terrestrial mammals to oil and gas activities under this alternative would be less than would occur under alternatives B and C.

Among the terrestrial mammal populations that could be affected by management actions under the final Preferred Alternative are the TLH, WAH, and CAH caribou. Caribou could be exposed to helicopter traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction. The TLH caribou movements within calving, insect-relief, and wintering areas could be disrupted by oil development activities. Although much of the construction associated with oil and gas development would occur primarily during winter, development would bring year-round facilities and activities into caribou range. If a field were developed in the area surrounding Teshekpuk Lake (excluding the NSO areas), production pads, pipelines, within-field roads, and other facilities would be located within areas used by the TLH for calving, insect relief, migration, and wintering. A field development in the northern section of the Planning Area would also require a connector pipeline to link the oil field with facilities to the east.

Studies done over the last decade have indicated that TLH caribou show high fidelity to the calving area near Teshekpuk Lake and that caribou that calve in the traditional calving area have much higher calving success than caribou found outside the area. Collared caribou that are found within the currently protected areas (as identified in 1998 ROD) during calving season have much higher calving success than caribou found outside the areas. In surveys conducted since 1990, 147 out of 163 (90 percent) TLH caribou that calved successfully calved within these protected areas. Of the 178 caribou that were found within the protected areas, 83 percent calved successfully. Of the 59 cows that were found outside the protected areas during calving season, 25 percent calved successfully (Carroll 2003).

If the TLH is displaced from its calving area, as the CAH has been, or if caribou are impeded from reaching the calving area, recent surveys indicate that calving success would most likely be reduced. While there have been no experiments conducted with the TLH to determine whether oil development in the calving area would displace caribou or affect the productivity of the herd, caribou behavior during 1997 and 2001 suggest that oil development in the TCH calving area could impact caribou. During 1996-97, most of the herd migrated much farther south than usual and many cows arrived late to the calving area. Only 8 of 21 collared caribou were found in the calving area during calving time and 6 of these calved successfully. Of the other 13 collared cows, only one calved successfully for an overall successful calving percentage of 33 percent. In 2001, heavy snow and a late snow melt-off slowed the migration and only 16 (44 percent) of 36 collared cows calved successfully. Calving success for collared cows that did make it back to the calving area in 2001 was much better (88 percent) than cows that did not make it back (10 percent). This suggests that if oil development takes place in such a way that it displaces caribou from the calving area, or interferes with their ability to get to the calving area, it could have an effect on productivity and population numbers (Carroll 2003).

The types of impacts of field development on caribou would be similar to those outlined under the No Action Alternative. However, given the possibility that a field would be developed within the calving, insect-relief, and wintering grounds of the TLH, impacts to caribou could be greater under the final Preferred Alternative than under the No Action Alternative. Lease stipulations created for the final Preferred Alternative would help to mitigate potential effects of development on the TLH. If fully implemented, these lease stipulations (along with the other proposed lease stipulations and ROPs) should limit the affects on caribou to a moderate level.

The WAH caribou could be exposed to oil development facilities in localized areas. Moose, muskox, grizzly bears, wolves, wolverines, foxes, and small mammals could be locally affected by activities associated with oil and gas exploration and development. Impacts to mammals would be similar to those discussed 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, and a greater amount of habitat would potentially be permanently lost.

It is expected that impacts to terrestrial mammals in the vicinity of Teshekpuk Lake would be greater under the final Preferred Alternative than under the No Action Alternative, particularly with respect to caribou calving and insect-relief habitat. Overall, impacts throughout the Planning Area would be greater under the final Preferred Alternative, given the greater overall scale of the planned development. Impacts associated with the final Preferred Alternative would be less than Alternative B given the additional Lease Stipulations K-4(h), K-9, K-10, and K-11 which help to mitigate many of the potential impacts to caribou. Similarly, impacts to terrestrial mammals under the final Preferred Alternative would be less than would occur under Alternative C, which has fewer restrictions on the locations of oil and gas activity.

In general, impacts to mammals from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where both types of activities occurred. Impacts to mammals from exploration and development activities would also be additive, except where development occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities.

4.6.9.2 Marine Mammals

Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, impacts associated with non-oil and gas activities would be similar to those described under the No Action Alternative. These activities could occur throughout the Planning Area and would not be affected by the increased availability of land for oil and gas leasing.

Overland moves could disturb a small number of polar bears within approximately 1 mile of the vehicle train. Disturbance of maternity dens could result in den abandonment and death of cubs. Additionally, a few ringed seals could be disturbed if overland moves were to occur over floating, shore-fast ice. Recreational camps could attract a small number of polar bears, increasing the potential for negative human-bear interactions that could require that a small number of bears be shot in defense of human life and property. It is expected that small fuel spills would occur under the final Preferred Alternative. These small spills should not have negative impacts on marine mammal populations in or near the Planning Area.

Under the final Preferred Alternative, it is expected that the effects of non-oil and gas activities on marine mammals would be localized and short term, with no or minor effects to marine mammal populations.

Oil and Gas Exploration and Development Activities

Effects of Disturbances

A small number of polar bears could be affected by seismic exploration occurring along the coast, although ROP C-1 would prohibit seismic activities within 1 mile of known or suspected polar bear dens or seal birthing lairs. The potentially greater amount of seismic exploration that would occur under the final Preferred Alternative would increase the likelihood that polar bears would be disturbed, relative to the No Action Alternative, and would be the same as Alternative B, although the increase in impacts would be modest, given the relatively low number of bears denning in the Planning Area.

It is expected that aircraft traffic could potentially disturb marine mammals under the final Preferred Alternative. The effects of aircraft traffic disturbance would be similar to those discussed under the other alternatives, but could be greater in extent than for alternatives A and B, given the potential for development in the area north of Teshekpuk Lake and the greater likelihood that fields would be developed near the coast. Aircraft would generally fly at 1,000 feet or higher AGL, minimizing the potential for disturbance to seals.

Under the final Preferred Alternative, exploratory drilling near the coast during winter would have the same likelihood of displacing or attracting polar bears as under the other alternatives. Female polar bears denning within approximately 1 mile of the construction activity could be disturbed by vehicle traffic and construction noise, which could result in the abandonment of the den and the potential death of cubs. Polar bears could be attracted to drilling sites by food odors and curiosity, increasing the potential for negative human-bear interactions and the possible death of bears in defense of human life and property. Non-lethal means of deterrence would be used in most cases, minimizing the number of bears lost as a result of such encounters.

Under the final Preferred Alternative, Lease Stipulation K-6 would prohibit the construction of permanent structures within ¾ mile of the coast, although exploration could occur in the area. The effects of exploration activities would be localized and would be unlikely to affect marine mammal populations. Most exploration and development activities would occur onshore, and would not likely affect individual marine mammals or populations.

Under the final Preferred Alternative, the projected levels of activities associated with oil and gas leasing and development could be incrementally higher than under the No Action alternative, given the larger area that would be available for leasing and the greater likelihood that fields would be developed near the coast. Higher levels of development would result in a greater potential for disturbance to marine mammals from increased aircraft and overland traffic, and increased barge traffic to transport supplies and modules. However, the level of activity anticipated under the final Preferred Alternative is lower than that expected under Alternative C, since production would be limited to several 300-acre or smaller developments in the area north of Teshekpuk Lake. It is assumed that development operations in the Planning Area would be staged out of the Prudhoe Bay Unit or the Kuparuk River Unit facilities, with no dock or causeway constructed along the Planning Area coast. Materials and equipment would likely be moved to staging areas in the Planning Area using trucks over ice roads in the winter months. Under this scenario, increased summer barge traffic could result in local and short-term displacement of cetaceans and seals, and local and short-term changes in marine mammal behavior, as barges and sealifts passed along the coast. It is not expected that local and short-term changes in distribution or behavior would reach levels that could result in high impacts to individual marine mammals or populations, although the fitness of some individuals could be impacted if disturbance were to become chronic. Mitigation measures that regulated the timing of shipments would minimize the potential for barge traffic to impact marine mammal populations. Under the final Preferred Alternative, the effects of oil and gas activities on marine mammals should be localized and short term, with few effects to species populations.

Effects of Abandonment and Rehabilitation

Impacts of abandonment and rehabilitation activities are expected to be similar to those for construction. Aircraft flights could disturb ringed or bearded seals and non-denning polar bears, and spotted seals could be disturbed by spring or summer activities. Denning polar bears could be disturbed, and mortality caused to cubs abandoned or prematurely introduced to inclement weather, by activities within about 1 mile of their dens if these dens were not detected and avoided as required by ROP C-1.

Effects of Spills

Effects from a Large Spill. Under the final Preferred Alternative, a large spill occurring near the Colville River could result in oil reaching the marine environment. Some spotted seals and beluga whales could be exposed to oil, as under the other alternatives.

Little or no contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected, because little oil would be likely to reach offshore feeding areas. Thus, as under the other alternatives, a spill in the Colville River Delta would not be likely to have any effects on marine mammal food chains.

Polar bears could be vulnerable to a spill in the Colville River Delta during winter or during spring break-up. As under the other alternatives, the number of polar bears affected would likely be small. Under the final Preferred Alternative, as under the other alternatives, it is expected that few marine mammals would be affected by a large spill in the Planning Area.

Effects from Small Onshore Spills. As under the other alternatives, small onshore spills would not be expected to have effects on marine mammals, unless the spills were to occur near and contaminate streams that enter the Colville River Delta, Fish Creek or Judy Creek, or the Kogru River. Spills reaching those waterways could impact a small number of ringed seals, spotted seals, or beluga whales. A small number of polar bears could also be affected, as under the other alternatives. Small onshore spills would not be likely to affect bearded seals, walruses, or gray whales occurring offshore of the Planning Area.

In general, the effects of small onshore spills to marine mammals under the final Preferred Alternative are expected to be localized and minor, with few impacts to the populations.

Effectiveness of Stipulations

The final Preferred Alternative includes the same lease stipulations and ROPs as outlined under alternatives B and C. These ROPs and lease stipulations should provide similar levels of protection as those developed for the No Action Alternative. The additional lease stipulations included in the final Preferred Alternative would have little effect on impacts to marine mammals.

Conclusion

Under the final Preferred Alternative, the effects of non-oil and gas activities on marine mammals, particularly polar bears and ringed seals along the coast of the Planning Area, would be short term and localized, occurring within 1 mile of aircraft corridors, survey activities, recreational camps, and overland moves. Under the final Preferred Alternative, oil and gas leasing and development activities would likely result in a greater level of noise and disturbance, primarily near the Colville River Delta and inner Harrison Bay, than under the No Action Alternative and Alternative B, but may not be as great as under Alternative C. Effects should be localized (within 1 mile of aircraft corridors and activities) and short term (generally less than 1 year). Lease Stipulation K-6 would minimize the potential for development to impact ringed seals, spotted seals, beluga whales, and polar bears in areas along the coast. While exploration could occur in this area under the final Preferred Alternative, surface occupancy would generally not be allowed. The effects of seismic exploration would be limited to short-term, localized disturbance to denning or hauled out ringed seals, denning polar bears within approximately 1 mile of the activity, and displacement or attraction of non-denning polar bears. The effects of development under the final Preferred Alternative are expected to be short term, with few effects on marine mammal populations.

A small number of ringed seals, spotted seals, beluga whales, and polar bears could be affected by oil spills entering the Kogru River, the Colville River, or drainages that empty into the Colville River, Fish Creek, or Judy Creek. It is expected that the impacts to marine mammals from a spill would be minor.

4.6.10 Threatened and Endangered Species

This section discusses the potential effects to bowhead whale, and spectacled and Steller's eiders, which could result from management action in the Planning Area under the final Preferred Alternative. Whales would be most affected by disturbance and oil spills. Most, but not all, activities that could potentially affect eiders in the Planning Area would be associated with oil and gas exploration and development. Other activities that could occur in the Planning Area include subsistence hunting, recreational use, and activities associated with scientific survey and research camps. A more detailed analysis of effects to spectacled and Steller's eiders is provided in Appendix D (Endangered and Threatened Species Consultation and Biological Assessment).

4.6.10.1 Activities Not Associated With Oil and Gas Exploration and Development

Effects on the Bowhead Whale

Under the final Preferred Alternative, effects to bowhead whale from non-oil and gas activities would be similar to those that would occur under the No Action Alternative, and Alternatives B and C, and would occur only when bowhead whales migrated exceptionally close to shore. Impacts from non-oil and gas activities would have no or minor impacts on individual bowhead whales or bowhead whale populations.

Effects on Spectacled and Steller's Eiders

Non-oil and gas activities that could affect spectacled and Steller's eiders under the final Preferred Alternative would be the same as those listed under the No Action Alternative—private or commercial air traffic, aerial surveys to inventory wildlife or other resources, summer research camps, hazardous material or debris removal, subsistence hunting and fishing, and recreational camps and boating activity. Under the final Preferred Alternative, a larger area is available for permanent oil and gas development than under the No Action Alternative and Alternative B. However, the potential for non-oil and gas activities to disturb, displace, or cause mortality to eiders would likely be similar under all alternatives. Lease stipulations and ROPs would effectively mitigate some of the potential effects of non-oil and gas activities on these threatened eider species.

4.6.10.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

Bowhead Whale

The effects of oil and gas activities on bowhead whales would likely be greater under the final Preferred Alternative than under the No Action Alternative, given the greater area available for development. The final Preferred Alternative opens up to 300 acres in each of seven lease blocks north of Teshekpuk Lake for development, including areas near the coast. If developments up to 300 acres in size were placed near the coast (although Lease Stipulation K-6 would require that permanent facilities be sited at least ¾ of a mile from the coastline to the extent practicable), then effects to bowhead whales could be as great as those possible under Alternative C. Vessel activity in Harrison Bay and other areas off the coast of the Planning Area could increase under the final Preferred Alternative when compared to the No Action Alternative and Alternative B, but may not increase to the same extent as under Alternative C. An increase in barge traffic along the coast to transport equipment and supplies for development within the Planning Area, and a potential increase in activity at staging areas along the coast, would increase the potential for impacts to migrating bowhead whales. Effects to bowhead whales would only be expected if bowhead whales were to migrate close to shore. Effects would be limited to short-term shifts of the southern edge of the migration corridor.

Spectacled and Steller's Eiders

Exploration. Because seismic surveys to collect geological data and exploration drilling activities would likely occur during the winter months when eiders are not present in the Planning Area, these activities would not directly affect eiders. Indirect impacts to eiders could potentially result from construction of ice-roads and ice-pads, and the associated water withdrawal. Under the final Preferred Alternative, the potential effects of ice-road and ice-pad construction would be similar to those described under the No Action Alternative, and would involve the temporary alteration of tundra vegetation. Water withdrawal for ice-road construction could also temporarily alter habitats adjacent to water source lakes, potentially affecting nesting or brood-rearing eiders. Rolligons and tracked vehicles used during winter exploration could also temporarily affect tundra vegetation; however, the wet areas occupied by eiders might be less susceptible to vehicle damage than drier habitats. Since a larger area would be available to oil and gas exploration activities under the final Preferred Alternative than under the No Action Alternative, the associated impacts to eiders could also potentially be slightly greater under Alternative B. Although a larger area is available for development under Alternative B compared to the final Preferred Alternative, the potential effects of temporary habitat alteration on eiders may be greater under the final Preferred Alternative because a large portion of the Goose Molting Area, which is also an area of relatively high spectacled eider use, that is closed to development under Alternative B is open under the final Preferred Alternative.

Predators, such as glaucous gulls and Arctic foxes, could be attracted to anthropogenic food sources associated with summer maintenance of exploratory drilling and seismic equipment or winter exploratory activities. Under the final Preferred Alternative, the potential for increased predation of eiders by predators attracted to development would be effectively reduced by ROPs A-2 and E-9, and the overall effects would likely be similar under all alternatives. Although the No Action Alternative would not have a provision similar to ROP E-9, which would require the lessee to utilize the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes, this lease stipulation may not be relevant to the temporary storage of exploratory drilling and seismic equipment.

Development and Production - Activities on Roads and Pads. Activities related to oil development and production in the Planning Area, such as vehicle, aircraft, pedestrian, and boat traffic, routine maintenance activities, use of heavy equipment, oil spill clean-up activities, and aerial surveys to inventory wildlife or other resources, could cause disturbances that would affect eiders. Under the final Preferred Alternative, the types of disturbances to eiders would be the same as those discussed under the other alternatives. These disturbances could result in temporary displacement from preferred foraging, nesting, or brood-rearing habitats, decreased nest attendance or nest abandonment, and increased energy expenditures that could affect physiological condition and rate of survival or reproduction. The likelihood for impacts to eiders would depend on the location of the disturbance, the number of eiders in the area, and the time of year.

The potential for disturbance from activities on roads and pads to threatened eiders would likely be greater under the final Preferred Alternative as compared to the No Action Alternative, because areas that support high spectacled eider concentrations occur in portions of the Goose Molting Area that would be available for oil and gas leasing under the final Preferred Alternative, but not under the No Action Alternative. The potential for disturbance to eiders from activities on roads and pads would also likely be greater under the final Preferred Alternative compared to Alternative B, because under the final Preferred Alternative roads and pads with facilities would be permitted throughout much of the areas of high eider use in the Goose Molting Area. Potential disturbance impacts would be reduced under the final Preferred Alternative compared to Alternative C.

Under the final Preferred Alternative and Alternative B, as compared to the No Action Alternative, there would be a greater level of disturbance to eiders in a 5 to 6 mile wide band south and west of Teshekpuk Lake that would be open to surface activity under the final Preferred Alternative and Alternative B, but closed under the No Action Alternative. Lease Stipulation K-5, designed to protect the Teshekpuk Lake Caribou Habitat Area, would also be effective in reducing disturbance effects to eiders by creating setbacks within which permanent oil and gas facilities would be prohibited, and by placing limits on various types of activities on roads and pads between May 20 and August 20. However, under the final Preferred Alternative, eiders would receive increased protection compared to Alternative B in the caribou habitat area east and southeast of Teshekpuk Lake, where low to medium densities of spectacled eiders occur and no surface activity would be permitted under the final Preferred Alternative.

Under the final Preferred Alternative, there could also be a greater level of disturbance to eiders in the Deep Water Lakes Area south of Teshekpuk Lake, than under the No Action Alternative. Under the No Action Alternative, no permanent oil and gas facilities would be permitted within ¼ mile of the any fish-bearing lake. Under the final Preferred Alternative, facilities would generally not be permitted within this buffer, but could be permitted, on a case by case basis, in consultation with federal, state, and NSB regulatory and resource agencies. Permitting facilities within the ¼-mile buffer of fish bearing lakes in the Deep Water Lakes Area could result in disturbance to eiders near the facilities and access roads. Although Lease Stipulation K-2 has been designed primarily to provide mitigation for deep-water fish habitat, it could also provide protection for eiders using habitats near these lakes. These same lease stipulations apply to alternatives B and C.

Air Traffic. Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment to airstrips or staging areas during development and production activities in the Planning Area. The types of effects to eiders from aircraft would be the same under the final Preferred Alternative as those that would occur under the other alternatives, and could include displacement from preferred feeding habitats, temporary or permanent nest abandonment, and temporary or permanent displacement from molting or brood-rearing areas. However, some eiders could either remain in habitats located near aircraft activities or move to nearby habitats.

Compared to alternatives A and B, it is likely that there would be a greater amount of disturbance to eiders from aircraft activity under the final Preferred Alternative, as a larger area would be available for oil and gas leasing in the Goose Molting Area. Much of this area is closed to development under alternatives A and B. In addition, the potential for pipeline construction throughout the Goose Molting Area would increase the likelihood that helicopter surveillance flights may be required for pipeline inspections. Under the final Preferred Alternative, eiders would receive increased protection from aircraft disturbance compared to Alternative B in the caribou habitat area east and southeast of Teshekpuk Lake. The potential for aircraft disturbance to eiders under the final Preferred Alternative would be reduced compared to Alternative C.

There would likely be a greater amount of aircraft disturbance to eiders in the Deep Water Lakes Area under the action alternatives, compared to the No Action Alternative, if facilities were located within the ¼ mile buffer around lakes. The degree of effects would depend on the number of eiders using habitats near the facility. Although Lease Stipulation K-2 was designed primarily to mitigate potential impacts to fish, this lease stipulation, which would provide for agency consultation prior to development within the ¼-mile buffer, could also help reduce potential impacts to eiders. However, few spectacled or Steller's eiders are likely to occur in the Deep Water Lakes Area.

Watercraft. Several types of watercraft could be used during the summer to transport equipment and supplies and to conduct oil spill response training drills. Summer barge traffic, with the potential to temporarily displace molting eiders could occur in offshore waters of the Planning Area from mid-July through October. Displaced eiders would probably move to adjacent habitats or return to original habitats after the barges passed though the area, and barge traffic would not be expected to substantially impact molting eiders. There would be a greater likelihood for disturbance to molting eiders under the final Preferred Alternative than under alternatives A and B because portions of the Goose Molting Area that are closed to development under alternatives A and B would be open for development under the final Preferred Alternative. Development in the Goose Molting Area would likely require barge traffic for transportation of equipment and supplies during oil field construction and operation. Potential disturbances to eiders from vessel traffic would be reduced under the final Preferred Alternative compared to Alternative C.

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the summer open-water season. Under the final Preferred Alternative, these activities would be more likely to disturb eiders than under alternatives A and B because there would be a greater likelihood that facilities would be located in areas of spectacled eider concentrations within the Goose Molting Area under the final Preferred Alternative. Wildlife resource surveys would be conducted prior to development, and suitable areas for conducting spill response training to minimize potential disturbance to eiders would be identified. Potential disturbances to spectacled and Steller's eiders would be reduced under the final Preferred Alternative compared to Alternative C.

Habitat Loss and Alteration. Gravel mining and placement for the construction of oil field infrastructure would have the greatest potential to result in loss of eider habitat. During construction of oil field roads and pads, tundra covered by gravel as well as tundra associated with gravel mine sites, would be lost as nesting, brood-rearing, and foraging habitat for eiders. Under the development scenario for the final Preferred Alternative, the amount of habitat lost to gravel placement would be increased compared the No Action Alternative, but would be decreased compared to alternatives B and C. The potential effects of habitat loss under any alternative would depend on the location of the development, the types of habitat lost, and the level of bird use in the areas to be developed. Under the final Preferred Alternative, the potential for habitat loss to impact spectacled and Steller's eiders would be increased compared to the No Action Alternative, but reduced compared to Alternative C. Although the amount of habitat that may be lost under the development scenario for Alternative B is greater than that for the final Preferred Alternative, impacts to eiders could be greater under the final Preferred Alternative if areas of high eider use in the Goose Molting Area that are available for development under the final Preferred Alternative are covered with gravel for roads or pads.

In addition to permanent habitat loss, temporary loss of tundra habitat adjacent to gravel roads and pads could occur as a result of thermokarst, dust deposition, snow accumulation, and impoundment formation. In addition, water withdrawal from lakes during ice-road construction could temporarily affect eiders in adjacent habitats if the lakes did not have adequate recharge capabilities. However, sheetflow of water across the tundra in the spring is usually more than adequate to recharge lakes. Under the final Preferred Alternative, the types of effects to eiders resulting from temporary habitat loss would be the same as those discussed under the other alternatives. As with permanent habitat loss, the degree of effects would depend on the location of gravel infrastructure and local use of adjacent habitats by eiders. Lease stipulations and ROPs would help to mitigate potential effects of habitat loss to eiders.

Mortality. Eider mortality could result from collisions with vehicular traffic, buildings, elevated pipelines, towers, boats, or bridges. The potential for collisions with oil field structures or equipment has been discussed under the other alternatives. Compared to alternatives A and B, there would be an increased risk that eiders would collide with offshore barge and vessel traffic under the final Preferred Alternative, because facilities could be constructed in portions of the Goose Molting Lakes north of Teshekpuk Lake that would be unavailable for leasing under the No Action Alternative and Alternative B. Given that the highest concentrations of spectacled eiders in the Planning Area occur in this area, the siting of facilities within this area may also result in increased eider mortality due to collisions with oil field structures or equipment. Under the action alternatives, ROP E-10 would require illumination to prevent migrating waterfowl from colliding with drilling structures, production facilities, and other structures exceeding 20 feet in height. Although there is no similar action under the No Action Alternative, the potential risk of eider collisions with oil field infrastructure could still be greater under the action alternatives because the potential benefits of illumination of facilities may not outweigh the presence of facilities within or near areas of high eider concentrations. There would also be an increased risk of eider collisions with vehicles under the final Preferred Alternative compared to alternatives A and B because of the potential for road construction in the Goose Molting Area. The overall risk of eider collision with development related facilities or equipment would be reduced under the final Preferred Alternative compared to Alternative C.

Some predators, such as ravens, gulls, Arctic fox, and bears, may be attracted to areas of human activity where they find anthropogenic sources of food and denning or nesting sites. The potential types of effects of increased predation to eiders under the final Preferred Alternative would be the same as those discussed under the other alternatives. Although all alternatives have lease stipulations in place to eliminate attraction of predators to anthropogenic sources of food, under the action alternatives the lessee would be required to use the best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, or foxes. There is no equivalent lease stipulation under the No Action Alternative.

Effects of Abandonment and Rehabilitation

Bowhead Whale

Noise from aircraft could, but in most instances would be unlikely to, disturb bowhead whales. The use of barges to remove materials from the planning area could also have localized impacts on bowhead whales if they were encountered during migration.

Spectacled and Steller's Eiders

Winter activities would cause little disturbance or displacement, because eiders are absent from the area during the winter. However, ice roads could cause formation of impoundments that could reduce habitat for nesting birds; such impacts would only affect nesting in the summer following ice road use. However, these impacts should be very minor since most ice roads have melted prior to the time of nest initiation. Summer road and air traffic generated by abandonment and rehabilitation activities could cause disturbance, displacement, and mortality to eiders similar to, and at the same levels as, those described for traffic during construction and operations. If pads, roads, and airstrips were not revegetated, habitat would be lost for eiders. If they were revegetated without removing the gravel, the habitat would not return to its condition before disturbance. If gravel was removed, habitat similar to that currently existing in the area could be created and used by eiders, though the precise mix of habitat types would likely not be the same as what was in the area prior to disturbance. If foam insulating materials were used in pad construction, they could be broken up during removal. Fine particles of foam that were not removed from the environment could be ingested by eiders. Depending on the material's toxicity and the amount ingested, this could cause mortality, though the number of eiders killed would be small.

Effects of Spills

Bowhead Whale

The potential for an oil spill to impact bowhead whales would be greater under the final Preferred Alternative than under the No Action Alternative and Alternative B, because a larger area would be available for development and it is more likely that developments would occur near the coast. The potential for a spill may be less than under Alternative C. It is unlikely, however, that spilled oil would reach bowhead whale migration habitat. The southward edge of the migration corridor could be shifted northward due to vessel activity associated with containment and clean-up activities occurring during the fall migration. In general, impacts to individual bowhead whales or the whale population would be minor, except in the case of a very large spill coincident with the fall migration, which is very unlikely.

Spectacled and Steller's Eiders

Oil spills would have similar types of effects to threatened eiders under all alternatives. However, there may be an increased risk of an offshore spill occurring under the final Preferred Alternative compared to alternatives A and B because of a potential for more barge traffic. In addition, a pipeline leak or other spill in the Goose Molting Area could affect eiders under the final Preferred Alternative; this area would be closed to leasing under the No Action Alternative and a large portion would be closed to leasing under Alternative B. The potential for an offshore or terrestrial spill to impact spectacled and Steller's eiders would be less under the final Preferred Alternative compared to Alternative C.

Oil entering rivers or streams could potentially spread into delta or coastal areas, where impacts to eiders could be more severe. Under the action alternatives, Lease Stipulation K-1 would help to reduce the likelihood that an oil spill would enter a major river or stream. This lease stipulation would provide setbacks of ½ to 3 miles from specified rivers, within which permanent oil and gas facilities would be prohibited, although pipelines could be permitted in some of these areas. The No Action Alternative has similar lease stipulations, except that the Tingmiaksiqvik River is protected under Alternative B and the final Preferred Alternative, but not under the No Action Alternative.

4.6.10.3 Effectiveness of Stipulations and Required Operating Procedures

Under the final Preferred Alternative, the same lease stipulations and ROPs that apply to alternatives B and C would apply. Bowhead whales would benefit from lease stipulations and ROPs that would help prevent spilled fuel, oil, or other toxic materials from reaching the marine environment, minimizing potential effects to individual bowhead whales or the population. These measures should be equally, or more, effective than the lease stipulation measures developed for the No Action alternative.

Under Alternative 4-K(h), a buffer around goose molting lakes within which surface occupancy would not be permitted would provide spectacled and Steller's eiders with protection from the effects of development in these areas. However, portions of the Goose Molting Area that receive protection under alternatives A and B would be open to surface occupancy under the final Preferred Alternative. The highest spectacled eider concentrations in the Planning Area occur in the Goose Molting Area and development in this area could result in a higher level of disturbance to eiders than would occur under alternatives A and B. In addition, under the final Preferred Alternative, road and pipeline construction would be permitted in the entire Goose Molting Area, which could result in increased levels of disturbance and habitat loss as well as increased potential for an oil spill in an area of high eider use. The area east and southeast of Teshekpuk Lake in the caribou habitat area, where no surface occupancy is permitted, would also provide some protection for disturbance and habitat loss for eiders although spectacled eiders occur in low to moderate densities in this area.

4.6.10.4 Conclusion

Under the final Preferred Alternative, activities associated with non-oil and gas transport, seismic activities, and recreation could disturb bowhead whales if whales were to migrate near the coast, coincident with the presence of vessel or low-altitude aircraft traffic. If developments occurred near the coast, as would be permitted under the final Preferred Alternative, then the potential for disturbance to bowhead whales would be larger than under the No Action alternative and Alternative B, but may not be as great as those possible under Alternative C. Bowhead whales could exhibit temporary avoidance behavior from vessel traffic associated with oil spill clean-up activities if these activities were to occur offshore of Harrison Bay, and during the fall migration. Effects from such exposures would not be likely to have a high impact on individual bowhead whales or the population. The lease stipulations and ROPs under the final Preferred Alternative would effectively minimize the potential for spilled oil, fuel, and other toxic materials to reach the marine environment, thereby minimizing the potential for effects to individual bowhead whales or the population. Increased barge traffic associated with an increased number of staging areas along the coast could have short-term impacts on whales migrating close to shore. Noise from the barge traffic could result in a short-term shift of the southern edge of the bowhead whale migration away from the coast.

Under the final Preferred Alternative, the types of disturbances related to vehicle, aircraft, pedestrian, and vessel traffic, routine maintenance activities, heavy equipment use, facility noise, and oil spill clean-up activities would be the same as those that would occur under the other alternatives. The potential for these disturbances to impact spectacled and Steller's eiders would be greater under the final Preferred Alternative, compared to alternatives A and B, because a greater portion of high eider use areas in the Goose Molting Area would be available for leasing and development under the final Preferred Alternative. Under the final Preferred Alternative, these impacts would be reduced compared to Alternative C.

The potential for habitat loss and alteration to affect eiders would be greater under the final Preferred Alternative compared to alternatives A and B because there would be a greater potential for infrastructure to be located in areas of high eider use in the Goose Molting Area. In addition, road and pipeline construction could occur throughout the Goose Molting Area, which could result in further loss of eider habitat and increased levels of disturbance. The potential for eider mortality resulting from collisions with vehicles and/or infrastructure and marine vessel traffic would also be greater under this alternative than under alternatives A and B. Under the final Preferred Alternative, development related impacts to spectacled and Steller's eiders would be less compared to Alternative C.

In general, impacts to eiders from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to eiders from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. However, once exploration and development/production ceased in an area, bird populations and habitat could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the potential for disturbance in a larger portion of the Goose Molting Area, impacts to eiders under the final Preferred Alternative would probably be slightly greater than Alternative B, and much greater than under the No Action Alternative. Under the final Preferred Alternative, impacts to eiders would be less compared to Alternative C.

4.6.11 Cultural Resources

4.6.11.1 Activities Not Associated With Oil and Gas Exploration and Development

Aircraft and watercraft traffic, scientific investigations (e.g., archaeological and paleontological surveys and excavation), summer camps, hazardous and solid waste material removal and remediation, overland moves, and recreation could cause effects to cultural resources. The effects of these non-oil and gas activities on cultural resources under the final Preferred Alternative would be the same as those occurring under the No Action Alternative, except that under the final Preferred Alternative these activities would affect approximately 389,000 more acres of land previously unavailable for leasing. There would be no difference in the occurrence of recreational use between the No Action Alternative and the final Preferred Alternative. However, a greater amount of scientific work would occur in the Planning Area under the final Preferred Alternative as exploration expands into areas previously unavailable for leasing, and there could be greater amounts of ground activity associated with continued surveying and conveying of Native allotments and other management activities by the BLM. As a result, there would be a greater likelihood of effects to cultural resources in the Planning Area under the final Preferred Alternative than under the No Action Alternative.

4.6.11.2 Oil and Gas Exploration and Development Activities

Under the final Preferred Alternative, the amount of area available for exploration along a geological feature known as the Barrow Arch, which is anticipated to hold significant deposits of hydrocarbons, would be greater than under the No Action Alternative. The final Preferred Alternative opens additional lands (approximately 389,000 more acres) for oil and gas exploration and leasing in the Teshekpuk Lake Special Area. These lands are closed to leasing under the 1998 Northeast IAP/EIS ROD (USDOI BLM and MMS 1998). The Teshekpuk Lake Special area contains a high density of documented archaeological, historical, and TLUI sites (see Map 3-35), and is likely to have a high density of undocumented archaeological, historical, and TLUI sites. Under the final

Preferred Alternative, the likelihood of impacts to known and undocumented cultural resources would increase with the increased occurrence of oil and gas related activity in the region.

Effects of Disturbances

Under the final Preferred Alternative, the level of disturbance associated with oil and gas exploration and development activities in the Planning Area would be higher than the No Action Alternative due to the greater acreage available for leasing. However, because most of the oil and gas activities would occur during the winter months when buried cultural resources are protected by snow cover and frozen soil, the potential for effects to buried cultural resources would be minor. As discussed for the No Action Alternative, the likelihood of oil and gas activities affecting surface cultural resources would be minor because of the isolated occurrence of these resources and because of the variety of lease stipulations and ROPs that would govern oil and gas exploration activities. At staging sites such as Camp Lonely and Inigok, where oil and gas activities occur year-round, the greater intensity and duration of these activities occurring under the final Preferred Alternative would likely have a greater risk of affecting known and undocumented cultural resources. Year-round staging activities could also occur at existing facilities at West Dock and Oliktok Point for sealift offloading and storage of modules.

Under the final Preferred Alternative, the effects of possible disturbance would be the same as those occurring under the No Action Alternative. Efforts to supply necessary materials for construction of gravel pads, airfields, and roads at this scale could increase the likelihood of damage to known or undocumented cultural resources in the Planning Area. The excavation of gravel material for the construction of the permanent facilities would be a primary source of potential effects to cultural resources. One approach to protect cultural resources would be a “roadless” scenario in which pipelines would not have associated all-weather gravel roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only effects on cultural resources resulting from pipeline construction would be associated with the placement of VSMs, and would depend on the depth at which the VSMs were set. If buried pipelines were used, effects to cultural resources could occur during excavation, construction, and burial, depending on the depth, size, and location of the pipeline.

Effects of Abandonment and Rehabilitation

It is unlikely that cultural resources would be impacted by abandonment activities unless the facilities to be abandoned were themselves historic.

Effects of Spills

Under the final Preferred Alternative, the effects of oil spills on cultural resources would be the same as those that would occur under the No Action Alternative. In the exploration stage, most spills would occur on an ice pad or ice road, or during winter conditions. In such a case, the spill or subsequent spill cleanup would probably not alter or destroy buried cultural resources. Warm oil, however, could melt through the snow and ice and impact cultural resources buried near the surface. An oil spill could affect surface cultural resources by covering these resources with oil or other spill material. A spill occurring during the summer would have a greater potential to affect surface and subsurface cultural resource sites than a spill occurring during the winter because the effects of both the spill and subsequent cleanup would be greater. Oil spills on cultural resource sites would cause damage proportional to the extent of contamination, and could require data recovery (excavation) as part of remediation and clean-up efforts. However, irreparable damage to some of the data could occur. Oil spills at cultural resource sites, either surface or buried, would make radiocarbon dating of that site problematic or impossible. The spilled oil would seep into organic materials used for radiocarbon dating such as charcoal, bone, and wood and contaminate them so that their radiocarbon dates could be inaccurate.

4.6.11.3 Effectiveness of Stipulations and Required Operating Procedures

Under the final Preferred Alternative, several lease stipulations and ROPs would minimize the effects of oil exploration and development activities on cultural resources. Required Operating Procedure E-13 requires that a survey for cultural resources be conducted prior to any ground disturbing activity. Required Operating Procedure I-1, which corresponds to Lease Stipulation 63 of the No Action Alternative, would be effective in reducing cultural and resource conflicts through an orientation program for personnel that would teach the importance of not disturbing archaeological resources, as well as sensitivity to community values, customs, and lifestyles. The “K” lease stipulations would require setbacks along rivers, streams, lakes, cabins, and the coast, providing effective protection to cultural resources in these areas. Lease Stipulations K-1, K-2, K-3 and K-7 would effectively minimize the loss of cultural resources through setbacks from certain rivers, lakes, and areas where concentrations of subsistence cabins and campsites occur. Additional “K” lease stipulations (K-8, K-9, and K-10) would apply to areas previously unavailable for leasing under the 1998 Northeast IAP/EIS ROD, but available for leasing under the final Preferred Alternative. Lease Stipulation K-9 would protect an area with a large number of cultural resource sites on the east side of Teshekpuk Lake from surface occupancy and would prohibit permanent oil and gas facilities, including major ROW, such as pipelines and major roads. However, Lease Stipulations K-4(h) and K-10, while prohibiting permanent oil and gas facilities within the NSO area, could allow ROW for pipelines in areas with concentrations of known cultural resources. In addition, Lease Stipulation K-11 would allow up to 300 acres of permanent surface disturbance in each of seven lease tracts north of Teshekpuk Lake, except in those areas of the Goose Molting Area that would be off limits to surface development. Cultural resources have been documented in the proposed lease tract areas (see Map 3-35).

Prior to any undertaking (i.e., ground-disturbing activities such as the construction of buried pipelines, all weather gravel roads, and gravel well pads) on federal lands, the NHPA would require that an archaeological resource survey be completed. If cultural resources were identified during such a survey, BLM guidelines and policy would require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Officer.

4.6.11.4 Conclusion

The probability of impacts to known and undocumented cultural resources would increase under the final Preferred Alternative, as compared to the No Action Alternative, because of the increase in the amount of land that could be impacted. Effects to cultural resources from oil and gas activities could occur in leased areas of the Planning Area and would continue for the duration of operations through abandonment. Known cultural resources would not be affected, but the presence of undocumented cultural resources in the Planning Area cannot be discounted. Multiple sales over the available portions of the Planning Area increase the likelihood of effects to undocumented cultural resources.

Approximately 2 to 3 percent of the Planning Area has been surveyed for cultural resources. The distribution of known cultural sites does not reflect locational preference of prehistoric and historic people, but rather indicates that only portions of the Planning Area (e.g., well sites, portions of the coast, the Colville River, the Ikpikpuk River, and the Teshekpuk Lake area) have been examined through some type of organized reconnaissance for the presence of cultural sites. The TLUI sites generally cluster in these same areas with greater density on the lower Ikpikpuk River and associated drainages (NSB 1978, 2003). Activities that could occur near these areas may have a greater likelihood of impacting cultural resources. For example, the Teshekpuk Lake Special Area contains a high density of documented archaeological, historical, and TLUI sites (see Map 3-35), and is likely to have a high density of undocumented archaeological, historical, and TLUI sites. Exploration and development activities in the Teshekpuk Lake Special Area are likely to impact these known and undocumented cultural resources.

In general, impacts to cultural resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. Impacts to resources from exploration and development activities would also be additive, except where development activities occurred in areas previously disturbed during exploration. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area and the potential for more oil and gas exploration and development activities, potential impacts to cultural resources under this alternative would be greater for oil and gas exploration and development activities as compared to the No Action Alternative. Impacts could increase, however, if oil and gas exploration and development activities occur in an area with a high concentration of cultural resources, such as the Teshekpuk Lake Special Area. These impacts would be effectively mitigated by lease stipulations and ROPs that prohibit oil and gas exploration and development in areas with a high likelihood of having cultural resources: enforcement of lease stipulations and ROPs that prohibit collection of artifacts and require training of workers regarding avoidance of effects on cultural resources; and compliance with all federal laws, including the National Historic Preservation Act, which requires surveys for cultural resources in areas where ground-disturbing activities are proposed.

4.6.12 Subsistence

4.6.12.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, non-oil and gas activities requiring permits from the AO could be subject to the lease stipulations outlined in Appendix F, as well as any other applicable federal, state, and NSB regulations. Non-oil and gas activities would include air and watercraft use, scientific research and data collection, recreation, solid and hazardous waste removal and remediation, and overland moves. During baseline monitoring of subsistence species and other resources prior to possible lease sales, many of the scientific and data collection activities would be conducted at an increased intensity and for a longer period than usual.

Effects on Subsistence Species

The effects of non-oil and gas activities on subsistence species would be similar to those that would occur under the No Action Alternative. Activities would be, in most cases, of limited duration and magnitude, and effects on subsistence species would be limited to the immediate area of the activity. However, the duration, extent, and magnitude of effects could be greater under the final Preferred Alternative than under the No Action Alternative. Under the final Preferred Alternative, aircraft and watercraft traffic could increase during summer to support activities (such as scientific research) that would be required prior to expanding lease areas, resulting in increased effects to subsistence species through temporary and localized diversion, deflection, or disturbance of animals.

As baseline data are gathered preparatory to further lease sales under the final Preferred Alternative, scientific research and data collection could increase as compared to the No Action Alternative. Clearance and inventory of cultural resources would increase in anticipation of further lease, development, and exploration activity in the Planning Area. Biological research and monitoring would increase to expand baseline data for future effects monitoring. The result of increased research and data collection would be temporary and would include localized diversion, deflection, or disturbance of subsistence species, including caribou, moose, wolf, wolverine, muskox, and spotted seals (USDOI BLM 2003a).

Under the final Preferred Alternative, there could be more recreation in the Planning Area than under the No Action Alternative, in response to publicity, but it would likely be limited to summer use of river corridors. Recreation would result in a temporary and local effect on subsistence species.

Solid and hazardous waste removal and remediation, such as monitoring of existing clean-up sites and aging infrastructure (e.g., wellheads), would be ongoing and independent of additional lease availability. Under the final Preferred Alternative, lease stipulations and ROPs would likely eliminate the need for further clean-up activity. The effect of solid and hazardous waste removal and remediation on subsistence species under the final Preferred Alternative would be similar to those that would occur under the No Action Alternative. Over the short term, a localized deflection of subsistence species could occur. Long-term effects could include a decreased potential for contamination of subsistence species with the cleanup of waste sites.

Overland moves may increase in order to stage research camps and activities. Similar to the No Action Alternative, overland moves would occur only by permit and would be subject to lease stipulations and ROPs. These moves would be very rare, and would take place in the winter on frozen tundra, an adequate accumulation of snow pack, or on ice roads. Overland moves could temporarily deflect local subsistence species when they did occur.

Effects on Subsistence Harvest Patterns

Non-oil and gas activities that could affect subsistence harvest patterns include air and watercraft use, scientific research and data collection, recreational use, solid and hazardous waste removal and remediation, and overland moves. As discussed under the No Action Alternative, these activities could alter the availability of subsistence species in traditional harvest areas through direct interference with hunts. This direct interference could affect harvest patterns by requiring hunters to travel further, because the subsistence resources are more wary than normal following a disturbance or are deflected from traditional harvest areas following the presence of vehicles, vessels, and aircraft. Nuiqsut residents noted in the *Alpine Satellite Development Plan EIS* that aircraft have diverted subsistence resources away from areas where hunters were actively pursuing them, directly interfering with harvests or causing harvests to fail (USDOI BLM 2004C). Increased travel distances would result in greater expenditures for fuel and equipment, as wear and tear on snowmachines, outboards, and four-wheel vehicles would occur.

Under the final Preferred Alternative, aircraft could divert migrating or insect-avoiding caribou, as well as seals, walrus, and whales from subsistence use areas. In addition, there could be fewer animals taken during subsistence harvests under the final Preferred Alternative, because the available and desirable subsistence use area would be smaller. This would increase the number and duration of trips needed to maintain the level of subsistence harvest necessary to support the community. In addition, subsistence users could have to travel farther to harvest subsistence foods, resulting in more time spent in pursuit of subsistence species, increased costs in fuel and time, and increased risk of equipment failure and meat spoilage. If subsistence resource users have an emergency far from existing communities and facilities, rescue efforts must be mounted by the NSB with the help of the nearest communities at increased cost due to increased travel distances. Nuiqsut subsistence users have repeatedly stated during scoping meetings that aircraft traffic reduces harvest access and success (Nukapigak 1998, Ahtuangaruak 2003, Kaigelak 2003, Olemaun 2003). The opening of areas to the north and west of Teshekpuk Lake could increase the amount of aircraft disturbance to subsistence species, relative to the No Action Alternative, thereby affecting Nuiqsut, Atqasuk, and Barrow hunters (see Maps 3-36, 3-38, 3-39, 3-40, 3-41, and 3-42). Under the final Preferred Alternative, the effects of watercraft on subsistence harvest patterns would likely be the same as those discussed under the No Action Alternative unless there was an increase in the number and duration of sealifts, nearshore seismic testing and exploratory drilling, or other marine activities, in which case marine mammals and birds could be deflected from normal harvest areas.

The amount of scientific research and data collection associated with lease sales would likely be greater under the final Preferred Alternative than under the No Action Alternative. Therefore, there would be an increased likelihood that these activities would affect subsistence harvest success. Research activities would predominately take place in the summer months. Aircraft-based biological surveys have the greatest likelihood of affecting subsistence harvest patterns because they cover a large area, last a long time relative to other research activities, and are known to elicit responses from caribou and waterfowl (Nukapigak 1998, Ahtuangaruak 2003, Kaigelak 2003, Olemaun 2003). Archaeological, paleontological, and geological activities involving personnel walking on tundra would have effects on subsistence species for the duration of the activity.

Similar to the No Action Alternative, recreational users would likely frequent waterways used by subsistence hunters during the summer months, potentially causing resource conflicts. The effects of these conflicts on subsistence harvest patterns would likely be localized and of short duration. Since the amount of recreation that would occur would be more or less the same under the No Action Alternative and the final Preferred Alternative, effects to subsistence harvest patterns would also be much the same.

As discussed under the No Action Alternative, solid and hazardous waste removal and remediation activities would have localized effects that would last for the duration of the activity. Evaluation activities would have little effect on long-term harvest patterns. Site cleanup and remediation activities could temporarily divert or disturb caribou, muskox, and grizzly and polar bears, but would have little effect on long-term subsistence harvest patterns.

Under the final Preferred Alternative, it is possible that there would be more overland moves during the winter than under the No Action Alternative, which could result in greater deflection or diversion of caribou and harm to denned bears. The lease stipulation and ROPs would mandate procedures to protect denned bears and minimize impacts to caribou. Overall, the effects of overland moves on subsistence harvest patterns would likely be similar to those under the No Action Alternative and Alternative B.

4.6.12.2 Oil and Gas Exploration and Development Activities

Effects of Disturbances

The effects of oil and gas exploration and development activities on subsistence uses and harvests in the Northeast National Petroleum Reserve - Alaska under the final Preferred Alternative would be greater in magnitude, extent, and duration than under the No Action Alternative. The types of disturbances would be similar, as the No Action Alternative already supports the expansion of the Alpine Satellites Development into the Planning Area. Areas that were unavailable for year-round occupation and development under the No Action Alternative would become available under the final Preferred Alternative, and subsistence uses in these areas could be affected by oil and gas development. Development activity would last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation. The primary effect of oil and gas exploration and development activities in the area surrounding Teshekpuk Lake would be to deflect subsistence users from the vicinity of development pads, roads, and pipelines. In addition, these activities could deflect caribou from their normal migration, calving, insect-relief, and grazing areas, and these activities may deflect the caribou from subsistence harvest areas used by Nuiqsut, Atqasuk, and Barrow residents. Pipelines, pads, and roads may concentrate caribou during certain seasons in areas where they would not likely be harvested by subsistence users due to proscriptions against hunting in industrial areas and fears of accidents and contamination. Development near Teshekpuk Lake could also affect subsistence uses of fish, waterfowl, and seals in areas near exploration, development, and production activities.

Subsistence Species

Should development proceed under the final Preferred Alternative, the duration, severity, and extent of the effects of oil and gas development activities on subsistence species could be greater than under the No Action Alternative, as there would be a larger area open for year-round occupation and development, which would include ecologically sensitive areas that would not be open under the No Action Alternative. The amount of habitat loss and degradation would be greater under the final Preferred Alternative than under the No Action Alternative. Oil and gas activities could divert caribou and waterfowl from normal habitat areas and deflect these species from normal migration routes until they were able to habituate to activities and infrastructure changes in these areas. Caribou might be deflected from preferred habitats at times of nutritional or energy stress. Development in the Teshekpuk Lake Special Area could reduce available areas for animals to use if set-aside areas are overgrazed or their value to the animals are reduced in response to climate, use, weather, drought or flood, and other possible forces which may change habitats. Increases in fox (red and Arctic), seagull, and jaeger populations associated with human activities could result in an increased risk for predation of molting geese, eggs, and fledglings. Changes in overwintering and seasonal fish habitat caused by oil development (e.g., turbidity, salinity changes, reduced dissolved oxygen, redirection of sheet flows, and possible spills) could harm fish populations. Some species, (e.g., wolves and wolverines) would avoid human activity, while others (e.g., bears and foxes) are attracted to such activity and could become nuisance animals.

Subsistence Harvest Patterns

Under the final Preferred Alternative, oil and gas activities would occur over a wider area than under the No Action Alternative, as areas previously unavailable for leasing would be available for exploration and development. Oil and gas activities would inhibit subsistence users from harvesting in their traditional use areas, including areas previously unavailable for leasing. Subsistence users tend to avoid areas of oil infrastructure and activity for the reasons noted in the No Action Alternative. Hunters from Nuiqsut, Barrow, and Atqasuk would be directly affected by development in the Teshekpuk Lake Special Area, where numerous subsistence camps, cabins, and ice cellars are located. Nuiqsut subsistence users have stated during scoping meetings and public testimony that air traffic reduces harvest success (Nukapigak 1998, Ahtuangaruak 2003, Kaigelak 2003, Olemaun 2003). The opening of the areas in the Teshekpuk Lake Special Area could increase the amount of aircraft disturbance to subsistence species, as compared to the No Action Alternative. As discussed in Section 3.4.2 (Subsistence), Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass depend on TLH caribou as a subsistence species. If oil and gas activities were to deflect, divert, or reduce the TLH caribou population, harvest of caribou by area residents could be reduced until the caribou were able to habituate to the increased activity and infrastructure in the area. Oil and gas activities in the northeast portion of the Planning Area could affect Nuiqsut subsistence and activities, deflecting migrating caribou away from traditional harvest locations, reducing harvest access and success. If TLH caribou were to move outside of their normal migration routes, Anaktuvuk Pass could suffer a shortage of caribou, its main subsistence resource, until the normal migration route was resumed. A greater expenditure and risk on the part of the subsistence hunters from Anaktuvuk Pass would be required, and other communities would supplement the loss of traditional foods at the cost of increased hunting effort and expenditure in their subsistence use areas. In the past, when the herd has failed to pass near the community, Anaktuvuk Pass hunters had to fly to other locations in search of subsistence food, increasing community stress and the time necessary for harvest success, as well as reducing the connection with traditional areas (SRBA 2003b).

Based on data from Pedersen et al. (2000) and Pedersen and Taalak (2001), as a consequence of oil development, Nuiqsut caribou harvesters tend to avoid development, with approximately 78 percent of the 1993 and 1994 caribou harvests occurring greater than 16 miles from the development east of the Colville River. More recently, 51 percent of the 1999-2000 harvests occurred greater than 16 miles from the Alpine field and 27 percent occurred 6 to 15 miles from the Alpine field. Oil and gas development could divert subsistence users a distance of 5 to more than 25 miles from facilities. Given current high gasoline costs on the North Slope (e.g., $3.25 per gallon for gasoline in Nuiqsut in November 2004), this additional travel would add considerable cost to subsistence harvests.

Nuiqsut, Barrow, and Atqasuk subsistence users harvest wolves and wolverines in the Planning Area. These species could be displaced by further exploration, development, and production in the area (Brower 1997). The final Preferred Alternative would have a greater effect on subsistence caribou harvests than the No Action Alternative because the areas of potential activity would be large, the duration of oil and gas activity in the area (approximately 40 years) would be longer, and the geographical extent of possible development (from the Colville River to the Ikpikpuk River engulfing Teshekpuk Lake) would be greater.

Waterfowl could be affected by activity in newly-opened areas during construction, development, and production. Helicopter traffic and persons walking on tundra or gravel pads would be the most likely sources of disturbance to nesting and molting waterfowl (USDOI BLM and MMS 2003). Increases in predator populations near developed areas could cause locally severe nesting failures (Burgess 2000, Johnson 2000b). However, these effects should be relatively minor, geographically widespread, and occur during the relatively brief period when these animals are present in the area. Some aspects of oil and gas development could create new habitat favorable to waterfowl survival, such as reclaimed gravel pits, dust fallout, and water impoundments near roads (Johnson 2000a, b; McKendrick 2000; Ritchie and King 2000; Sedinger and Stickney 2000). Reclaimed gravel pits complicate some subsistence harvests, however, by making it difficult to recover waterfowl from the deep lakes left behind. A possible indirect effect of development in the Teshekpuk Lake area would be the placement of restrictions on harvests of waterfowl on the North Slope, the Y-K Delta areas, and along the Pacific Flyway, in response to reduced waterfowl populations. These restrictions would reduce subsistence harvests (USDOI BLM and MMS 1998).

Subsistence fish harvests take place in all seasons, primarily in freshwater rivers and lakes. Nuiqsut's primary harvest area for fish is located in the northeast quarter of the Planning Area, in the Colville River and its delta channels and Fish and Judy creeks, where development is already in the planning stages. A loss or reduction in Nuiqsut's fish harvest would be a hardship for the community, as fish provide approximately one-third of all subsistence harvest by weight in the community (see Section 3.4.2, Appendix J, Tables J-5 and J-6). Barrow residents harvest fish during caribou harvest activities along the coast and in the Teshekpuk Lake and Chipp and Ikpikpuk river areas (see Map J-2), and they receive fish in trade from Nuiqsut residents. Atqasuk residents fish in several lakes near Teshekpuk Lake and in the Chipp and Ikpikpuk rivers (SRBA 2003b). Under the final Preferred Alternative, exploration and development activities could impact fish harvest patterns; however, the lease stipulations and ROPs should be effective in protecting fish numbers to ensure availability for subsistence harvests. More development in previously restricted areas may deflect subsistence users from harvest areas and impede access for subsistence users, however. Therefore, effects of the final Preferred Alternative on subsistence fishing could be greater than the No Action Alternative.

As noted for the No Action Alternative, oil and gas development could inhibit subsistence harvesters' use of traditional harvest areas, which could reduce harvest success; increase the cost, effort, and risk involved with subsistence harvest; increase the and wear and tear on equipment used for harvesting subsistence foods; devalue elders' knowledge of the traditional landscape; increase the importance of local knowledge of oil industry schedules and practices; and reduce the enjoyment of eating traditional foods, should harvests be reduced or perceptions of contamination of subsistence resources arise.

Effects of Abandonment and Rehabilitation

During the dismantlement and removal phase of abandonment and rehabilitation, subsistence resources and activities would be subject to impacts similar to those caused by construction activities, assuming gravel fill was removed. Following abandonment and closure activities, subsistence resources and activities would be subject to fewer impacts. If the roads were left in place and remained serviceable, they could continue to provide access to subsistence resources. However, if local residents came to utilize the oil field roads to access subsistence resources and depend on oil-reliant incomes to help support subsistence harvesting, loss of this income and dismantling of the roads could make it difficult for local residents to realize any improvement in subsistence harvests.

Effects of Spills

Subsistence Species

As discussed under the No Action Alternative, the magnitude of the effects of a crude oil spill on subsistence resources would depend on the context of the spill, the area covered by spilled product, and the amount of time the product was in the environment before clean-up efforts commenced. Oil spills on snow or frozen tundra would be typically contained and cleaned up relatively quickly, regardless of the area covered. It might be impossible to completely clean spills into waterways in open water or broken ice conditions (USDOI BLM 2003). As there would potentially be more oil and gas activity occurring over a larger area under the final Preferred Alternative than under the No Action Alternative, the likelihood that oil spills would affect subsistence species would be greater under the final Preferred Alternative.

Crude oil spills could affect caribou and waterfowl populations if the oil were on the ground and over a large area. This type of event has occurred at natural seeps located at Cape Simpson and Fish Creek (Ebbley and Joesting 1943). It is likely that only a very large spill on land would have population level effects on terrestrial mammals and waterfowl. In the case of a small or large spill that did not enter waterways, the effects would be localized, although contamination could last several years (USDOI BLM 2003). Tundra vegetation could also be contaminated by oil spills, which could harm mammals and waterfowl eating the oiled vegetation or using it for nesting or bedding. Under the final Preferred Alternative, pipelines would be allowed in the Goose Molting Area, thus increasing the risk of oil spills in an area that is important for molting geese and subsistence hunters.

If oil were to be spilled into waterways in large volumes, waterfowl, fish, and marine mammals could be fouled, contaminated, or killed. In the case of a large spill, the effects could spread beyond the immediate vicinity of the spill, depending on the season. For example, during ice breakup, sheet flow could carry oil over a vast area, which could include nearshore and offshore waters. Small and large spills would not necessarily be immediately toxic to fish, but could contaminate them for years even in cleaned habitats (USDOI BLM 2003). Waterfowl and marine mammal populations could be affected by the death of animals from hypothermia caused by oiling, reactions to toxic components of spilled oil, and gastric distress resulting from attempts to clean themselves. In addition, scavengers feeding on their remains, such as foxes, could also be harmed.

Subsistence Harvest Patterns

Large spills could affect subsistence patterns by reducing populations of subsistence species, contaminating subsistence species or their habitats, or rendering resources as unfit to eat. These effects could reduce the amount of subsistence foods harvested, cause changes in traditional diets, increase risks and wear and tear on equipment if users were required to travel farther to obtain subsistence resources, and cause social stress due to the reduction or loss of preferred foods harvested in the traditional fashion. Effects on subsistence harvest patterns would be greater under the final Preferred Alternative than under the No Action Alternative because oil and gas activity would likely occur over a larger area at a higher intensity, thus increasing the likelihood of an oil spill. In addition, the final Preferred Alternative allows for oil and gas development in the Teshekpuk Lake Special Area, an area important to caribou (e.g., before and after calving, for migration, and for insect relief), nesting and molting geese, and to subsistence hunters from Barrow, Nuiqsut, and Atqasuk.

4.6.12.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs are intended to protect subsistence resources to the same extent as the 1998 Northeast IAP/EIS ROD prescriptive lease stipulations under the No Action Alternative. Under the final Preferred Alternative, oil exploration and development would be allowed over a wider area and in more sensitive areas and habitats than under the No Action Alternative; however, ROPs (e.g., ROPs H-1 and H-2) intended to minimize conflicts between subsistence uses and oil and gas activities would be in place. During scoping, subsistence users stated that the proposed revision to the 1998 Northeast IAP is a breach of faith, that opening up more areas in the Planning Area would have severe negative effects on subsistence users from Barrow and Nuiqsut, and that the BLM was acting as an advocate for development rather than managing the land for multiple compatible uses (Ahmaogak 2003, NSB 2004).

Local municipal government and tribal governments generally have few paid staff and limited funding, and local government officials and tribal leaders feel they are overtaxed when asked to provide meaningful input to BLM on permitted activities. Institutional overload affects subsistence users by placing increased, non-compensated demands on their time, further reducing the time available to continue subsistence pursuits and most severely for those working year-round, full time jobs. These officials and leaders contend that the change from the prescriptive lease stipulations in the 1998 Northeast IAP/EIS ROD to performance-based ROPs and lease stipulations in the Northwest IAP/EIS (and as proposed in this amendment) would place them in the position of having to defend subsistence interests because compliance is now defined in terms of meeting a management objective rather than meeting an absolute prescriptive standard. To effectively respond, they would have to further stretch their existing capabilities to review and comment on increasingly numerous industry proposals and their impact on subsistence (NSB 2004).

The BLM holds that performance-based lease stipulations and ROPs would provide equivalent protection, while gaining flexibility for adaptive management. The flexibility of the new approach places greater reliance on on-going monitoring to insure that these procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues.

Effectiveness of Stipulations and Required Operating Procedures on Subsistence Species

Under the final Preferred Alternative, several ROPs and lease stipulations would address subsistence species. With the exception of Lease Stipulations K-4(h), K-9, K-10, and K-11, the ROPs and lease stipulations for the final Preferred Alternative would be the same as for alternatives B and C. Required Operating Procedure A-2 would be effective in seeking to avoid human-caused changes in predator populations (i.e., avoid attracting wildlife to food and garbage). Required Operating Procedures A-4 to A-7 would be effective in minimizing the impact of contaminants (spills) on wildlife and the environment and to protect subsistence resources. Required Operating Procedures B-1 and B-2 would be effective in maintaining populations, of and habitat for, fish and invertebrates.

Required Operating Procedure C-1 would be effective in protecting bear denning and birthing sites during overland moves. Required Operating Procedures C-2 to C-4 would be effective in protecting streams and prevent additional freeze down of deep-water pools harboring overwintering fish and invertebrates. Required Operating Procedure E-1 would be effective in protecting subsistence use and access to traditional subsistence fishing areas and minimize the effects of oil and gas development on fish resources. Required Operating Procedures and Lease Stipulations E-2, E-3, E-6, and E-8 would be effective in maintaining free passage of marine and anadromous fish and protecting fish habitat, as well as subsistence use and access to traditional subsistence fishing. Required Operating Procedure E-7 would be effective in minimizing disruption of caribou movement and subsistence use by elevating pipelines to a minimum of 7 feet as opposed to the 5-foot minimum in the 1998 Northeast IAP/EIS ROD. Required Operating Procedure E-9 would be effective in minimizing human caused increases in populations of species that prey on ground nesting birds. Required Operating Procedure E-10 would be effective in preventing migrating waterfowl from striking oil and gas facilities during low-light conditions. Required Operating Procedure E-11 would be effective in minimizing the take of species listed under the Endangered Species Act (e.g., spectacled and Steller's eiders) and minimizing disturbance to other species caused by interaction with oil and gas facilities.

Required Operating Procedure F-1 would be effective in minimizing the effects of low-flying aircraft on wildlife. Lease Stipulations K-1 and K-2 would be effective in minimizing the disruption of natural flow patterns; changes to water quality; changes to floodplain and riparian areas; and loss of fish spawning, rearing, or overwintering habitat through setbacks along rivers and around lakes. Lease Stipulations K-3, K-5, K-6, and K-7 would be effective in protecting fish and wildlife habitat and minimizing disturbance of caribou and alteration of migration patterns in the Teshekpuk Lake region and in coastal areas.

Lease stipulations proposed under the final Preferred Alternative would limit surface occupancy and disturbance while making 95 percent of the Northeast National Petroleum Reserve – Alaska available for leasing, exploration, and eventual production. Lease Stipulation K-4(h) would limit surface occupation in the Goose Molting Area north of Teshekpuk Lake to pipelines and allow winter seismic testing and exploratory drilling. Lease Stipulation K-9 would prohibit all surface occupancy in an area between the east shore of Teshekpuk Lake and the western extent of the Kogru River, including pipelines, but would allow winter seismic exploration and exploratory drilling. Lease Stipulation K-10 would set aside an area south and east of Teshekpuk Lake, and including the Kogru River, as a caribou calving, post-calving, and insect-relief area. No permanent facilities, except for pipelines, would be allowed in this area. Lease Stipulation K-11 would divide the area north of Teshekpuk Lake into seven large lease tracts. No more than 300 acres of surface disturbance would be allowed in each tract for permanent facilities, excluding pipelines. The limitations on surface area disturbance would be intended to reduce impacts to caribou and goose habitats. While these additional lease stipulations provide some protection for caribou and geese in areas opened for leasing under the final Preferred Alternative, subsistence resources could still be affected by oil and gas activities, as pipelines would be allowed in all but 16,000 acres of the area opened up for leasing.

Effectiveness of Stipulations and Required Operating Procedures on Subsistence Harvest Patterns

In general, the ROPs and lease stipulations seek to protect specific resources by establishing spatial buffer zones around facilities and infrastructure, scheduling disruptive activities for periods when there is the least potential for conflicts with other users, making efforts to include community residents in project planning, monitoring effects on subsistence resources, and making efforts to minimize the interference of oil and gas exploration and development activities and structures with subsistence resources and users. The effectiveness of these measures depends heavily on their ongoing implementation, enforcement, and local participation. With the exception of Lease Stipulations K-4(h), K-9, K-10, and K-11, the ROPs and lease stipulations for the final Preferred Alternative are the same as for alternatives B and C. Required Operating Procedure A-4 would be effective in minimizing the impact of contaminants (spills) on fish, wildlife, and the environment, and would protect subsistence activities and resources. Required Operating Procedure E-1 would be effective in protecting subsistence use and access to traditional subsistence hunting and fishing areas. Lease Stipulation E-3 would be effective in maintaining free passage of marine and anadromous fish and protect subsistence use and access to traditional subsistence hunting and fishing. Required Operating Procedure E-7 would be effective in minimizing the disruption of caribou movement and subsistence use by requiring that pipelines and roads be designed to allow the free movement of caribou and the safe and unimpeded passage of subsistence hunters. Ground pipelines would be elevated a minimum of 7 feet to facilitate wildlife passage and subsistence passage. Access, ramps would be placed, after consultation with appropriate federal, state, and NSB regulatory and resource management agencies, in areas where facilities or terrain funnel caribou movement. Pipelines and roads would be separated by 500 feet, where possible.

Required Operating Procedure F-1 would be effective in minimizing the effects of low-flying aircraft on wildlife, traditional subsistence activities, and local communities. This ROP is designed to minimize aircraft disturbance of caribou and bird populations and sensitive habitat areas, especially near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting). Required Operating Procedures H-1 and H-2 are subsistence-specific mitigation procedures designed to provide opportunities for participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas activities, including seismic exploration. Required Operating Procedure H-2 would define potentially affected cabins or campsites and would provide for additional consultation requirements for geophysical exploration beyond those required in ROP H-1. Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers to minimize cultural and resource conflicts with local inhabitants. Of special concern is aircraft use near traditional subsistence cabins and campsites during spring goose and fall caribou and moose hunting.

Lease Stipulations K-1 and K-2 would be effective in minimizing impacts to subsistence cabins and campsites and disruptions to subsistence activities by prohibiting permanent oil and gas facilities (e.g., gravel pads, roads and airstrips, and pipelines) through setbacks along/around the Colville, Ikpikpuk, Miguakiak, Kikiakrorak and Kogosukruk rivers, Fish and Judy creeks, and the Deep Water Lakes areas. Lease Stipulation K-3 would be effective in protecting subsistence resources and access to the Teshekpuk Lake area by ensuring that there would not be unreasonable conflicts with traditional subsistence uses and access or impacts to seasonally concentrated fish and wildlife resources. Lease Stipulation K-6 would be effective in minimizing impacts to subsistence activities in coastal areas through a setback of ¾ of a mile from the coastline, to the extent practicable, as well as the use of previously occupied sites (e.g., Camp Lonely, various Husky/USGS drill sites and DEW-Line sites).

The final Preferred Alternative has added lease stipulations regarding development in the Teshekpuk Lake Special Area as compared to alternatives B and C. Lease Stipulation K-4(h) allows for exploration in the Goose Molting Area, but allows for no permanent facilities, except for pipelines. This lease stipulation would limit impacts to sensitive geese during molting, nesting, and fledging periods. Pipelines affect the migration, grazing, insect-relief, and calving habitat use of caribou. Other animals, such as caribou, muskox, wolves, wolverines, moose, polar and brown bears, and Arctic and red fox, could be disturbed air traffic associated with monitoring pipelines and resupplying facilities, and pipeline-related habitat changes (McKendrick 2000). If wildlife were deflected or disturbed, subsistence harvest patterns could be affected as hunters would be required to travel further to harvest resources.

Lease Stipulation K-9 would close a 16,000 acres between Teshekpuk Lake and the Kogru River to all surface occupancy, but would allow for winter exploration activities. This area is an important passageway for caribou migration, as well as for calving, post-calving and insect relief. Winter exploration activities such as seismic testing and exploratory drilling could disturb overwintering caribou, fish, wolves, wolverines, and denned brown bears. Caribou diverted from this area could be subject to increased harvest pressure if they escape oil exploration activity by walking towards Barrow, Nuiqsut, or Atqasuk. This lease stipulation would protect caribou calving, post-calving and insect-relief habitats, but could alter the distribution of caribou and make it more difficult for subsistence users to hunt caribou.

Lease Stipulation K-10 would designate 141,000 acres southeast of Teshekpuk Lake, and including the Kogru River, as No Surface Occupancy for permanent facilities, but would allow for pipelines and for winter exploratory activities. This lease stipulation would reduce direct impacts to a key caribou calving, post-calving, and insect-relief area. Allowing pipelines through this area could divert or disturb caribou during critical calving and post-calving periods. Air traffic associated with pipeline monitoring could potentially disturb calving and post-calving caribou in the spring and summer and could disturb overwintering caribou. This lease stipulation would also reduce potential conflicts with subsistence users by limiting the amount of surface occupancy by permanent oil and gas facilities. By allowing pipelines in this area, however, use of the area by subsistence resource users could be impeded.

Lease Stipulation K-11 would divide the area north of Teshekpuk Lake into seven lease tracts. No more than 300 acres could be disturbed within each lease tract for permanent oil and gas facilities, excluding pipelines. Permanent oil and gas facilities and pipelines in this area could affect waterfowl, caribou, wolves and wolverines. Winter exploration, development and production activity in this area could divert or disturb overwintering caribou, wolves, wolverines, denned brown bears, and overwintering fish. Summer activity could divert or disturb waterfowl, caribou, fish, wolves, wolverines, brown bears, seals and walrus. Subsistence users from Barrow, Nuiqsut, and Atqasuk use the area for subsistence harvests in all seasons and may not use area if oil and gas development and production occurred in the area.

4.6.12.4 Conclusion

Most impacts to subsistence species associated with oil and gas development would be localized and would not substantially affect subsistence species numbers, as long as the activities occurred outside of key habitat areas or migratory zones when animals were present. In addition, the ROPs and lease stipulations discussed above, could be effective in protecting subsistence species and may help to resolve conflicts between the oil and gas industry and local residents. Even in the best case scenario of species protection and consultation, however, subsistence users could be constrained by oil and gas facilities from harvesting subsistence resources, would question the health of those resources, and would tend to harvest resources at least 5 miles from areas of development. Should oil and gas exploration and development activities divert resources from their accustomed routes and places, greater effort would be required on the part of subsistence users to locate, access, and harvest sufficient quantities of these resources. This could increase their costs in terms of fuel, time, equipment wear, and health.

As expressed in public scoping testimony, local residents are fearful for the future of subsistence hunting on the North Slope, their ability to carry on with traditional customs and ways in their preferred locations without interference, and their ability to be able to pass along these traditions to their children. Under the final Preferred Alternative, these fears could be realized if oil and gas development occurs in the Teshekpuk Lake Special Area, and subsistence resources are impacted by these activities.

4.6.13 Sociocultural Systems

4.6.13.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, the effects of non-oil and gas activities on sociocultural patterns would be greater than under the No Action Alternative. There would be a greater amount of scientific research and data collection undertaken prior to lease sales and as part of federal land management responsibilities. These research efforts and associated aircraft use could cause temporary and localized diversion or deflection of subsistence species. It is not expected that the amount of recreational and solid and hazardous waste removal and remediation would be greater under the final Preferred Alternative, but more overland moves could be required to support scientific and other activities in the areas newly available for leasing. Several families from Atqasuk, Barrow, and Nuiqsut use cabins, camps, caches, and other sites along the coast and inland to Teshekpuk Lake for subsistence activities. The area is also an important route for residents who travel by snowmachine between Barrow, Atqasuk, and Nuiqsut for social, subsistence, and employment reasons. Continued use of this area helps maintain family connections and a feeling of relatedness and stability, which could be impeded or reduced by increased activity if these areas are opened to oil and gas development. In general, effects from non-oil and gas activities under the final Preferred Alternative would be temporary and localized, and would be unlikely to affect overall sociocultural patterns.

4.6.13.2 Oil and Gas Exploration and Development Activities

Oil and gas exploration, development, and production would require a seasonal network of ice roads, permanent gravel roads, runways, and pads, a year-round corridor for pipelines and powerlines, and permanent gravel pads and production facilities.

Effects of Disturbances

The types of effects on sociocultural patterns from disturbances caused by oil and gas activities under the final Preferred Alternative would be the same as under the No Action Alternative, but would be greater in intensity and duration. Increases in the amount of area available for leasing and exploration would have a corresponding increase in effects to subsistence harvests as compared to those for the No Action Alternative. The development proposed for the Planning Area would require increased staging and overland travel during the winter, and in summer would require increased use of aircraft for supplies, equipment, and crew changes, as compared to the No Action Alternative. In all seasons, noise, lights, personnel, and traffic near oil and gas infrastructure could temporarily deflect or divert caribou in areas where activities are occurring; however, gravel pads could provide caribou with insect-relief habitat. These effects could change the distribution, timing, and location of the caribou harvest, which could require increased effort and expenditure on the part of subsistence hunters, resulting in sociocultural consequences, such as increased stress and a decreased sense of well-being. Oil and gas development could divert subsistence users from facilities at distances from 5 to more than 25 miles. Given the high gasoline costs on the North Slope (e.g. $3.25/gallon in Nuiqsut, November 2004), this would add additional cost to subsistence harvests. Increased fuel costs and wear and tear on hunters and their equipment would increase the need for wage labor to support subsistence pursuits and reduce the time available to pursue subsistence activities, which would result in sociocultural consequences, such as increased stress and a decreased sense of well-being. Increases in the speed, range, and reliability of outboards and snowmachines have facilitated the mixed subsistence and wage economy, but could not compensate for impacts to subsistence harvest activities from continued development and production activities in important subsistence harvest areas as proposed under the final Preferred Alternative.

As discussed under the No Action Alternative, long-term change to sociocultural patterns would result from a weakening of stabilizing traditional institutions through prolonged stress and disruptive effects that could be exacerbated by activities occurring under this alternative. These changes are already occurring to some degree on the North Slope because of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and increasing penetration of television and the Internet. North Slope Borough institutions, such as the school district that promotes the teaching of Iñupiat language and culture, the Alaska Eskimo Whaling Commission that negotiates with industry to protect Iñupiat subsistence whaling interests, the NSB Department of Wildlife Management, and other regional and village Native corporations and organizations, have been working vigorously and successfully to prevent the weakening of traditional Iñupiat cultural institutions and practices. Increased social interactions between oil-industry workers and Nuiqsut residents could occur over the long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to immediately disrupt sociocultural systems or displace existing institutions, but could do so if large population changes occurred in response to development and the communities were overrun with new residents (USDOI BLM and MMS 1998, 2003).

Effects of Abandonment and Rehabilitation

Abandonment and rehabilitation activities would restore habitat for caribou and other subsistence species and subsistence resources would be subject to fewer impacts, potentially improving subsistence opportunities. Abandonment and rehabilitation activities would likely provide jobs for local residents for several years. However, after oil and fields were reclaimed and abandoned, jobs associated with them would cease. At present, very few long-time Nuiqsut residents have jobs in the oil fields; people instead move to Nuiqsut if they get employment at the oil fields (CRA 2002). If local residents were to become substantially integrated into oil field operations and the local communities were to become dependent on revenues associated with their operation, the community would face a period of sharp adjustment as fields were abandoned. The NSB is currently undergoing a period of contraction in services and funding as oil field revenues decline, and has had to cut police presence and privatize services in some rural communities (NSB 2000, Anchorage Daily News 2004).

Effects of Oil Spills

The effects of oil spills would be the same as those discussed in the No Action Alternative. Under the final Preferred Alternative there would be a greater likelihood that a spill event could occur with the potential to damage unique critical habitats and subsistence use areas. Effects would vary in severity depending upon the timing and location of the spill event, but fish, waterfowl, and marine and terrestrial mammals could all be affected. An oil spill could result in contamination of subsistence resources and would be a threat to the health and lifestyle of the affected communities. If a large oil spill occurred in a traditional use area, then subsistence users would have to travel further to harvest uncontaminated resources, which would result in high effects to sociocultural patterns for a much longer time than the period that subsistence resources would be measurably contaminated. An oil spill that reached coastal waters could affect the harvest of marine mammals, including bowhead whale harvests, which are at the center of Iñupiat sociocultural organization.

Activities associated with cleanup of an oil spill could have an effect on sociocultural systems. In the event that a large spill contacted and extensively oiled habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. These events would supply short-term employment for local residents, at the expense of long-term subsistence resource availability and long-term employment. Because it is expected that oil spills from activities would be small, chronic events and would normally be contained on the drill pad, effects from the spills themselves and potential disruptions from clean-up activities would be unlikely to cause excessive disturbance to sociocultural systems or the surrounding environment. A large oil spill, however, would be catastrophic to the sociocultural structure of the whaling peoples of the North Slope if it were to occur in a riverine, nearshore, or marine environment.

4.6.13.3 Effectiveness of Stipulations and Required Operating Procedures

The performance-based lease stipulations and ROPs proposed under the final Preferred Alternative would provide equivalent or greater setbacks from rivers and lakes than under the No Action Alternative, but would allow drilling within larger lakes and permanent facilities and pipelines in the Teshekpuk Lake Special Area. Exploration, including seismic testing and exploratory drilling, would be allowed in the Teshekpuk Lake Special Area. Lease Stipulation K-11 would divide the area north of Teshekpuk Lake into seven lease tracts. No more than 300 acres of permanent oil and gas facilities, excluding pipelines, would be allowed within each tract.

Required Operating Procedure I-1 would require the lessee to provide a cultural orientation program for all oil and gas personnel involved in Planning Area activities in order to effectively minimize cultural and resource conflicts with local inhabitants. This orientation program, as it relates to subsistence pursuits and cultural concerns, would: 1) provide sufficient detail to notify personnel of applicable lease stipulations and ROPs, as well as inform them about specific types of environmental, social, traditional, and cultural concerns that relate to the region; (2) address the importance of not disturbing archaeological and biological resources and habitats, and provide guidance on how to avoid disturbance; 3) be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas where personnel would be operating; 4) include information about avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation; and 5) include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low flying aircraft (e.g., aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall moose hunting seasons, and flights near North Slope communities).

4.6.13.4 Conclusion

Under the final Preferred Alternative, areas of importance to subsistence users, including areas surrounding subsistence camps, critical habitat for subsistence species, and large concentrations of historic and prehistoric cultural resources, could be impacted by oil and gas activities and could increase anxiety in Nuiqsut, Barrow, and Atqasuk. If oil and gas development occurs near the north shore of Teshekpuk Lake, and is connected by roads and pipelines to the Alpine field, an important subsistence use area used by residents of Nuiqsut, Barrow, and Atqasuk could be avoided by subsistence users. Bowhead whales would be deflected and their behavior made more dangerous to hunters if marine traffic increases in the Point Lonely area (NSB 2004). Development in the area north of Teshekpuk Lake could impact anadromous and amphidromous fish numbers, habitat, migration patterns, and quality as subsistence foods. Increased air and ground traffic could take place at the Alpine field and at a proposed staging area south of Nuiqsut, and could divert caribou and other subsistence species away from Nuiqsut. Increased traffic and activity could also make subsistence harvesting more difficult for residents who do not own or have access to motorized transportation or depend on walking, trucks, and OHVs to travel to harvest areas. Traffic that occurred north and south of Nuiqsut could isolate the community from subsistence resource harvest areas and could prevent residents from using their homelands, subsistence cabins and camps, and unspoiled open areas for resource harvests and pursuits. This would further degrade the quality of life and connection of people with their land and environment.

Under the final Preferred Alternative, economic impacts on the communities should be positive at the Borough level, but may not benefit local communities if the jobs and revenue generated in the communities do not offset the effects of loss of subsistence harvests and land use. Circumpolar Research Associates reported that long-time Nuiqsut residents did not get jobs in the oil field, rather, people were hired from other communities and moved to Nuiqsut after getting the jobs (CRA 2002). Sarah Kunaknana, a Nuiqsut elder, and others in the communities have noted a growing divide in the communities that originates in the uneven distribution of benefits and costs from oil and gas exploration and development (NSB 2004). Nuiqsut residents have been impacted by industrial activity near the community, but do not feel that they have received a proportional amount of impact funds or other compensation.

While federal trust responsibilities would remain unchanged under all alternatives, residents stated during scoping that the proposed lease stipulations and ROPs would be more permissive to lessees, would not sufficiently protect subsistence use areas or resources, and would diminish what local residents consider to be the BLM's trust responsibilities in supporting and maintaining subsistence uses in the Planning Area. In their view, the BLM would be shifting the responsibilities for enforcing the lease stipulations and ROPs to other local, state, and federal agencies (Ahmaogak 2003, Napageak 2003, NSB 2004). Under the final Preferred Alternative, areas specifically protected under the 1998 Northeast IAP/EIS ROD would be made available for oil and gas leasing and development. The possibility that important subsistence use areas would be developed, and thus placed off-limits to other land users, has caused increased anxiety for residents of Nuiqsut, Barrow, and Atqasuk. Residents noted during scoping for this amendment that the existing lease stipulations had not been in effect long enough to be adequately tested, and that the provisions of the 1998 Northeast IAP/EIS ROD have not prevented ConocoPhillips from applying for, and the BLM from considering, development in the Fish Creek Setback as part of the Alpine Satellite Development Plan.

Commentors on this amendment stated that the granting of exceptions to the lease stipulations and ROPs was a factor undermining the credibility of the proposed Amended IAP/EIS. The consultation period leading to the 1998 Northeast IAP/EIS ROD, while long by BLM standards, was noted by local residents as being a "rushed" 18 month program with no power on the part of the communities to reject or veto any particular course of action (NSB 2004). Local residents felt that instead of being consulted, they were being "informed" by the BLM, which did not build confidence on the part of the communities, and reinforced their feelings of being powerless to oppose changes being imposed by outside agencies and industry (NSB 2004). As a result, some residents regard any effort to

participate in consultation or other management processes as futile. This can create a feedback loop of decreased participation, decreased interest in cooperation with agencies, and increased conflict between agencies, lessees, and local resident groups as evidenced in scoping transcripts for 30 years of hearings held on the North Slope.
The BLM considers “informing” another of one’s intentions does not mean that the opportunity for further communication is not possible or precluded. This general definition of consultation does mean that, at a minimum, “informing” interested parties of the proposed action must occur, and if deemed necessary, will initiate further consultation. If informed parties have no issues and do not wish to participate in further discussions, that is there choice and “consultation” may be complete. The BLM perspective on the effectiveness of mitigation measures also differs from that of village residents. The BLM believes that the proposed performance-based approach to protecting the environment using lease stipulations and ROPs provides the agency greater flexibility to achieve the necessary protections to mitigate the potential impacts from oil and gas development in areas proposed to be opened to oil and gas activities under the action alternatives. The prescriptive approach adopted in the 1998 Northeast IAP/EIS ROD gained legitimacy and credibility through the extended consultation leading to the final decision. The new approach proposed for the final Preferred Alternative is not well known or understood, and some local residents doubt that the new approach would provide equivalent protection. The flexibility of the new approach places greater reliance on on-going monitoring to insure that modified procedures do in fact achieve equivalent protections. The BLM is committed to directing the necessary resources to this on-going monitoring requirement, including support for the continuing work of the Subsistence Advisory Panel to provide oversight, exchange information, and develop solutions for any emerging issues. Based on input from the local communities during public hearings on the Draft Amended IAP/EIS, the BLM developed Lease Stipulations K-8 through K-11 for the final Preferred Alternative to address community subsistence concerns.

4.6.14 Environmental Justice

4.6.14.1 Activities Not Associated With Oil and Gas Exploration and Development

The non-oil and gas activities likely to occur in the Planning Area would primarily be transitory in nature, of short duration, and highly localized. They could temporarily divert, deflect, or disturb subsistence species from their normal patterns. Non-oil and gas activities could alter the availability of subsistence species in traditional harvest areas, which could affect harvest patterns by requiring hunters to travel further in pursuit of resources. Increased travel distances would result in greater expenditures for fuel and equipment, and increased wear and tear on snowmachines, outboards, and four-wheel vehicles. Consequently, there could be an effect on the subsistence hunting activities of the local minority population as a result of non-oil and gas activities. Under the final Preferred Alternative, these effects could be slightly greater than under the No Action Alternative, but would still be minor, temporary, short term, and generally highly localized.

4.6.14.2 Oil and Gas Exploration and Development Activities

Effects of Disturbance

Under the final Preferred Alternative, disturbances caused by oil and gas activities would be the same as those discussed under the No Action Alternative, but their effects on subsistence would be increased in magnitude, extent, and duration. Areas that would be unavailable for year-round occupation and development under the No Action Alternative would be available for lease and year-round surface occupation under the final Preferred Alternative, and could be affected by oil and gas development. Development activity could last at least 30 years, following 8 to 12 years of permitting, planning, and oil deposit testing and delineation. This time frame would likely represent the duration of effects for species unable to habituate to the oil and gas development activities.

The final Preferred Alternative could have long-term effects on several terrestrial mammal species. In particular, effects on caribou herds would likely be slightly greater than under the No Action Alternative (Section 4.3.9; Mammals). It is expected that effects on waterfowl harvested for subsistence would more frequent and more widespread than under the No Action Alternative, given the greater area available for petroleum leasing. Little or no effect on marine mammals would be expected from onshore activities under the final Preferred Alternative, but noise and disturbance associated with offshore barge and vessel traffic could impact bowhead whale migration patterns. There are concerns that, depending on the particular activity and, especially, the location of the activity, actions occurring under the final Preferred Alternative, as under the No Action Alternative and alternatives B and C, could cause local effects on fish populations. All of these effects would be experienced primarily by the subsistence dependent minority Iñupiat population.

Effects of Abandonment and Rehabilitation

Activities associated with dismantling and removing of production pads and facilities could disproportionately impact Nuiqsut residents through disturbance, displacement, and mortality of subsistence resources, through subsistence users' avoidance of areas undergoing dismantlement and removal, and through potential impacts to water, air quality, and noise. Once abandonment and rehabilitation were completed, Nuiqsut residents would be disproportionately impacted by the reduction in local and Native corporation revenues and by fewer local jobs and business opportunities. Local residents could benefit from a reduction in impacts on subsistence resources, compared to during construction and operation.

Effects of Oil Spills

As discussed elsewhere, the magnitude of effects of a crude oil spill on subsistence resources would depend on the context of the spill, the volume and area covered by spilled product, and the amount of time the product was released before clean-up efforts commenced. Tundra oil spills could affect small numbers of terrestrial mammals and waterfowl unable to avoid the spill area, but would be unlikely to have population level effects. Oil spills (any size) directly into a water body, particularly in difficult to contain conditions such as breakup or broken ice, could spread widely and have effects on fish and waterfowl. In the nearshore environment, a large to very large spill, particularly during broken ice or storm conditions, could affect marine mammals including seals, and beluga and bowhead whales.

The Iñupiat people consider contamination from oil spills in nearshore waters to be a catastrophic possibility that would threaten their very existence, primarily because of the potential effects of spills on bowhead whales, which are a very important part of their culture in addition to being a favored food source (Brower 1976, Itta 2001). Potential effects on subsistence harvest patterns would be greater under the final Preferred Alternative than under the No Action Alternative because oil and gas activity would potentially occur over a larger area in the Planning Area than under the No Action Alternative, and there would thus be a greater potential for oil spills. Potential effects on harvest patterns would be less under the final Preferred Alternative than under Alternative C and slightly less than under Alternative B because of the smaller disturbance area for oil and gas activity. A major oil spill on the North Slope would result in effects that would impact Iñupiat subsistence users more than any other human group.

4.6.14.3 Effectiveness of Stipulations and Required Operating Procedures

The lease stipulations and ROPs for the final Preferred Alternative would protect subsistence resources to the same extent as the lease stipulations under the No Action Alternative. Required Operating Procedures H-1 and H-2 would be highly effective in reducing conflicts between subsistence uses and oil and gas activities. Lease Stipulations K-4(h), K-9, K-10 and K-11, which are specific to the final Preferred Alternative, would indirectly support subsistence use, and users, by abetting the caribou and waterfowl population successes.

4.6.14.4 Conclusion

Several lease sales have already taken place in the Planning Area. Exploration programs, consisting of seismic testing and drilling using ice pads, are ongoing. Residents of Barrow, Nuiqsut, and Atqasuk have noted some effects from these activities on subsistence (SRBA 2003a, b). One effect included the redistribution of caribou, wolves, and wolverines in response to seismic activity and cat trains operating in the National Petroleum Reserve - Alaska (SRBA 2003a, b). These effects would continue under the final Preferred Alternative, and would be somewhat greater than under the No Action Alternative. Most effects of disturbance would still be short term, but the extent and magnitude would likely increase. Effects from oil spills would depend greatly on the size, location, and season of the spill. Small spills on gravel pads would have little or no environmental justice effects. A major spill into a watercourse, on the other hand, could have long term serious effects on Iñupiat subsistence activities. While any major spill would have serious consequences, the worst, from an environmental justice standpoint, would be one that occurred in a key harvest area or near a community, particularly Nuiqsut or areas used by Barrow residents in the northwest portion of the Planning Area.

4.6.15 Coastal Zone Management

4.6.15.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, non-oil and gas activities would be subject to all applicable lease stipulations and ROPs, as well as any other federal, state, or NSB regulations pertaining to the activities in question. These activities would be subject to permitting, and would include the activities noted in Section 4.2.1.1 (Activities Not Associated with Oil and Gas Exploration and Development) and evaluated for the No Action Alternative in Section 4.3.15.1 (Coastal Zone Management). As non-oil and gas activities are normal occurrences under existing BLM management practices, they would, in most cases, be of limited duration and magnitude, and effects on neighboring uses, primarily subsistence resources and harvest patterns of nearby communities, would be limited to the immediate area of the activity. Coastal Zone Management regulations would be adhered to.

4.6.15.2 4.6.15.2 Oil and Gas Exploration and Development Activities

As described in Section 4.3.15 (Coastal Zone Management) of this document, Section 307(c)(3)(B) of the CZMA requires applicants to certify that each of their activities that affects any land use or water use in the coastal zone complies with, and would be implemented consistent with, the state's coastal program. In the following discussion, ACMP standards for uses and activities are used to evaluate activities and effects that would occur under the final Preferred Alternative. Policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. If additional lease sales were to occur, the projected exploration and development activities in this amendment could be changed as the lessees explored, developed, and produced petroleum products from leases offered for sale, which could affect the accuracy of this assessment.

Effects of Exploration and Development on the Alaska Coastal Management Program

Coastal Development (11 AAC 112.200)

Water dependency is a prime criterion for development along the shoreline. The intent of this policy is to ensure that onshore developments and activities that could be placed inland would not displace activities that depend on shoreline locations, which include marine shores, lakeshores, and river waterfronts. Under the final Preferred Alternative, almost the entire Beaufort Sea coast within the Planning Area would be open to leasing, although Lease Stipulation K-11 would limit permanent surface disturbance to not more than 300 acres in each of seven coastal large lease tracts and Lease Stipulation K-4(h) would specify No Surface Occupancy in much of the area between Teshekpuk Lake and the Beaufort Sea coast. Lease Stipulation K-6 would be highly effective in discouraging permanent oil and gas facilities within ¾ mile of the coast, and other ROPs and lease stipulations would address sensitive issues areas along parts of the coast and near deep-water lakes and major creeks and rivers.

Other lease stipulations and ROPs in place under the final Preferred Alternative would further reduce the potential for conflicts with this policy around lakes and rivers. Specifically, ROPs and lease stipulations related to waste-prevention, handling, and disposal and spills; ice roads and water use; facility design and construction; abandonment; protections for subsistence and traditional use sites; and other activities restrictions would be effective in reducing conflicts, making the final Preferred Alternative consistent with the statewide standard.

Natural Hazard Areas (11 AAC 112.210)

This statewide standard permits coastal districts and state agencies to identify and designate areas in which natural hazards are known to exist that may present a threat to life or property. Development in these areas would be prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life were provided.

Flooding, earthquakes, active faults, tsunamis, landslides, volcanoes, storm surges, ice formations, snow avalanches, erosion, and beach processes in the Planning Area should be considered. Onshore development would be sited in areas of permafrost. Development in these areas would be required to maintain the natural permafrost insulation quality of existing soils and vegetation (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). The final Preferred Alternative would be required to comply with the statewide standard.

Coastal Access (11 AAC 112.220)

Districts and state agencies shall ensure that projects maintain and, where appropriate, increase public access to, from, and along coastal water. It is expected that the final Preferred Alternative would be consistent with this standard, although the larger leasing area along the Beaufort Coast could lead to some conflicts with access opportunities, as compared to the No Action Alternative.

Energy Facilities (11 AAC 112.230)

The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent practicable, on 16 criteria within the energy facilities standard. Lease stipulations and ROPs in place under the final Preferred Alternative would be effective in reducing conflicts, making the alternative consistent with the statewide standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained (11 AAC 112.230 (a) [3] and [14]). Under the final Preferred Alternative, ROPs and lease stipulations would be effective in protecting biologically sensitive areas, although leasing would be permitted in coastal areas that would be off limits under the No Action Alternative. The NSB CMP also requires that transportation facilities and utilities be consolidated to the maximum extent possible (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under the final Preferred Alternative would also be required to comply with siting standards that apply to all types of development, which are discussed below under Habitats; Air, Land, and Water Quality; and Historic, Prehistoric, and Archeological Resources.

Utility Routes and Facilities (11 AAC 112.240) and Transportation Routes and Facilities (11 AAC 112.280)

These statewide standards require that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. Utility routes and facilities along the coast must avoid, minimize, or mitigate alterations in drainage patterns, disruption in wildlife transit, and blockage of existing or traditional access.

The NSB CMP contains several additional policies related to transportation and utilities that would be relevant to this analysis; all but one are best-effort policies and are subject to some flexibility. Transportation development, including pipelines, which significantly obstructs wildlife migration, is subject to three conditions (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Interference with caribou movements would be temporary and brief under the final Preferred Alternative, and would be specifically limited by Lease Stipulations K-9 and K-10; caribou migrations and overall distribution should not be greatly affected. Lease stipulations and ROPs in place under the final Preferred Alternative would be effective in reducing conflicts, making the alternative consistent with the statewide standard.

Transportation facilities would 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), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires consolidation of transportation facilities and utilities. Lease stipulations and ROPs required under the final Preferred Alternative would be highly effective in reducing conflicts, making this alternative consistent with the statewide standard.

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 water features associated with transportation and utilities be minimized, and that periods critical for fish migration be avoided. Lease Stipulation K-6, in particular, would be effective in ensuring compliance with this standard.

Sand and Gravel Extraction (11 AAC 112.260)

The ACMP statewide standards indicate sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits if no practicable noncoastal alternative is available to meet the public need. Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Substantially more gravel could be required under the final Preferred Alternative than under the No Action Alternative, but ROPs and lease stipulations would place restrictions on gravel mining locations and thus effectively reduce conflicts to ensure compliance with this standard and the NSB policies. The final Preferred Alternative would require somewhat less gravel than Alternative B and substantially less than Alternative C.

Subsistence (11 AAC 112.270)

The statewide standard for subsistence indicates a project within a designated subsistence use area must avoid or minimize impacts to subsistence uses of coastal resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under the final Preferred Alternative, most of the Beaufort Sea coast would be open to leasing, albeit limited by constraints by ROPs and lease stipulations. As a consequence, access to subsistence resources could be more limited than under the No Action Alternative. Disturbances and oil spills associated with oil and gas activities would have short-term and localized impacts on the TLH caribou and other terrestrial mammals, fish, birds, and bowhead whales and other marine mammals. The impacts would result in more difficult and somewhat reduced success at subsistence harvests for Barrow, Atqasuk, and Nuiqsut hunters. Subsistence-hunter concerns about access to resources, resource disturbance, and resource contamination would be greater than for the No Action Alternative, but less than for alternatives B and C. Lease stipulations would offer protection to subsistence resources and activities. Surface, air, and foot traffic near the oil fields would be expected to increase more than under the No Action Alternative and would potentially displace larger numbers of caribou, moose, muskox, grizzly bears, wolves, and wolverines, but again to a lesser degree than under alternatives B and C. Roads and pipelines would be constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects on caribou, potential conflict with the subsistence policies would be greater under the final Preferred Alternative than under the No Action Alternative, although the final Preferred Alternative would likely still comply with the statewide standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and is then subject to the conditions of best-effort policies. Conflict with these standards and policies would be somewhat greater under the final Preferred Alternative than under the No Action Alternative.

Several important NSB CMP policies relate to effects on subsistence resources. The NSB CMP Policy 2.4.3(a) (NSBMC 19.70.050.A) relates to extensive impacts to a subsistence resource that are likely and cannot be avoided or mitigated. In such an instance, development must not deplete subsistence resources below the subsistence needs of local residents of the NSB. Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses development that would likely result in substantially decreased productivity of subsistence resources or their ecosystems. Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities.

The development scenario under the final Preferred Alternative predicts that there would be an onshore pipeline for oil delivery to the TAPS and that a pipeline spill could potentially contaminate the Colville River. A spill entering the Colville River potentially could affect the subsistence harvest by reducing fish populations, disrupting subsistence-fishing activity, and curtailing the subsistence hunt by tainting resources or causing subsistence users to perceive them as tainted. However, the number and size of oil spills estimated for the final Preferred Alternative would still be small. It is anticipated that the potential for effects from spills and associated clean-up activities would be greater under the final Preferred Alternative than under the No Action Alternative, but less than under alternatives B or C. The impact on subsistence resources and harvest patterns would remain minor.

Conflict with policies to protect subsistence resources would be possible during the exploration, development, and production phases. Under the final Preferred Alternative, ROPs and lease stipulations designed to protect subsistence resources, and to establish procedures and advisory bodies to address subsistence concerns, would be effective in minimizing policy conflicts. Therefore, the final Preferred Alternative should be consistent with the statewide standard.

Habitats (11 AAC 112.300)

The statewide standard for habitats contains an overall standard policy, plus policies specific to nine habitat areas: offshore areas; estuaries; wetlands; tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes (including associated floodplains and riparian management areas); and important upland habitat. The NSB CMP contains a district policy that reiterates the applicability of the statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under the final Preferred Alternative, fewer sensitive habitat areas would be excluded from leasing than under the No Action Alternative. However, applicable ROPs and lease stipulations, including four that are specific to this alternative, would provide effective protection for fish, birds, and terrestrial mammals, and their habitats (see Lease Stipulations K-4(h), K-9, K-10 and K-11. Therefore, conflicts with the ACMP standards would be minimized to the degree possible, making activities under the final Preferred Alternative consistent with the statewide standard.

The ACMP statewide standard for habitats in the coastal zone requires that habitats be managed to avoid, minimize, or mitigate significant adverse impacts to habitat resources. This policy is supported by an NSB CMP policy requiring that development be located, designed, and maintained in a manner that prevents or minimizes 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 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 ROPs and lease stipulations placed on permits. The final Preferred Alternative ROPs and lease stipulations would be effective in reducing potential conflicts, and the activities would be consistent with the statewide standard.

Oil and gas development activities could affect several of the habitats identified in the statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Therefore, onshore-development activities would need to be designed and constructed to avoid, minimize, or mitigate significant adverse effects.

It is expected that caribou of the CAH and TLH would be disturbed and their movements delayed along the pipeline during periods of aircraft overflights, but that disturbances would not affect migrations or overall distribution. It is expected that surface, air, and foot traffic near the oil fields would be greater under the final Preferred Alternative than under the No Action Alternative and could displace some large mammals, though not enough to substantially affect North Slope populations. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes that roads and pipelines must provide for unimpeded wildlife crossing and provides a set of guidelines and an intent statement specifically to implement the policy.

Rivers, lakes, and streams are managed to avoid, minimize, or mitigate significant adverse impacts to natural water flow, active floodplains, and natural vegetation within riparian management areas. Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that would ensure the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in Section 11 AAC 112.260. The ROPs and lease stipulations in place under the final Preferred Alternative would be effective in reducing conflicts, and would be consistent with the statewide standard.

Air, Land, and Water Quality (11 AAC 112.310)

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. North Slope Borough policies (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11) address water quality issues, and development must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). Under the final Preferred Alternative, there could be some short-term conflict with these policies due to potential oil spills, which would likely to be more frequent under the final Preferred Alternative than under the No Action Alternative, although less frequent than under alternatives B or C. However, the ROPs and lease stipulations in place under the final Preferred Alternative would be effective in reducing conflicts, and the alternative would be consistent with the statewide standards.

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 these emissions comply with all state and federal regulations, which is consistent with the statewide standard.

Discharges of drilling muds, cuttings, and fluids are regulated closely. Formation water produced from the wells along with the oil is regulated by the USEPA. The Alaska Oil and Gas Conservation Commission has primacy for this program. Some wastes are disposed through the annulus of producing wells, an activity that is exempt from the Underground Injection Control program. However, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges of drilling muds, cuttings, and drilling fluids are closely regulated, no conflict is anticipated with the statewide standard or NSB CMP Policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that industrial and commercial development be served by solid waste disposal facilities that meet state and federal regulations. There would be no inherent conflict between the proposed activities of the final Preferred Alternative and the ACMP water-quality provisions.

Air quality also must conform to federal and state standards (11 AAC 112.310, 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 the final Preferred Alternative in Section 4.6.1 (Air Quality) indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

Historic, Prehistoric, and Archeological Resources (11 AAC 112.320)

The ACMP 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, including natural processes.

The NSB 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) also requires that development not disturb newly discovered historic or cultural sites prior to archaeological investigation. It is likely that new cultural and paleontological sites would be discovered under the final Preferred Alternative. No conflicts with these policies would be expected; however, ROPs and lease stipulations would be highly effective by requiring an inventory of traditional use sites prior to conducting any activities. Therefore, the final Preferred Alternative would be consistent with the statewide standard.

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 use sites. No conflict with these policies would be expected.

Effects of Abandonment and Rehabilitation

Land ownership would not be affected by abandonment and rehabilitation. Upon completion of abandonment and rehabilitation, land uses and management could return to something similar to the current situation.

Effects of Spills

Because of the interrelated nature of the ACMP and NSB CMP policies, the potential effects of spills were addressed with the effects of disturbances under each major policy area above.

4.6.15.3 Effectiveness of Stipulations and Required Operating Procedures

Lease stipulations and ROPs referred to under each of the Coastal Zone Policy standards discussed above should be sufficient for the final Preferred Alternative to achieve compliance with ACMP and NSB CMP policies and standards. While it is expected that there could be land use and CZMP conflicts over the life of the alternative development scenario, any such conflicts should be short term and subject to resolution. Conflicts, should they occur, would most likely result from oil and gas development activities interrupting subsistence activities, but the scale of development and enforcement of applicable lease stipulations and ROPs should be effective in minimizing the conflicts and quickly returning the development to compliance with policies and standards.

4.6.15.4 Conclusion

It is expected that disturbance and oil spills associated with oil and gas activities would cause short-term and localized impacts to the TLH caribou and other terrestrial fish, birds, mammals, and bowhead whales and other marine mammals. In general, impacts to subsistence and other coastal zone resources from non-oil and gas activities, and from exploration and development activities, would be additive, except where these activities occurred in areas previously disturbed during exploration or development.

These impacts would likely be greater under the final Preferred Alternative than under the No Action Alternative, as would subsistence-hunter concerns about access to resources and resource contamination. The greater degree of impacts would result from opening additional area to leasing in caribou, waterfowl, and fishing areas, and because the expected level of development would be greater. The impacts would be less under the final Preferred Alternative than under alternatives B or C, however. Conflicts with ACMP and NSB CMP policies related to effects on subsistence resources resulting from periodic disturbance and oil spills would be possible, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Implementation of ROPs and lease stipulations would effectively ensure that the final Preferred Alternative would comply with coastal management policies and standards of the ACMP and NSB CMP. Combined oversight by the BLM, the ADNR, and the NSB, under the guidance of their respective standards, should be sufficient to deal with any potential conflict that could arise between the final Preferred Alternative and the policies addressed in this section.

4.6.16 Recreational Resources

4.6.16.1 Activities Not Associated With Oil and Gas Exploration and Development

Under the final Preferred Alternative, impacts to recreation resources from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves would be very similar to recreation effects from the No Action Alternative that were addressed in Section 4.3.16.1 (Recreational Resources). The level of activities would likely increase as a result of higher levels of oil and gas exploration and development activities.

Temporary structures, vehicles, noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term effects on the experience of solitude, naturalness, or primitive/unconfined recreation. As under the No Action Alternative, the short-term impacts from the final Preferred Alternative would be confined primarily to the activity site viewshed or noiseshed within approximately ½ mile in any direction of the activity (500 acres). All of the identified non-oil and gas activities would be transitory and short term; the likelihood of recreationists encountering them in any given location in the 4.6 million acre Planning Area would be small. If such activities were encountered, the recreation experience and opportunity for solitude on the North Slope would be diminished. Depending on the activity, there may be some increased likelihood of an encounter with recreationists because of the propensity to concentrate on major rivers and coastal areas.

A longer-lasting impact would be green trails resulting from overland moves. These trails do not necessarily develop over the entire route of an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They are typically more difficult to recognize from the ground. Vegetation can also be damaged along these trails from broken stems or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails. Because overland moves would be relatively constant from year to year and generally follow the same route(s), several thousand miles of intermittent green trail in some phase of recovery would likely be visible from the air during any one summer season. Though still relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would reduce the sense of naturalness and unconfined primitiveness to a small degree.

4.6.16.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the final Preferred Alternative, seismic work would occur throughout most of the Planning Area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Mobile seismic camps would consist of a train of trailer sleds pulled by tractors. These moving camps and associated noise and activities would result in a short-term effect on the primitive setting of the Planning Area and a loss of solitude and naturalness. The effects would be confined primarily to the activity site viewshed or noiseshed, or within approximately ½ mile in any direction. As many as five seismic operations could take place in a season, temporarily affecting approximately

2,500 acres. The potential effect on recreation opportunities and experience would be minimized by the fact that very little recreation takes place in the area.

Similar to non-oil and gas activities, a longer-lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, however, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route; they would be visible for about 2 to 5 years. Assuming two to five operations per season for the first 10 years of the lease, the number of miles of intermittent green trails during any summer season could peak at several hundred to thousands of miles. The number of miles of trail visible would decline as this phase of exploration slows. Although relatively short term in nature, the linear nature of these trails would emphasize the presence of man, which would slightly reduce the sense of naturalness and unconfined primitiveness.

A total of 10 to 83 (60) exploration and delineation wells are anticipated under the final Preferred Alternative, and from one to four (two) wells would be drilled annually. Drilling would primarily occur over several winter seasons using ice pads, roads, and airstrips, although summer drilling could occur within lakes in the Teshekpuk Lake Caribou Habitat Area, but not within Teshekpuk Lake. Temporary on-site location of structures (e.g., drill rigs), noise from generators, vehicles, and aircraft, human presence, and associated activity all would have short-term impacts on solitude, naturalness, and primitive/unconfined recreation experiences. These impacts would be expected to be greatest within a 2-mile radius of the drill site, which is an area of approximately 8,000 acres per well site. Accordingly, under the final Preferred Alternative, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 8,000 to 32,000 (16,000) acres. This would be equivalent to about 0.2 to 0.7 percent of the Planning Area and the potential effect on recreation opportunities and experience would be further minimized by the fact that most drilling occurs during winter when very little recreation takes place in the area.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating 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 would be 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 noticeable from the air for 2 to 5 years and somewhat less noticeable from the ground. Another impact at these sites would be vegetation actually being damaged or broken, especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, and that half of the sites are vacated, approximately 250 to 2,075 (1,500) acres would be in various states of recovery.

Exploration wells also would leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 feet tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet away.

Effects of Development

Two to 13 (10) production pads, 110 to 190 (180) miles of pipeline, and zero to two (one) staging bases are anticipated under the final Preferred Alternative. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have impacts on the experience of solitude, naturalness, and primitive/unconfined recreation opportunity during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term impacts are expected to be greatest within 2 miles of a pad or staging area site (or an area of about 8,000 acres).

Pipelines also would impact recreation values. Pipelines would be elevated a minimum of 7 feet above the ground surface. There would be little if any pipeline associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines would be expected to be minimal beyond about ½ mile. This equates to about 640 acres per mile of pipeline. Impacts to recreation values from a staging base would be similar to those resulting from a production pad and its facilities, or about 8,000 acres impacted per staging base. Accordingly under this alternative, there would be a long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunity over an area of 203,200 acres (i.e., [8,000 acres/pad x 10 pads] + [8,000 acres/staging base] + [640 acres/mile x 180 miles of pipeline]). This would be equivalent to about 4.4 percent of the Planning Area. Short-term, routine/daily inspection flights also would impact solitude and naturalness along the length of all pipelines as long as they are in use. The potential effect on recreation opportunities and experience would be greatest for development activities because it would entail year-round activity and would thus continue during the summer when most recreational activity in the Planning Area occurs. Nevertheless, the effects would be expected to be minor because they would impact only a small portion of the Planning Area, and because there is such a small amount of recreation use in the area. The actual effects would depend greatly on where development fields were located relative to major watercourses and the Beaufort Sea coast. The area subject to recreation effects from development under the final Preferred Alternative would be approximately 1.8 times the affected area under the No Action Alternative.

Future potential for formal wilderness or wild and scenic-river designation would likely be reduced in limited areas near oil and gas development facilities, but most of the Planning Area would not be affected.

Effects of Abandonment and Rehabilitation

While abandonment and rehabilitation activities occurred, small number of recreational users in the area of rehabilitation could have their wilderness experience diminished by noise, marred views, and disturbance to animals which they have come to observe (bird-watchers) or harvest (hunters).

Effects of Spills

Most spills 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, effects on solitude, naturalness, or primitive and unconfined recreation opportunities resulting from spills likely would be confined to the same area described above as impacted by the development.

A large spill that could reach a river, especially the Colville River, and move rapidly downstream would have substantial short-term (and possibly long-term) impacts on recreation values. Under the final Preferred Alternative, outstandingly remarkable river values along the Colville River would not receive any special protection under the Wild and Scenic Rivers Act, although buffer areas are included in applicable ROPs and lease stipulations for other reasons. As such, management activity near the Colville River (and other major watercourses) would be substantially limited with possible exceptions for subsistence structures or essential pipeline crossings. These management standards should minimize any major impacts to recreation values in this scenic and important recreation area.

Effects to Wilderness and Wild and Scenic River Values

None of the identified non-oil and gas activities would diminish requisite characteristics sufficiently to preclude wilderness or wild and scenic river designations in the future.

Potential wilderness values of naturalness and outstanding opportunities for solitude and primitive, unconfined recreation experiences would be affected by long-term development of petroleum resources on as much as 5 percent of the Planning Area under the final Preferred Alternative, about 2 times the area that would be similarly affected by the No Action Alternative. In addition, there could be portions of the area that were explored unsuccessfully that would experience lesser residual effects that would reduce wilderness values. Despite the lost values, nearly 4.4 million acres (95 percent) of the Planning Area would likely retain substantial wilderness values. For perspective, the Wilderness Act specifies a minimum of 5,000 acres to qualify for wilderness consideration in most cases.

The "outstandingly remarkable values" that support Wild and Scenic River eligibility for the Colville River include recreation, wildlife viewing, geology and archeology upstream from Umiat, and paleontology and wildlife from Umiat to Nuiqsut. Only a small portion of the Colville River would experience effects to these values from activities associated with the final Preferred Alternative, primarily from an expected pipeline crossing of the river in an as yet undetermined location. Specified buffer areas would provide substantial protection for the river, except in the area very near the pipeline crossing. Although pipeline crossings are discouraged in designated Wild and Scenic River areas, they are permissible, when unavoidable, if measures to minimize effects on the river's outstandingly remarkable values are utilized.

Wild and Scenic River designation is not planned or proposed for the Colville River, as noted in Section 3.4.6.3, but the applicable lease stipulations and ROPs would preserve most, if not all, of the character and values that could qualify the river for designation in the future, if local and state political sentiments should ever determine designation to be favorable. A potential pipeline would not disrupt the requisite "free flowing" nature of the river and, to the degree possible, it would be sited to avoid the areas specific to the "outstandingly remarkable values" noted above. Selection of a river crossing location for the pipeline would require a permit from the BLM, which would afford an opportunity for more detailed review of effects on the Wild and Scenic River eligibility of the Colville River.

Wild and Scenic River effects would not be a concern for the Ikpikkpuk River because it was determined to be ineligible for designation (see Section 3.4.6.3).

4.6.16.3 Effectiveness of Stipulations and Required Operating Procedures

Although the lease stipulations and ROPs do not specifically address recreation activities and there is no current intention to consider designation of wilderness or wild and scenic rivers in the Planning Area, many of the performance-based lease stipulations and ROPs required for development of the final Preferred Alternative would serve to protect recreation values in the area. For example, areas excluded from leasing and several ROPs and lease stipulations address protection of subsistence values and wildlife in the Planning Area. Also, buffer requirements serve to minimize potentially damaging activity in and near creeks, rivers and lakes. Since wildlife viewing, big game hunting and boating are major factors attracting recreationists to the Planning Area, these lease stipulations and ROPs associated with the final Preferred Alternative also serve to protect and preserve recreation values.

4.6.16.4 Conclusion

There would be approximately 2,000 to 3,000 acres in temporary effects on recreation values from activities other than oil and gas exploration and development. Short-term, temporary effects from ongoing oil and gas exploration activities would impact approximately 8,000 to 32,000 (16,000) acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 1,500 acres. Seismic operations would result in many hundreds to thousands of miles of green trails. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities would not accumulate.

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation opportunities over an area of approximately 203,200 acres (or 4.4 percent of the Planning Area) for the life of production fields and pipelines. The area subject to recreation effects would be approximately 1.8 times the level of effects for the No Action Alternative. Lease stipulations to mitigate for recreation impacts would be similar for both the final Preferred Alternative and the No Action Alternative. In general, impacts from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped.

4.6.17 Visual Resources

4.6.17.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the final Preferred Alternative, impacts to visual resources would result from on-the-ground management activities, such as archaeological collection efforts, field camps, survey work, overland movements, and hazardous and solid material removal and remediation activities.

Temporary structures (e.g., sleds, tents), vehicles (e.g., Rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impacts on visual resources or scenic quality by creating a contrast to the line, color, and texture of a primarily horizontal natural landscape. The colors of structures and equipment would contrast the white color of the snow-covered landscape and the various hues of greens and browns, and the smooth texture of the facilities would contrast the varied textures of the windswept terrain and the irregular texture of vegetation. Non-oil and gas activities would need to occur within the Foreground-Middleground Zone of the viewshed in order to attract the attention of the casual observer.

A longer-lasting impact would be the green trails resulting from winter overland moves. Between 20 and 60 trains comprised of one to six vehicles and attached sleds could engage in overland travel each year. Green trails form when vehicles compact snow and dead vegetative material, resulting in a greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails would not necessarily develop over the entire route of the overland move. Vegetation could be damaged along these trails and the tops of tussocks could be scraped off, although current operating procedures would ensure that such damage was an infrequent problem. Green trails would be visible for about 2 to 5 years. However, because they visually modify existing vegetation, rather than introducing something foreign into the viewshed, green trails would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

4.6.17.2 Oil and Gas Exploration and Development Activities

Effects of Exploration

Under the final Preferred Alternative, the impacts from exploration would generally be the same as those under alternative B and C, except that fewer exploration and delineation wells would likely be drilled. The area of long-term disturbance associated with the new wells would result from a 10-acre footprint per well. Drill rigs (average height of 208 feet) would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also produce a strong visual contrast to the white background of the snow covered landscape. Drill rigs, because of their height, could be seen and attract the attention of the casual observer if they were located within the Foreground-Middleground Zone.

In addition to the impacts that would result from ongoing exploratory drilling operations, the greening of vegetation under vacated ice pads, ice airstrips, and ice roads would cause impacts to visual resources during the summer. This greening of vegetation would be caused by the same conditions that create green trails—a greater availability of moisture and nutrients as ice or compacted snow melts. However, greening of vegetation would not necessarily occur wherever ice pads were constructed or snow was compacted. There would also be a “ring effect” around ice pads, ice airstrips, and ice roads caused by the death of vegetation adjacent to these snow and ice structures. Approximately 50 acres of ice pads, airstrips, and roads per drill site would be in various states of recovery from greening and ring effects under the final Preferred Alternative. Because greening and ring effects visually modify the existing vegetation, they would not produce much contrast to line, form, or texture. The color contrast would be minimal from ground view because of the natural variation in hue, and would be almost nonexistent from more that a few hundred feet away.

Exploration wells would also leave behind a marker pipe, which would likely be 6 feet tall and no larger than a square foot on the surface. This marker would essentially be a permanent impact, but would be almost unnoticeable from a distance of several hundred feet.

Effects of Development

Production rigs would introduce strong vertical lines into a predominantly horizontal landscape. Because they are painted red, most drill rigs would also introduce strong contrast to the natural browns landforms and greens of the vegetation. In addition, burn-off flares and general work lighting would contrast against the dark night sky. Drill rigs, because of their height and color, could be seen and dominate the attention of the casual observer if they were located within the Foreground-Middleground Zone.

Long-term surface disturbance would result from staging bases, pads, roads, airstrips, gravel pits, and CPFs. Pad sites generally contain one-story buildings and pipelines. The tan gravel pads would generally be only 3 to 5 feet above the surrounding green tundra, and would be relatively unnoticeable beyond a few thousand feet. Facilities would introduce strong vertical lines from buildings into the landscape of predominately soft horizontal lines. There would also be a visual contrast between the simple, regular form of the buildings and the complex, irregular forms of the vegetation. Colors of buildings and materials would be in contrast with the greens, browns, and blues of vegetation and water bodies. Some of the buildings could be up to three stories in height above the tundra, and would attract and dominate the view of the casual observer if located within the Foreground-Middleground Zone.

There would be no on-the-ground activity associated with pipelines, except during construction and repair. Pipelines would introduce shiny and smooth horizontal lines into the naturally irregular brown and green landscape. They would also introduce regularly spaced vertical supports into an irregular horizontal landscape. Pipelines would be elevated at least 7 feet above the surrounding tundra, but could be elevated as high as 20 feet above ground level. At these elevations, pipelines would attract and dominate the attention of the casual observer if located within the Foreground-Middleground Zone.

Other facilities associated with development would include gravel mine sites, bridges, roads, airstrips, and communications towers. Disturbance associated with gravel mine sites would generally occur below the ground surface, with only stockpiled materials being visible aboveground. While these sites could be large in size or footprint, very little material would remain as stockpile at any one time. If located within the Foreground-Middleground Zone, only bridges, because of their contrast with smooth water bodies, and communications towers, because of vertical height above the horizon, would be likely to attract the attention of a casual observer.

Effects of Abandonment and Rehabilitation

During abandonment and rehabilitation activities, vehicle traffic on roads would create short-term noticeable visual impacts through the creation of fugitive dust. Once closure activities are completed, the strong contrasts with the surrounding vegetation colors created by structures, such as pipelines and buildings, would be eliminated.

Effects of Spills

Most spills (65 to 80 percent) would be confined to a pad. Spills not confined to a pad would usually be confined to the limited area immediately around the pad or pipeline. Thus, there would be no new visual impacts associated with the spill.

4.6.17.3 Effectiveness of Stipulations and Required Operating Procedures

Although there are no ROPs or lease stipulations specific to visual resources, ROPs and lease stipulations designed to minimize impacts to solid and hazardous wastes; regulate overland moves, seismic work, and exploratory drilling; and regulate facility design, construction, and siting would reduce the visual impacts that would occur under the final Preferred Alternative.

4.6.17.4 Conclusion

Under the final Preferred Alternative, visual impacts would be greater than those under the No Action Alternative, because there would be more overall exploration and development. Several thousand miles of seismic lines and several thousand acres associated with exploratory drilling could be in various states of recovery from greening and ring effect. Additional disturbance would be associated with drilling sites each winter. There could also be disturbance associated with staging bases, pads, roads, airstrips, gravel pits, and CPFs. In general, impacts to visual resources from non-oil and gas activities, and from oil and gas activities, would likely be additive, except in those areas where the two types of activities overlapped. However, once exploration and development/production ceased in an area, visual resources could recover, reducing overall effects in the Planning Area. In areas where two or more activities occurred, overall impacts would reflect those impacts associated with the first activity and any new impacts associated with later activities. Because of the larger disturbance area and the potential for more oil and gas exploration and development activities, impacts to visual resources under this alternative would be significantly greater for oil and gas exploration activities, and significantly greater for oil development activities, as compared to the No Action Alternative.

4.6.18 Economy

4.6.18.1 Activities Not Associated with Oil and Gas Exploration and Development

Under the final Preferred Alternative, there would be recreational employment that would generate approximately 30, 1-week long float trips per year. This is equivalent to one person working for 8 months.

4.6.18.2 Oil and Gas Exploration and Development Activities

It is expected that the projected oil and gas exploration, development, and production activities under the final Preferred Alternative would generate additional employment and government revenues for more than 20 years.

State and NSB property tax revenues would be directly proportional to the value of onshore oil and gas infrastructure and facilities. Royalty income and severance tax revenues that accrue to the State of Alaska would be proportional to production. The level of employment would be determined by the scale of the infrastructure rather than the amount of oil and gas produced. A wide range of production would be handled by a given level of infrastructure. Therefore, once the infrastructure has been developed, the number of workers needed to operate a facility during the production phase would be independent of the amount of product flowing through the pipeline.

As in the other alternatives, the scenarios for the final Preferred Alternative were developed based on the assumption that oil prices would range between $20 and $30 per bbl (in constant dollars), with a more likely long-term average of $25 per bbl. The effects of the final Preferred Alternative on employment and revenues are presented for each oil price scenario. At $25 per bbl, peak annual oil production is projected to be 54 million barrels (Table 4-23). Based on the latest information from the Alaska Department of Revenue, the Arctic North Slope West Coast price of oil averaged $25.64 per barrel from March 1999 to March 2004. The Department's revenue forecast assumes that, over the long-term, oil prices will average $22 per barrel, which is the lower end of the price range (of $22 to $28 per barrel) by which OPEC determines its production quota policies (ADR 2004a). In early October 2004, the price of oil was near $50 per bbl.

Effects on Revenues

Under the final Preferred Alternative, projected oil and gas activities are estimated to generate government revenues of about $108 million in property taxes, $521 million in royalties, and $442 million in severance payments. Tables 4-22, 4-23, and 4-24 show the estimated annual and total tax revenues and royalties that could accrue to the North Slope Borough, the State of Alaska, and the federal government at $20, $25, and $30 per bbl, respectively. These estimates should be considered with the understanding that various uncertainties affect the factors that determine actual revenues.

The State of Alaska depends heavily upon oil royalties and taxes to fund its operating budget. Petroleum revenues account for about 80 percent of the State's general fund unrestricted revenues, and 35 percent or more of all state revenues (ADR 2003b). Revenues resulting from the final Preferred Alternative could improve the State's fiscal conditions.

Royalty tax payments associated with the National Petroleum Reserve - Alaska are treated differently than those from other state or federal lands. Federal law establishes a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska. The estimated royalty and severance payments shown in Tables 4-22, 4-23, and 4-24 are based on currently available information on the tax structure for the National Petroleum Reserve - Alaska[3]. The model incorporates the projected production schedule for oil, and the assumed wellhead values under the final Preferred Alternative.

Table 4-22. Estimated Property Taxes, Royalties, and Severance Taxes for the final Preferred Alternative at $20 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$2.31	$0.19	$3.02	$3.02	$6.03	$9.05
2	$6.48	$0.53	$8.45	$8.45	$16.90	$25.34
3	$8.79	$0.71	$11.47	$11.47	$22.93	$34.39
4	$8.79	$0.71	$11.47	$11.47	$22.93	$34.39
5	$8.79	$0.71	$11.47	$11.47	$22.93	$34.39
6	$8.79	$0.71	$11.47	$11.47	$22.93	$41.27
7	$7.86	$0.64	$10.26	$10.26	$20.52	$36.92
8	$6.94	$0.56	$9.05	$9.05	$18.10	$32.58
9	$6.01	$0.49	$7.84	$7.84	$15.69	$28.24
10	$5.55	$0.45	$7.24	$7.24	$14.48	$26.06
11	$4.63	$0.38	$6.03	$6.03	$12.07	$21.72
12	$4.16	$0.34	$5.43	$5.43	$10.86	$19.55
13	$3.70	$0.30	$4.83	$4.83	$9.66	$17.38
14	$3.24	$0.26	$4.22	$4.22	$8.45	$15.20
15	$3.24	$0.26	$4.22	$4.22	$8.45	$15.20
16	$2.78	$0.23	$3.62	$3.62	$7.24	$13.03
17	$2.31	$0.19	$3.02	$3.02	$6.03	$10.86
18	$2.31	$0.19	$3.02	$3.02	$6.03	$10.86
19	$1.85	$0.15	$2.41	$2.41	$4.83	$8.69
20	$1.39	$0.11	$1.81	$1.81	$3.62	$6.52
Total	$99.90	$8.10	$130.35	$130.35	$260.69	$441.64

3 Federal royalty rate is 16.67 percent; oil severance tax rate is 12.5 percent for the first 5 years and 15 percent for later years

Table 4-23. Estimated Property Taxes, Royalties, and Severance Taxes for the final Preferred Alternative at $25 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$4.63	$0.38	$8.12	$8.12	$16.24	$24.35
2	$6.48	$0.53	$11.37	$11.37	$22.73	$34.09
3	$8.33	$0.68	$14.61	$14.61	$29.23	$43.83
4	$22.92	$1.86	$31.22	$31.22	$62.45	$91.48
5	$25.56	$2.07	$34.87	$34.87	$69.74	$102.18
6	$28.28	$2.29	$38.56	$38.56	$77.12	$133.43
7	$36.38	$2.95	$49.58	$49.58	$99.16	$171.57
8	$36.38	$2.95	$49.58	$49.58	$99.16	$171.57
9	$36.38	$2.95	$49.58	$49.58	$99.16	$171.57
10	$36.38	$2.95	$49.58	$49.58	$99.16	$171.57
11	$31.65	$2.57	$43.15	$43.15	$86.30	$149.31
12	$28.92	$2.35	$39.46	$39.46	$78.92	$136.56
13	$22.92	$1.86	$31.22	$31.22	$62.45	$108.04
14	$18.19	$1.47	$24.79	$24.79	$49.58	$85.78
15	$14.82	$1.20	$20.20	$20.20	$40.40	$69.90
16	$12.10	$0.98	$16.51	$16.51	$33.02	$57.15
17	$8.09	$0.66	$11.02	$11.02	$22.05	$38.14
18	$6.73	$0.55	$9.18	$9.18	$18.36	$31.76
19	$5.37	$0.44	$7.33	$7.33	$14.67	$25.39
20	$2.73	$0.22	$3.69	$3.69	$7.38	$12.75
21	$2.00	$0.16	$2.74	$2.74	$5.49	$9.51
22	$1.39	$0.11	$2.44	$2.44	$4.87	$8.77
Total	$396.60	$32.16	$548.82	$548.82	$1,097.63	$1,848.70

The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough, and is subject to local property tax limitations. The 2002 property tax rate for the NSB was 18.5 mills (ADCED, 2003), leaving the state portion of the property tax at 1.5 mills. The NSB faces a declining property tax base because of depreciation of petroleum-production facilities that comprise most of the assessed valuation. Additional infrastructure associated with the final Preferred Alternative (the final Preferred Alternative) is anticipated to increase assessed property valuation and result in additional property taxes.

An estimate of the potential property tax revenues that would be generated under the final Preferred Alternative can be calculated using a unit factor estimate of $0.50 per barrel (ADR 2003b). The estimated property taxes using the per barrel unit factor for $20, $25, and $30 per bbl of oil are shown in Tables 4-22, 4-23, and 4-24.

Effects on Employment

The final Preferred Alternative would generate direct, indirect, and induced employment in the North Slope and other parts of Alaska. The gains in direct employment would include jobs in petroleum exploration, development, and production. Indirect employment would be generated in the oil and gas support sectors, including air transportation, trucking services, catering services, security services, information technology, consulting services and other support sectors. Induced employed would be generated primarily in retail sectors, personal services sectors, and other household consumption sectors.

Tables 4-25, 4-26, and 4-27 show the employment effects by place of residence at $20, $25, and $30 per bbl of oil, respectively. Employment is expressed as annual average jobs by place of residence for each phase of activity. The employment effects were estimated using a model developed by Northern Economics. The employment model incorporates estimated expenditures for exploration, development, and production activities anticipated under the final Preferred Alternative at various oil price scenarios. Employment multipliers are used to calculate the indirect and induced employment. The multipliers were based on an input-output model of the state economy.

Table 4-24. Estimated Property Taxes, Royalties, and Severance Taxes for the final Preferred Alternative at $30 per Barrel.

Year	Total Property Taxes ($million)		Total Royalties ($million)			Total Severance ($million)
	NSB	Alaska	NSB	Alaska	Federal	Alaska
1	$5.09	$0.41	$11.22	$11.22	$22.44	$33.66
2	$6.94	$0.56	$15.30	$15.30	$30.61	$45.90
3	$15.54	$1.26	$34.28	$34.28	$68.56	$102.82
4	$20.78	$1.68	$42.73	$42.73	$85.45	$127.00
5	$28.13	$2.28	$57.75	$57.75	$115.49	$171.61
6	$38.27	$3.10	$74.61	$74.61	$149.21	$261.27
7	$42.49	$3.45	$82.24	$82.24	$164.48	$287.50
8	$47.02	$3.81	$88.15	$88.15	$176.29	$305.75
9	$49.27	$3.99	$89.41	$89.41	$178.82	$307.56
10	$47.63	$3.86	$83.75	$83.75	$167.49	$285.67
11	$43.90	$3.56	$74.69	$74.69	$149.39	$252.47
12	$39.91	$3.24	$66.24	$66.24	$132.49	$222.33
13	$35.30	$2.86	$57.98	$57.98	$115.96	$194.00
14	$30.60	$2.48	$50.26	$50.26	$100.51	$168.14
15	$26.55	$2.15	$43.59	$43.59	$87.18	$145.84
16	$23.00	$1.86	$37.79	$37.79	$75.59	$126.48
17	$19.99	$1.62	$32.84	$32.84	$65.68	$109.87
18	$17.40	$1.41	$28.56	$28.56	$57.12	$95.54
19	$15.01	$1.22	$24.74	$24.74	$49.48	$82.84
20	$12.98	$1.05	$21.46	$21.46	$42.92	$71.92
21	$11.31	$0.92	$18.60	$18.60	$37.19	$62.24
22	$6.98	$0.57	$9.90	$9.90	$19.80	$31.56
23	$6.19	$0.50	$8.75	$8.75	$17.50	$27.86
24	$5.20	$0.42	$7.40	$7.40	$14.81	$23.64
25	$1.23	$0.10	$1.03	$1.03	$2.07	$2.48
26	$1.23	$0.10	$1.03	$1.03	$2.07	$2.48
27	$1.05	$0.09	$0.89	$0.89	$1.77	$2.12
Total	$598.98	$48.57	$1,065.18	$1,065.18	$2,130.36	$3,550.57

Table 4-25. Effects on Employment (Expressed as Annual Average Jobs) for the final Preferred Alternative at $20 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	2	3	5
Development phase	46	32	78
Production phase	5	4	9
Rest of Alaska			
Exploration/delineation phase	23	70	94
Development phase	479	631	1,109
Production phase	174	222	396
Total Statewide Effects			
Total exploration/delineation	25	73	98
Total development	525	662	1,187
Total production	179	226	405

Table 4-26. Effects on Employment (Expressed as Annual Average Jobs) for the final Preferred Alternative at $25 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	10	17	28
Development phase	151	103	254
Production phase	18	15	33
Rest of Alaska			
Exploration/delineation phase	137	414	552
Development phase	1,560	2,055	3,615
Production phase	665	846	1,512
Total Statewide Effects			
Total exploration/delineation	148	432	579
Total development	1,711	2,158	3,868
Total production	683	861	1,544

Table 4-27. Effects on Employment (Expressed as Annual Average Jobs) for the final Preferred Alternative at $30 per Barrel.

Phase of Activity	Direct Workers	Indirect and Induced Workers	Total
North Slope Borough			
Exploration/delineation phase	14	24	38
Development phase	242	165	407
Production phase	28	24	52
Rest of Alaska			
Exploration/delineation phase	191	577	768
Development phase	2,502	3,296	5,798
Production phase	1,050	1,336	2,386
Total Statewide Effects			
Total exploration/delineation	206	601	806
Total development	2,744	3,461	6,205
Total production	1,078	1,360	2,438

Employment effects presented in Tables 4-25, 4-26, and 4-27 represent the number of potential direct, indirect, and induced jobs that could be held by NSB residents and workers from the rest of Alaska (the numbers do not include out-of-state workers). The regional breakdown of employment by place of residence was based on the Northwest IAP/EIS.

During the last decade, between 22 and 29 percent of Alaska's oil industry workers have been nonresidents of Alaska (Fried and Windisch-Cole 2003). These workers, who commute to residences outside the state, do not generate any significant induced employment in the local economy in the North Slope, and the relative economic impacts of non-resident employment on the economy of the rest of the U.S. is negligible.

Due to the development of facilities or the continued use of facilities taxable by the NSB, the NSB would receive additional revenues, which would most likely be used for ongoing infrastructure construction and operational expenses that could support additional NSB-government jobs.

4.6.18.3 Effectiveness of Stipulations and Required Operating Procedures

No lease stipulations or ROPs were developed to address economic concerns.

4.6.18.4 Conclusion

The combined average annual property taxes to the NSB and State of Alaska could range between $5.4 million and $24 million depending on the price of oil and the resulting infrastructure development. This would represent a 2-fold to 5-fold increase in annual property taxes estimated to be generated under the No Action Alternative.

The estimated annual royalty and severance payments under the final Preferred Alternative would be higher compared to the No Action Alternative. Annual royalty payments are estimated to range from $13 million to $79 million for the federal government, $6.5 million and $39.4 million for the NSB, and $6.5 million and $39.4 million for the state government. Moreover, annual severance taxes estimated to be generated under the final Preferred Alternative would range from $22 million to $131 million.

It is anticipated that under the final Preferred Alternative, annual NSB resident employment would increase in the range of 78 to 407 jobs during the peak of development and 9 to 52 jobs during production. During development, this would be about a four to nine-fold gain over employment levels under the No Action Alternative. During production, NSB employment is higher than the No Action Alternative only if the price of oil is higher than $25 per bbl. The annual employment of Alaska residents (excluding residents of the NSB) would increase in the range of 1,109 to 5,798 jobs in the peak of development, and 396 to 2,386 jobs during production.

The proximity of Nuiqsut to the area of interest (northeast NPRA) enhances the community's opportunities to benefit from development and production activities associated with the final Preferred Alternative. These opportunities could extend to community businesses that might provide goods and services, as well as residents who might obtain work as a result of the development and production activities.