Chapter Five: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

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Until discoveries are made, the Division of Oil and Gas (DO&G) cannot predict when any oil and gas activity might occur or the type, location, duration, or level of activity. Therefore, it is impossible to predict the potential effects of all possible activities. General mitigation measures and lessee advisories have been developed to minimize pollution and habitat degradation and disturbance to fish and wildlife species, subsistence users, and local residents. In addition, project-specific and site-specific mitigation measures will be applied to exploration and development proposals when they are submitted. Despite these protective measures, impacts may occur. This section discusses the potential impacts and briefly summarizes the measures to mitigate these impacts. See Chapter Seven for complete mitigation measures and lessee advisories. Chapter Six also provides a discussion of the effects related to geophysical hazards and likely methods of transportation.

Strategies used to explore for, develop, produce, and transport petroleum resources will vary depending on factors unique to the individual area, lessee, operator, or discovery. If a commercially viable deposit is found, development will require construction of one or more drill sites. If commercial quantities of oil and gas are located, construction of pipelines would be likely, and other production and transportation facilities would be necessary. New roads may be required, and machinery, labor, and housing would be transported to project sites.

The state of Alaska as a whole, the North Slope Borough, and especially local communities may experience the effects of oil and gas development activities. The potential effects of exploration, development, and production are listed in Table 5.1. All leasing activities are subject to applicable local, state, and federal statutes, regulations, and ordinances, along with the mitigation measures presented in Chapter Seven.

Table 5.1: Potential Effects of Oil and Gas Exploration, Development, and Production

Erosion	Water quality changes
Use conflicts	Chemical/pollutant releases
Disturbance to wildlife	Impacts to human environment
Oil spills	Air quality degradation
Alteration of hydrology	Siltation
Loss of fish and wildlife	Employment opportunities
Increased noise and traffic	Road, dock, airstrip, sanitary facilities, and utilities construction
Habitat loss or change	State petroleum tax and royalty revenues
Environmental studies	Local oil and gas property tax revenues

A. Post Leasing Phases

Lease-related activities proceed in phases with each subsequent phase's activities depend on the completion or initiation of the preceding phase. Table 5.2 lists activities that may occur during these phases.

Table 5.2: Exploration, Development, and Production Phase Activities

Exploration	Development	Production
Permitting	Gravel pits, pads, and roads	Well work over (rigs)
Water usage	Docks and bridges	Gravel pads and roads
Environmental studies	Drilling rigs	Produced water
Seismic tests	Pipelines	Air emissions
Exploratory drilling	Work camps	Pipeline maintenance
Land clearing	Permitting	Work camps
Drilling muds and discharges	Monitoring	Trucking
Gravel road beds	Well heads	
Work camp	Re-injection wells	
Increased air traffic		
Temporary gravel pads		
Research and analysis		

1. Exploration

Exploration activities are designed to gather as much information about the petroleum potential of an area as possible. Exploration activities may include the following: examination of surface geology, conducting geophysical surveys, researching data from existing wells, performing environmental assessments, and drilling exploratory wells. Surface analysis includes the study of surface topography or the natural surface features of the area; near-surface structures revealed by examining and mapping exposed rock layers; and geographic features such as hills, mountains, and valleys.

a. Geophysical Exploration

Geophysical companies usually conduct seismic surveys under contract with leaseholders. Geophysical exploration activities are regulated by 11 AAC 96. The Alaska Department of Natural Resources (ADNR) tailors each permit approval to the specifics of the proposed project. Restrictions on geophysical exploration permits depend on the duration, location, and intensity of the project. They also depend on the potential effects the activity may have on fish and wildlife resources or human use in the area. The extent of effects on important species varies, depending on the survey method and the time of year the operation is conducted.

Geophysical surveys help reveal what the subsurface may look like. Before proceeding, companies must acquire one or more permits from the state, depending on the timing and extent of the proposed activity. Companies will gather two-dimensional (2-D) and possibly three-dimensional (3-D) seismic data; 2-D seismic programs usually have fewer crewmembers and employ less equipment than 3-D programs.

Land-based seismic surveys are typically conducted in winter. To gather seismic data, an energy source is required to generate energy waves that travel into the subsurface. The difference in densities of the layers of rock beneath the surface influences the energy waves, which are reflected back from the various rock layers and are received by vibration-sensitive devices called geophones. Impulses are recorded, processed on high-speed computers, and displayed in the form of a seismic reflection profile.

Geophysical companies use various methods of generating energy, depending on the terrain and conditions. These methods include explosives, vibroseis, or weight dropping. Explosives may be placed into drill holes and detonated, or they may be suspended on stakes above the ground (Poulter Method). Drill holes are typically 15 to 25 feet deep with five pounds of explosive set at the bottom of the hole. The drill holes are either drilled with track-mounted drills or, if in remote or sensitive areas, slung into position by helicopters. Vibroseis, a more common methodology, utilizes a vibrator as the energy source. The vibrating plate is attached to a low ground pressure tracked vehicle and creates a sinusoidal vibration of continuously varying frequency, typically lasting seven seconds or longer. Weight dropping can be accomplished with specially designed vehicles or with helicopters. Depending on the location, terrain, and vegetation cover, several energy source techniques might be needed. As discussed in Chapter One, all seismic surveys must go through the permitting process before they are authorized.

b. Exploration Drilling

Exploratory drilling only occurs after seismic surveys are conducted, and only if interpretation of the seismic data reveals oil and gas prospects. Exploration drilling is the only way to learn whether a prospect contains commercial quantities of oil or gas and aides in determining whether to proceed to the development phase. Drilling operations collect core samples, well logs, cuttings, along with a variety of other data. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled. A well log is a record of one or more physical measurements as a function of depth in a borehole and is achieved by lowering measuring instruments into the well bore.

If the exploratory well is successful, the operator may drill additional wells to delineate the extent of the discovery and gather more information about the field. The lessee needs to know how much oil and gas may be present and must determine the quality of the product to decide whether to proceed to the next phase.

The drilling process is as follows:

- Special steel pipe (conductor casing) is bored into the soil.
- The bit rotates on the drill pipe to drill a hole through the rock formations below the surface and into the earth.
- Blowout preventers are installed on the surface and only removed when the well is plugged and abandoned. Blowout preventers are large, high-strength valves that close hydraulically on the drill pipe to prevent the escape of fluids to the surface.
- Progressively smaller sizes of steel pipe, called casing, are lowered into the hole and cemented in place to: keep the hole from caving in; seal off rock formations; seal the well bore from groundwater; and provide a conduit from the bottom of the hole to the drilling rig.
- The well produces, is capped, or is plugged and abandoned.

An exploratory drilling operation generates approximately 12,000 cubic feet of drilling cuttings. Cuttings are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by the mud pumped into the well (Gerding, 1986). Gas, formation water, and fluids and additives used in the drilling process are also produced from drilling operations. The fluids pumped down the well are called “mud” and are naturally occurring clays with small amounts of biologically inert products. Different formulations of mud are used to meet the various conditions encountered in the well. The mud cools and lubricates the drill bit, prevents the drill pipe from sticking to the sides of the hole, seals off cracks in down-hole formations to prevent the flow of drilling fluids into those formations, and carries cuttings to the surface.

ADNR discourages the use of permanent reserve pits, and most operators store drilling solids and fluids in tanks until they can be disposed of, generally down the annulus[1] of the well, in accordance with 20 AAC 25.080. Frozen cuttings may also be temporarily stored on the pad. In most circumstances, the cuttings are transported to a grind and inject facility. If necessary, a flare pit may be constructed to allow for the safe venting of natural gas that may emerge from the well. If the exploratory well reveals an oil or gas reservoir, it is likely that the pad used for the exploratory well will also be used for production testing operations.

[1] The annulus of a well is the space between any piping, tubing, or casing and the piping, tubing, or casing immediately surrounding it.

2. Development and Production

The development and production phases are interrelated and overlap in time; therefore, this section discusses them together. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. These phases can begin only after exploration has been completed and tests show that a discovery is economically viable (Gerding, 1986).

After designing the facilities, the operator constructs production facilities to last the life of the field and drills production wells. As production proceeds, the operator may have to design and add new facilities for enhanced recovery operations. Figure 5.1 depicts a production wellbore schematic for the North Slope. Gravel pads are used for production facilities and can be rehabilitated following field depletion.

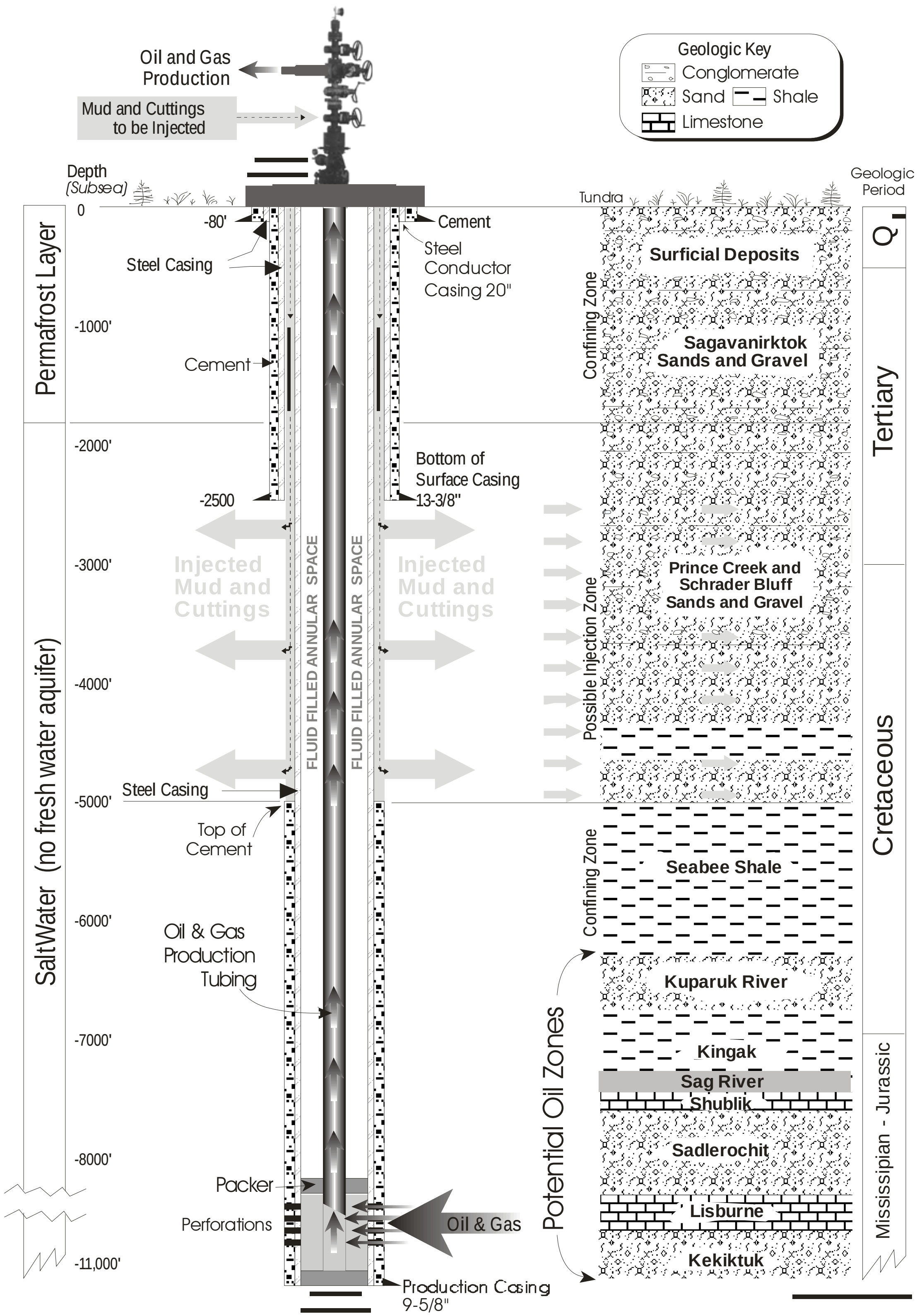
The development "footprint" in terms of habitat loss or gravel fill has continued to decreased in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes (see Figure 5.2). A single production pad and several directionally drilled wells can develop more than one and possibly several 640-acre sections. Unless pool rules (oil or gas field rules governing well drilling, casing, and spacing that are designed to maximize recovery and minimize waste) have been adopted under 20 AAC 25.520, existing spacing rules stipulate that where oil has been discovered, not more than one well may be drilled to that pool on any governmental quarter section (20 AAC 25.055(a)). This would theoretically allow a maximum of four well sites per 640-acre section. Where gas has been discovered, not more than one well per section may be drilled into the pool.

Directional drilling means extracting more oil and gas from a larger subsurface area (by increasing the drainage area) than would be possible from a single straight wellbore. See also Appendix C.

Production facilities will likely include several production wells, water injectors, gas injection wells, and a waste disposal well. Wellhead spacing may be as little as 10 feet. A separation facility would remove water and gas from the produced crude, and pipelines would carry the crude to the Trans-Alaska Pipeline System (TAPS). Some of the natural gas produced is used to power equipment on the facility but most is re-injected to maintain reservoir pressure. Produced water is also reinjected. Often, seawater is treated and injected into the reservoir in order to maintain pressure, improve recovery, and replace produced fluids.

At this phase it is impossible to predict what a full development scenario will entail. The final project parameters will depend upon the surface location, size, depth, and geology of a specific commercial discovery.

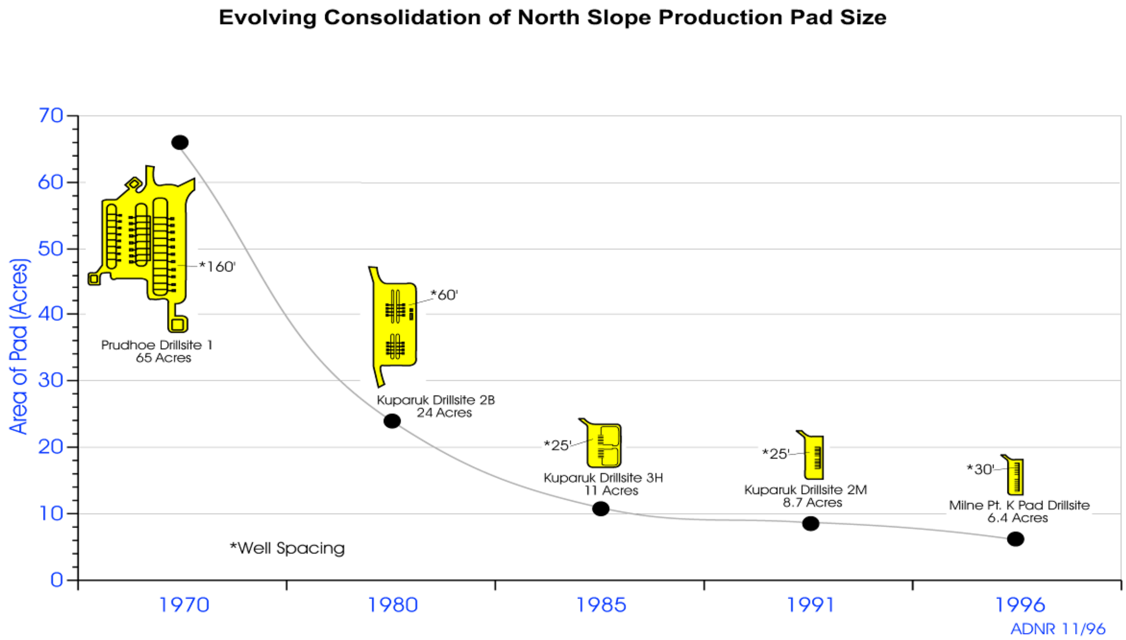
FIGURE 5.1 Typical Production/Injection Well (North Slope, Alaska)



Please Note:

1. When injection phase is completed, the 9-5/8" X 13-3/8" annular space is pumped full of cement and permanetly sealed.
2. In the Kuparuk River Unit the surface casing is set through the West Sak interval (to approxima tely -4000 ss). ADNR 3/07

Figure 5.2



B. Statewide and Local Fiscal Effects

1. Statewide Fiscal Effects

Alaska's economy depends heavily on revenues related to oil and gas production, and the government spending resulting from those revenues. The following statistics illustrate various ways in which the leasing program could generate income to state government.

Bonus Payments. Bonus payments are the amounts paid by winning bidders for the individual tracts leased. Since 1959, 6,710 tracts have been leased, generating more than $2 billion in bonus income and interest to the state (ADNR, 2007).

Rentals. Each lease requires an annual rental payment. The first year rent is $1 per acre or fraction of an acre, and the rent increases in 50-cent increments to $3 per acre or fraction of an acre in the fifth and all subsequent years of the lease. The lessee must pay the rent in advance and receives a credit on the royalty due under the lease for that year equal to the rental amount. Rental income from state leases for fiscal year (FY) 2007 (July 2006 through June 2007) were approximately $7.4 million. Rentals from federal leases were approximately $2 million (ADNR, 2008).

Royalties. Royalties represent the state's share of the production as the mineral interest owner. Royalties, including bonuses, rents, and interest provided more than $2.0 billion in revenue to the state in FY 2007. Royalty rates can vary depending on the area. For the most recent North Slope Areawide Oil and Gas Lease Sale held in October 2007, the royalty rate was 12.5 percent to 16.666 percent (ADNR, 2008).

Production Taxes. In 2007, the state replaced the Petroleum Profits Tax (PPT) with the Alaska's Clear and Equitable Share (ACES). The revision boosted overall rates and narrowed allowances for cost deductions and investment credits. With the new law, oil revenue estimates are significantly higher than would have been expected under the prior law. For FY 2007 production taxes were 2.29 billion; for FY 2008 they are forecast to be 3.40 billion (ADOR, 2007).

Income Taxes. All corporations in the state must pay corporate income tax for all taxable income derived from sources within the state. Special provisions apply to apportioning total income worldwide for corporations involved in producing or transporting oil and gas. Most, if not all, producers and transporters of oil and gas in Alaska are corporations. For FY 2007, oil and gas corporation taxes were $594.4 million (ADOR, 2007).

Petroleum Property Taxes. An annual tax is levied each year on the full and true value of property taxable under AS 43.56. This includes exploration property, production property, and pipeline transportation property. Property taxes amounted to $65.6 million in FY 2007 (ADOR, 2007).

In addition, tax settlements to the Constitutional Budget Reserve Fund amounted to approximately $560 million and National Petroleum Reserve-Alaska (NPR-A) royalties, rents, and bonuses amounted to $12.8 million, for total oil revenue of $5.2 billion (ADOR, 2007).

Together these revenues comprised approximately 87 percent of the state's general fund unrestricted revenue in FY 2007 (ADOR, 2007). Such revenues finance the state's education funding, operating budget, and capital budget. State spending supports nearly one out of every three jobs, and $3 of every $10 of personal income result from state spending. Nearly one of every two local government jobs (including school district jobs) in Alaska relies on state funding (ISER, 1990). Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to every eligible state resident.

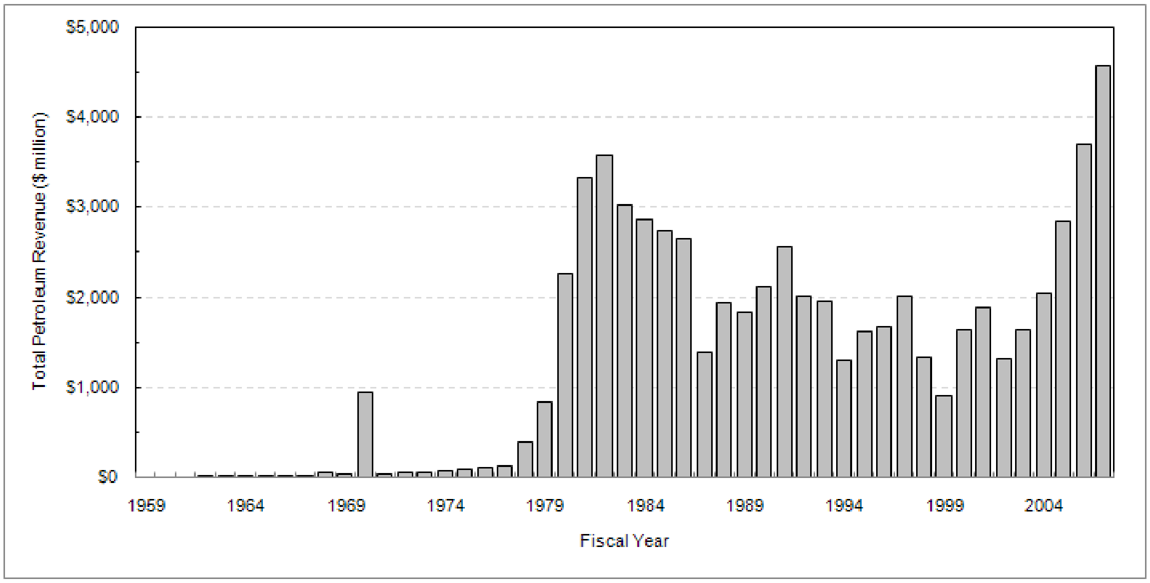
In FY 1988, Alaska North Slope production peaked at 2.006 million barrels per day and has steadily declined since (Figure 5.4). ADOR projects Alaska North Slope oil prices will average $72.64 per barrel for the fiscal year ending June 30, 2008, and $66.32 for FY 2009. Alaska North Slope crude production is forecast to be 731,000 barrels per day for the fiscal year ending June 30, 2008, a 1.2 percent decrease over FY 2007. Production for FY 2009 is projected to decrease to 701,000 barrels per day.

In November 2007, one year after the implementation of the Petroleum Profits Tax (PPT), the legislature passed the Alaska Clear and Equitable Share (ACES). Like the PPT, ACES is levied on the net value of oil and gas production. The base tax rate under ACES is 25% (it was 22.5% under PPT) and the progressive surcharge tax rate under ACES is 0.4% for every dollar that the net profit per barrel exceeds $30 (it was 0.25% on profits exceeding $40 per barrel under PPT). ACES continues to authorize credits for capital expenditures, exploration costs, prior year investments, and small producer incentives as did the PPT. The majority of ACES is retroactive to July 1, 2007, although some provisions are retroactive to the implementation of the PPT on April 1, 2006.

The energy industry is Alaska's largest industry, spending $2.1 billion annually in the state. The industry directly spends $422 million on payroll in Alaska and $1.7 billion on goods and services in the state. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and value added to the Alaska economy of $1.8 billion for total output of $3.1 billion. Oil and gas accounts for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest average wage in Alaska. The average producer company pays a monthly wage of $7,754, which is 2.8 times higher than the statewide average of $2,798 (McDowell, 2001).

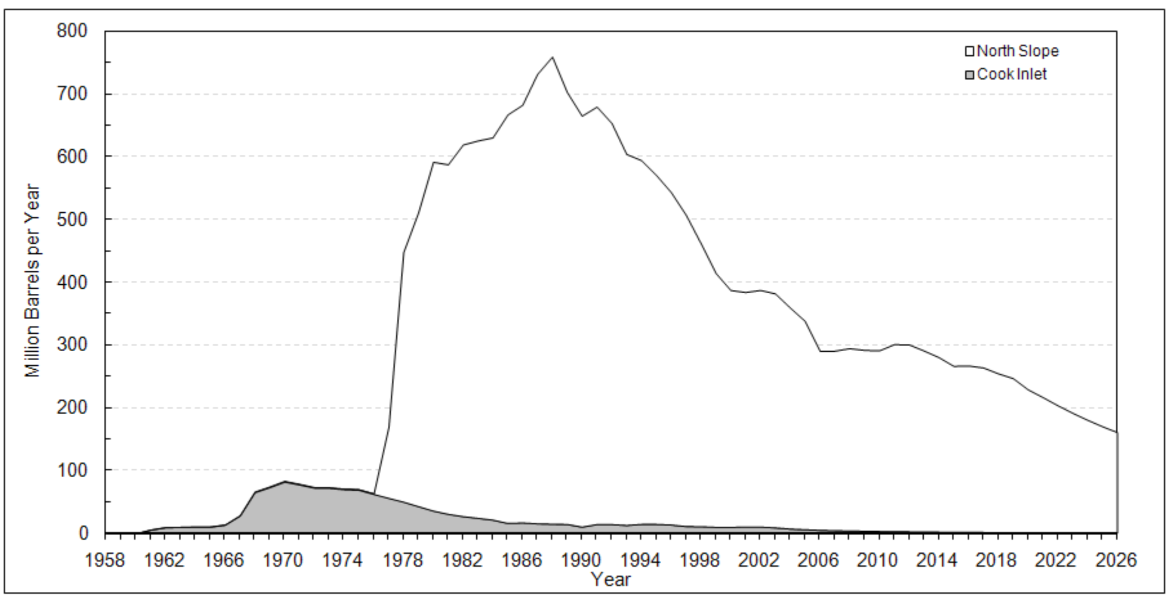
Through state and local government spending of oil and gas revenues, Alaska's petroleum industry has significant indirect impacts on local communities. In 1999, $1.5 billion was spent throughout the state, including capital projects, support of basic government operations (including payroll for state government employees), revenue sharing and municipal assistance, education funding, and Permanent Fund dividends (McDowell, 2001). Furthermore, the total economic effect of any spending, including state government

Figure 5.3: Historic Alaska Petroleum Revenue



Notes: Includes petroleum corporate income tax; production tax; petroleum property tax; oil and gas royalties (net); bonuses, rents and interest (net); and petroleum special settlements. Does not include Permanent Fund contributions and Constitutional Budget Reserve Fund.

Figure 5.4: Historic and Projected Alaska Oil Production



(DO&G Annual Report, 2007)

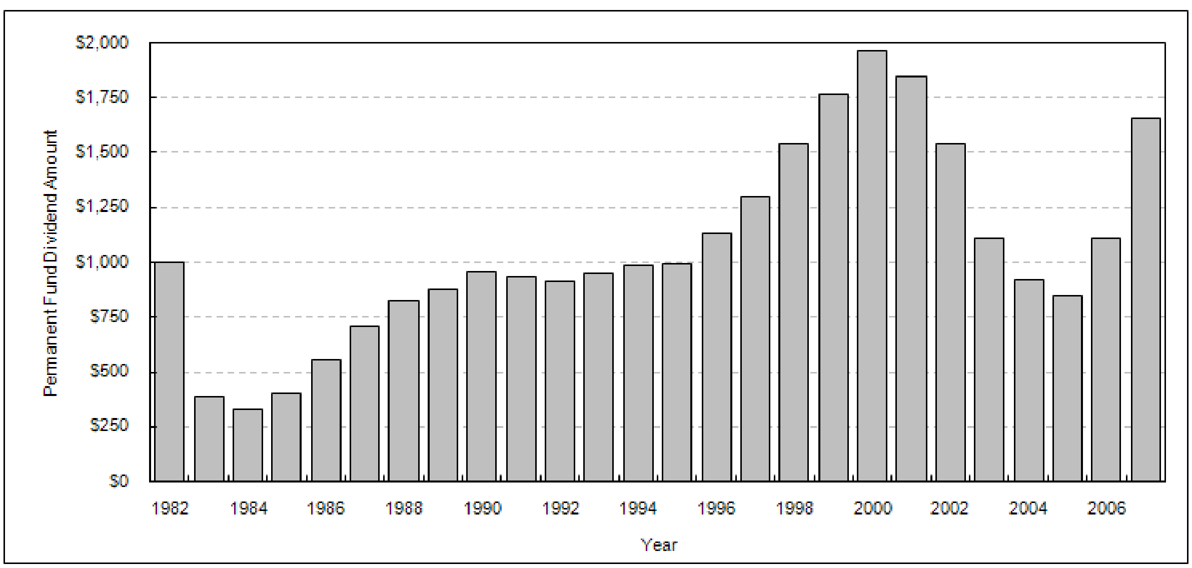
spending and salaries paid to private oil and gas industry employees, is always greater than the direct effect. When money is re-spent in the economy, its original value multiplies. For example, this "income multiplier" is calculated at 1.35 for state spending. This means that for every dollar of income Alaskans receive directly from state spending, an additional 35 cents of income is generated when that dollar is re-spent in the local economy (ISER, 1990).

In 2005, statewide oil industry (major oil companies and oilfield services) nonresidents accounted for 29.6 percent of the industry's workforce, a nearly one and a half percentage point increase over 2003. Earnings paid to nonresidents working in the oil industry increased from $191.4 million in 2003 to $226.6 million in 2004. The nonresident share of earnings in the oil industry rose from 25.1 percent in 2003 to 26.7 percent in 2004, a figure much higher than the statewide private sector average of 14.2 percent. By comparison, Alaska's seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2004 – more than 72 percent of workers were nonresidents (ADOL, 2007).

The mitigation measures encourage lessees to employ local Alaska residents and contractors, to the extent they are available and qualified. Lessees must submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator's plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors.

The Alaska Permanent Fund Dividend (PFD) is also funded with oil and gas revenues. The fund was established by ballot proposition in 1976. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund. The state's oil-wealth savings account is forecast to exceed $39 billion in FY 2008. All eligible Alaskans who timely apply receive an annual dividend from the earnings of the fund. In 2007, the dividend check totaled $1,654; more than $999 million was distributed under the program to 604,129 eligible Alaskans (ADOR, APFC, 2007). See Figure 5.5. The PFD is an equitable benefit transfer because it reaches every eligible individual regardless of income or socio-economic status. The PFD, with its large annual infusion of cash, has contributed to the growth of the state economy like any other basic industry.

Figure 5.5: Alaska Permanent Fund Dividends (1982-2007)



Source: ADOR, Alaska Permanent Fund Corporation, 2007

C. Effects on Municipalities and Communities

1. Fiscal Effects

The North Slope Borough (NSB) is host to the production center for the state's oil industry and no other borough is more influenced by the oil and gas industry. More than two thirds of all jobs in the NSB are directly linked to the oil industry or to its support industries (Table 5.3).

Although the borough relies on oil revenues, most local residents pursue a traditional and community-based economic life. The finances of the NSB government depend predominately on tax revenues from oil properties. Approximately 98 percent of all local property tax collections come from oil producers. In 2006, property tax receipts were $198.4 million (NSB, 2006).

Oil and gas property is exempt from local municipal taxation, but the state levies a 20-mill tax against this property. Each municipality with oil and gas property within its boundaries is reimbursed an amount equal to the taxes which would have been levied on the oil and gas property, up to the 20-mill limit. The 2005 property tax rate for the NSB was 19.03 mills. Since the 1980s, the NSB property tax base has consisted mainly of high-value property owned or leased by the oil industry in the Prudhoe Bay area (BLM, 2007)

A critical issue facing the NSB is the growing shortfall in revenues due to the decline in assessed value resulting from depreciation of petroleum-production related facilities. The real property assessed valuation for the NSB has declined from $11.5 billion in 1992 to $194 million in 2005. The full value determination of real property was $10.36 billion in 2005. Future assessed values could be higher than current projections if industrial infrastructure is built in the NSB. In the near term, a decline in tax revenues and bonding capacity is anticipated (BLM, 2007).

A primary goal of the NSB has been to create employment opportunities for Alaska Native residents. The NSB has been successful in hiring large numbers of Alaska Natives for NSB construction projects and operations. The NSB employs many permanent residents directly and finances construction projects under its Capital Improvement Program. The NSB pay scales have been equal to, or better than, those in the oil and gas industry, while working conditions and the flexibility offered by the NSB are considered by Alaska Native employees to be superior to those in the oil and gas industry. In addition, NSB employment policies permit employees to take time off, particularly for subsistence hunting (BLM, 2007).

While the NSB ranks highly on income statistics, it also has one of the highest costs of living in the state. The Cooperative Extension Service of the University of Alaska Fairbanks surveys food prices in 24 locations in the state. In June 2004, it listed Nuiqsut and Barrow as the second and fourth most expensive places for weekly food costs for a family with two school-age children. Food items were more than 2.3 times higher in Nuiqsut and 2.1 times higher in Barrow than in Anchorage (ADOL, 2005).

Table 5.3: NSB Employment Profile: Average monthly employment and earnings, First Quarter 2007

Industry	Workers	Average Monthly Earnings
Mining (includes Oil and Gas)	7,299	$8,143
Construction	163	$7,628
Transportation/Trade/Utilities	444	$6,075
Retail Trade	204	$2,842
Federal Government	18	$4,953
State Government	62	$5,006
Local Government	1,713	$3,413
Financial Activities	208	$9,141

According to a spring 2004 construction cost survey conducted for the Alaska Housing Finance Corporation, Barrow bears the highest material costs among 11 surveyed Alaska locations. A basic construction market basket that does not include doors or windows was quoted to cost $37,873, exceeding the Anchorage price by 114 percent. Most of the additional price is attributed to transportation costs. Airfares are also among the highest in the state because of the distance and the costs involved with service to remote locations (ADOL, 2005).

The NSB established its own permanent fund that contains assets that are to be held in perpetuity. At the end of fiscal year 2006, the value of the fund was approximately $483 million (NSB, 2006). Income from the fund is to be added to the corpus of the fund, except that an annual transfer is made to the general fund in an amount up to eight percent of the average total fair value of the fund at the end of the three preceding fiscal years (NSB Comprehensive Annual Financial Report, 2005).

2. Employment

Very few Alaska Native residents of the North Slope have been employed in oil-production facilities and associated work in and near Prudhoe Bay since production started in the late 1970s (Table 5.4). A study contracted by MMS showed that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised less than 1percent of the 6,000 North Slope oil-industry workers (BLM, 2007).

Table 5.4: Estimated Number of Resident Jobs by Sector, NSB Communities, 2003

Sector	Anatuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright
Federal Government	1	0	45	1	0	10	2	2
State Government	2	0	22	0	1	0	1	0
City Government	12	1	21	3	5	14	2	8
NSB Government	51	20	464	27	29	44	24	48
NSB School District	30	20	194	21	27	62	29	44
NSB CIP	0	0	4	0	2	0	1	3
Oil industry	3	0	14	1	3	2	0	0
Private Construction	4	0	23	5	3	1	4	4
ASRC	3	0	69	5	3	1	4	3
Village Corporation	19	27	87	18	37	60	9	38
Finance	0	0	5	0	0	0	1	0
Transportation	0	0	48	0	1	3	1	1
Communications	0	0	8	0	0	0	0	0
Trade	0	1	27	0	0	2	0	1
Service	4	0	103	0	0	0	1	0
Ilisavik College	0	0	58	0	0	2	1	1
Other	2	3	132	3	10	25	5	18

Source: BLM, 2007

The NSB is concerned that the oil industry has not done enough to accommodate training of workers, or to accommodate their cultural and economic needs to participate in subsistence-hunting activities. In response, BP Exploration initiated the Itqanaiyagvik Program, a training partnership with Arctic Slope Regional Corporation (ASRC), Illisagvik College, and the NSB School District to provide education and training for oil industry professional and craft jobs.

ConocoPhillips has worked closely with Kuukpik Corporation, ASRC, and other companies to hire and train Alaska Natives. ConocoPhillips, in cooperation with Kuukpik Corporation, sponsors mentoring and training at the Alpine field for North Slope residents. As a result of current development of the Alpine field, Nuiqsut has received a number of economic benefits and employment opportunities including construction, catering, seismic, surveying, trucking, and security.

As exploration takes place, and if development occurs, the North Slope Areawide Oil and Gas Lease Sale would add jobs to the local economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered and developed. Discovery and development of commercial quantities of petroleum or natural gas in the sale area would bring direct economic benefits to the local and regional economy.

3. Effects on Public Health

In commenting on the preliminary best interest finding, the NSB asked ADNR to consider the reasonably foreseeable effects of the sale on public health. Health status on the North Slope is determined by a wide array of factors, including genetic susceptibility, behavioral change, environmental factors, diet, and socio-cultural impacts. The state is currently developing a policy regarding Health Impact Assessments (HIA) for large resource extraction projects. HIA is a predictive tool that seeks to identify potential lasting or significant changes, both positive and negative, of different actions on the health and social well-being of a defined population as a result of a program, project, or policy. The Alaska Inter-Tribal Council received a grant from the Robert Wood Johnson Foundation to integrate an HIA into the federal environmental impact process. In 2007, the NSB was awarded a $1.67 million NPR-A impact grant to perform an HIA. The goal of the HIA is to aid the NSB in analyzing and understanding potential impacts of proposed development on the health of communities and to design appropriate mitigation measures.

Each year, under AS 38.05.035(e)(6)(F), ADNR issues a call for comments requesting substantial new information that has become available since the most recent finding for that sale area was written. Based on information received, ADNR will determine whether it is necessary to supplement the finding. By this mechanism, ADNR will have the opportunity to consider health impacts once the Alaska Inter-Tribal Council and NSB complete their HIAs and the state finalizes its HIA policy.

HIA’s have not been routinely performed in the United States, however, BLM in its NPR-A Draft Supplemental considered health effects of North Slope oil and gas development. BLM’s analysis is summarized below.

The overall health of Alaska Natives, including the North Slope Inupiat, has improved significantly since 1950 due to the combination of improved socio-economic status, housing, sanitation, and health care and infection control efforts. Health status on the North Slope has continued to improve as measured by overall mortality and life expectancy. Since 1979, overall mortality has declined roughly 20 percent (BLM 2007, citing to Goldsmith 2004; Bjerregaard, Young et al 2004; Day et al 2006). Despite these improvements, significant disparities remain between Alaska Natives and the general U. S. population as cancer, social pathology, and chronic diseases are rapidly increasing (BLM, 2007).

The incidence and the mortality rates for cancer have increased roughly 50 percent since 1969. Cancer is now the leading cause of death on the North Slope. Three cancers, breast, colon, and lung, account for much of the overall increase. By a small margin, North Slope Alaska Natives have the highest incidence of cancer in Alaska, at 579/100,000. The increase in lung cancer and possibly breast and colon cancer may be due to smoking, although there are no definitive studies to prove this (BLM, 2007). However, smoking rates on the North Slope are extremely high (BLM 2007 citing to Wells, 2004).

Psychological and social problems including alcohol and drug abuse, depression, assault, sexual abuse, and suicide are highly prevalent on the North Slope, as they are in many rural Alaska Native and Arctic Inuit villages in Canada and Greenland. The prevalence of suicide on the North Slope in recent years has been estimated at roughly 45/100,000, more than four times the rate in the general U.S. population. Unintentional injury rates are high in the North Slope because of factors such as high rates of alcohol and substance abuse and risk-taking behavior in youth. Research suggests that social pathology problems are related to the rapid cultural changes that have occurred. Alcohol prohibition has been demonstrated to reduce rates of suicide, homicide, and other social pathology (BLM, 2007).

Diabetes, obesity, and related metabolic disorders were previously rare or non-existent in the Inupiat but are now increasing. The prevalence of diabetes in the North Slope is estimated at only 2.4 percent compared with the U.S. rate of roughly 7 percent. However, between 1990 and 2001, the rate of diabetes climbed roughly 110 percent, nearly three times the rate of increase in the general U.S. population (Alaska Native Medical Center Diabetes Program). Subsistence diets and the associated active lifestyle are known to be the main protective factors against diabetes. The increase in diabetes may reflect the increased use of store-bought food, a more sedentary lifestyle, and potentially genetic susceptibility (BLM, 2007, citing to Murphy, Schraer et al., 1995; Naylor, Schraer et al., 2003; Ebbesson, Kennish et al., 1999).

Cardiovascular disease rates are significantly lower in Alaska Natives than in non-Natives in the U.S. On the North Slope, recent mortality figures show death rates roughly 10 percent less than the U.S. population (BLM, 2007, citing to Day, et al., 2006). However, many of the risk factors are increasing, and as noted above, smoking rates are already extremely high (BLM 2007 citing to Wells, 2004).

North Slope residents have the highest mortality rate in the state from chronic lung diseases, at nearly three times the mortality rate for the U.S. (130/100,000 compared with 45/100,000) (Day et al 2006). The disparate rates of increase and mortality from pulmonary disease are accompanied by high smoking rates, which many public health experts believe to be the primary explanation. It is impossible to estimate the contribution of environmental factors because there are no available data on local fine particulate concentrations, hazardous air pollutants, and indoor air quality. Data generally does not exist to allow the direct attribution of a particular illness to a specific development project. However, an ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999 as a State of Alaska permit condition for the Alpine field. Data collected indicate that air quality is in compliance with National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards (BLM, 2007).

BLM concludes that while the health status of the North Slope Inupiat people has improved significantly since the 1950s due to reductions in infectious diseases, the rates of cancer, chronic diseases such as diabetes, hypertension, asthma, and social pathology have increased. At present, no evidence exists to conclusively link rates of any of these problems to oil and gas development. Current public health efforts focus on smoking cessation, early detection, surveillance of carcinogens in subsistence foods, and curtailing exposure to known carcinogenic compounds as much as possible (BLM, 2007).

D. Cumulative Effects

1. Effects on Water

Water quality characteristics that may be altered by oil and gas activities include: pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential impacts that may alter surface water quality parameters include accidental spills of fuel, lubricants, or chemicals; increases in erosion and sedimentation causing elevated turbidity and suspended solids concentrations; and oil spills.

Geophysical exploration with tracked seismic vehicles is not expected to alter water quality because seismic surveys are conducted in winter and permit conditions mitigate potential damage. Under standard ADNR permit conditions for winter seismic exploration, the use of ground-contact vehicles for off-road travel is limited to areas where adequate ground frost and snow cover prevent damage to the ground surface. Operations are restricted to the winter seasonal opening. Equipment, other than vessels, must not enter open-water areas of a watercourse during winter, and any roads, bridges, or approach ramps constructed near river, slough, or stream crossings must be free of extraneous material before breakup. Alterations of the banks of a watercourse are prohibited. Adherence to these conditions avoids or minimizes post-seismic increases in erosion, turbidity, and suspended solids in a drainage area.

The extent and duration of water quality degradation resulting from accidental spills depends on the type of product, the location, volume, season, and duration of the spill or leak, and the effectiveness of the cleanup response. Heavy equipment, such as trucks, tracked vehicles, aircraft, and tank trucks, commonly use diesel fuel, gasoline, jet fuel, motor oil, hydraulic fluid, antifreeze, and other lubricants. Spills or leaks could result from accidents, during refueling, or from corrosion of lines (Parametrix, 1996). Under standard ADNR permit conditions for off-road activity, fuel and hazardous substances must have secondary containment apparatuses. A secondary containment or surface liner must be placed under all container or vehicle fuel tank inlet and outlet points. Appropriate spill response equipment must be on hand during any transfer or handling of fuel or hazardous substances. Vehicle refueling is prohibited within annual floodplains (ADGC, 1995). Impacts of oil spills are discussed in Chapter Six.

Other standard ADNR land use permit conditions serve to protect water quality from facility construction and operation. Work areas must be kept clean. Trash, survey markers, and other debris that may accumulate in camps or along seismic lines and travel routes that are not recovered during the initial cleanup must be picked up and properly disposed. All solid wastes, including incinerator residue, must be backhauled to a solid waste disposal site approved by ADEC. Vehicle maintenance, campsites, and the storage or stockpiling of material on the surface of lakes, ponds, or rivers is prohibited (ADGC, 1995).

The federal Clean Water Act established NPDES to permit discharges of pollutants into U.S. waters by “point sources,” such as industrial and municipal facilities. In Alaska, the U.S. Environmental Protection Agency (EPA) issues NPDES permits, designed to maximize treatment and minimize harmful effects of discharges as water quality and technology improvements are made. ADEC certifies that these discharge permits will not violate the state’s water quality standards.

ADEC issues industrial and municipal wastewater permits and monitors wastewater discharges and the water quality of waterbodies receiving the discharges. ADEC certifies federal wastewater permits with mixing zones that allow industrial and municipal facilities to meet state water quality standards. Industrial and municipal wastewater facilities are inspected annually. ADEC also certifies U.S. Army Corps of Engineers dredge and fill permits in wetlands and navigable waters to ensure compliance with state water quality standards. ADEC provides technical assistance for design, installation, and operation of industrial and municipal wastewater systems.

a. Effects of Drilling Muds and Produced Water

For onshore operations, most drilling wastes are disposed of under ADEC’s solid waste disposal program. Re-injection is the preferred method of drilling fluid disposal and the method of disposal of drilling mud and cuttings requires permit approval. Byproducts of drilling and production activities include muds and cuttings, produced water, and associated wastes. During drilling and after a well is in production, water comes to the surface mixed with oil and gas and must be separated before further refining. Drilling employs the use of carefully mixed fluids, called muds. Cuttings are small fragments of rock up to an inch across that are dislodged and carried to the surface by drill muds. Drilling muds are mostly water-based mixtures of clay and other earthen materials, such as almond husks, which are used to cool and lubricate the drilling bit, facilitate the drilling action, flush out cuttings within the well bore, seal off cracks in down-hole formations to prevent the flow of drilling fluids into these formations, and maintain reservoir pressure. Chemicals may be added to maximize the effectiveness of drilling and casing (See Table 5.5). Oil-based muds and synthetic-based muds may also be used depending on the well depth, well diameter, and subsurface formations (NRC, 1983;Veil, Burke and Moses, 1996).

Produced water contains natural occurring substances such as clay, sand, oil, water and gas. These substances are found in the subterranean strata. Produced waters are usually saline with some level of hydrocarbons. Associated wastes are other production fluids such as tank bottom sludge, well work-overs, gas dehydration processes, tank wastewater, and other residues that are considered non-hazardous (low-toxicity) by the EPA. Like drilling muds, chemicals may be added to produced water to remove harmful bacteria, halt corrosion, break up solids, prevent scale buildup, and break oil/water emulsions (EPA, 1995).

Table 5.5: Drilling Additives

	Common Additive	Use
Weighting material	Barite (barium sulfate ore)	Adds density and counters formation pressures
Viscosifiers	Bentonite clay (mostly sodium montmorillonite)	Removes cuttings, prevents fluid loss, helps seal wellbore
Natural and synthetic polymers	Bentonite and drilled clays, corn and potato starch, modified starch, natural gums	Mud cake, prevent fluid loss, cuttings transport, hydraulics
Thinners	Plant tannins, polyphosphates, lignitic materials	Reduce temperature effects, reduce viscosity
pH and ion control	Soda ash, baking soda, sodium hydroxide	Control corrosion, remove harmful gas (H2S)
Lubricants	Natural and synthetic oil-based compounds	Reduce friction in wellbore
Bacteria control agents	Depends on ability to meet effluent guidelines	Mitigate fermentation of organics in drill system
Surfactants	Salts, soaps, fatty acid derivatives	Emulsifier, wetting agent, foamers, defoamers, reduce clay hydration

(NRC, 1983)

According to a 1993 EPA report, the use of water-based muds generates 7,000 to 13,000 barrels of waste per well. Depending on the depth and diameter of the well, 1,400 to 2,800 barrels of those are cuttings. Oil-based mud volumes are generally used less than water-based muds, because they are more efficient, may be reconditioned, reused, and re-sold. Newer synthetic-based muds produce even less waste, improve drilling efficiency, are reusable, and have advantages in environmental protection over oil or water-based muds (Veil, et al., 1996). Discharge of untreated oil-based muds into any water column violates federal and state pollution laws.

b. Current Waste Treatment and Disposal Practices

Most oil field wastes are considered non-hazardous and waste fluids are recycled, filtered, and treated before reinjection or disposal. Cuttings and waste fluids must be made non-hazardous before injection. Produced water is treated using heat, gravity settling, and gas flotation devices to remove hydrocarbons. After treatment, produced water is reinjected into either the oil-bearing formation to maintain pressure and enhance recovery or into an approved disposal well. Cuttings disposal is done through grinding and injecting on-site, or cuttings are transported to an approved disposal site. Cuttings disposal can cost more than the total cost to drill a well (Powell, 1996). Wastewater, including sanitary and domestic graywater, is also treated to meet effluent guidelines before discharge.

The AOGCC ensures proper and safe handling and disposal of drilling wastes. The AOGCC functions as the regulatory agency overseeing the underground operation of the Alaska oil industry on private and public lands and waters. The commission administers the Underground Injection Control Program for oil and gas wells, acts to prevent waste of oil and gas resources and ensure maximum recovery, and protects subsurface property rights. All disposal wells inject fluids deep beneath any drinking water aquifers.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to water quality. For a complete listing of mitigation measures and lessee advisories, see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Stream buffers: To the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses. In addition, no facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Shaviovik, and Kavik rivers.
- Wetland protection: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas.
- Habitat loss minimization: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Additionally, pipelines must utilize existing transportation corridors where conditions permit. Finally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Turbidity reduction: Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Water quality monitoring: A fresh water aquifer monitoring well, and quarterly water quality monitoring, is required down gradient of a permanent storage facility, unless alternative acceptable technology is approved by ADEC.
- Drilling waste: The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands. Discharge of produced waters into open or ice-covered marine waters of less than ten meters in depth is prohibited.

- Water conservation: Removal of water from fish-bearing water bodies requires prior written approval by DMLW and ADF&G. Regulations for Appropriation and Use of Water are subject to the provisions of 11 AAC 93.035 - 11 AAC 93.147.

2. Effects on Air Quality

Air quality throughout the sale area is good, with concentrations of regulated pollutants below the maximum allowed under the National Ambient Air Quality Standards. In order to ensure that air quality standards are maintained, emissions of nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone and particulate matter are closely watched under the provisions of the Prevention of Significant Deterioration Program, which is administered by ADEC (ADEC, 2007).

Routine activities associated with oil and gas exploration, development, and production that are likely to affect air quality are emissions from construction, drilling, and production. Air pollutants include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter, and volatile organic compounds (VOC) (MMS, 1995). Effects from VOC emissions would be insignificant because of the low potential for ozone formation. Photochemical pollutants, such as ozone, form in the air of the lower atmosphere from the interaction of hydrocarbons and nitrogen oxides in the presence of strong sunlight .In the upper atmosphere ozone is beneficial because it absorbs solar ultraviolet radiation. In the lower atmosphere its strong oxidizing trait can be harmful to humans and plant life. There is a low potential for ozone formation on the North Slope because the summertime air temperatures remain relatively low (MMS, 1996b).

Trucks, heavy construction equipment, and earth-moving equipment would produce emissions, such as engine exhaust and dust. Sources of air emissions during drilling operations include rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, incinerators, and well test flaring equipment. Emissions would be generated during installation of pipelines and utility lines, excavation and transportation of gravel, mobilization and demobilization of drill rigs, and during construction of gravel pads, roads, and support facilities. Emissions would also be produced by engines, turbines, and heaters used for oil/gas production, processing, and transport. In addition, aircraft, supply boats, personnel carriers, mobile support modules, as well as intermittent operations such as mud degassing and well testing, would produce emissions (MMS, 1996b).

Other sources of air pollution include evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOC and sulfur dioxide (MMS, 1995c). Gas blowouts, evaporation of spilled oil and burning of spilled oil may also affect air quality. Gas or oil blowouts may catch fire. A light, short-term coating of soot over a localized area could result from oil fires. However, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains (MMS, 1995).

The probability of a gas blowout from a pad is estimated to be low. If a gas blowout did occur, it is estimated that it would not persist more than one day and that it would release less than two tons of volatile organic compounds (MMS, 2003).

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) (BLM, 2005).

Mitigation Measures

At the lease sale stage, it is not possible to predict with certainty the amount of pollutants that may be produced. Regardless, all industrial emissions must comply with the Clean Air Act (42 U.S.C. §§ 7401-7642) and state air quality standards. 18 AAC 50 provides for air quality control and contains the state air quality standards, permit requirements, permit review criteria, and regulation compliance criteria, and state statutes and regulations that will mitigate potential impacts to air quality include:

- 42 U.S.C. §§ 7401-7671: Federal Clean Air Act;
- AS 46.03: Which provides for environment conservation; control of water, land, and air pollution; radiation and hazardous waste protection; and
- 18 AAC 50: The purpose of which is to identify, prevent, abate, and control air pollution in a manner that meets the purposes of AS 46.03, AS 46.14. and 42 U.S.C. 7401 – 7671q (Clean Air Act).

ADEC's Air Permit Program regulates stationary sources of air contaminants to protect and enhance air quality and abate impacts on public health and the environment. The Act established air quality programs to regulate air emissions from stationary, mobile, and other sources that pose a risk to human health and the environment. ADEC monitors compliance with regulations and air quality standards through annual inspections and enforcement procedures. The agency issues operating permits to existing major facilities incorporating all applicable requirements and issues construction permits to new facilities and for expansions of existing facilities.

3. Effects on Fish and Wildlife Habitat, Populations and Their Uses

a. Effects on Land Habitat

During oil and gas development and production, various activities could impact vegetation in the sale 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.

<u>Transportation</u>: Winter seismic surveys can affect tundra vegetation depending on snow depth, vehicle type, traffic pattern, and vegetation type. Camp-move trails disturb vegetation more than seismic trails. Multiple vehicles in a single narrow trail cause more disturbance than dispersed tracks. Trails in shrub-dominated tundra recover slower than other vegetation types (Jorgenson and Martin, 1997).

Seismic surveys can compress microtopography, resulting in a wetter microenvironment and decreased vegetation cover of upright shrubs (willows), lichens, and mosses. Winter seismic trails have little adverse effect on, and may possibly enhance growth of, *C. aquatalis* and *E. angustifolium* due to the resulting wetter microenvironment (Noel and Pollard, 1996, citing to Felix and Raynolds, 1989). Effects can be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra that should disappear with the recovery of the vegetation within a few years. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact so that plants should recover. Dry, snowless ridges and vegetated sand dunes are at higher risk of damage. Damage to vegetation can be avoided by limiting travel to areas with at least 6 inches of snow cover, and avoiding minimum radius turns. In areas where damage is extensive and natural recovery not expected, restoration may be required of operators (Schultz, 1996).

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 (BLM, 2005).

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 one percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about one 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 areas with adequate snow cover would greatly reduce the potential for thermokarst and long-term impacts to the tundra (BLM, 2005). Based on earlier studies there should be no long-term impacts to vegetation from seismic lines (BLM, 2005).

Important lease stipulations for thermokarst would be the restriction on bulldozing of trails, the requirement that snow depth average six 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 waterbodies

After a review of study results and the available scientific literature, ADNR established the minimum combination of ground and snow conditions which are needed to achieve the protection for both wet sedge tundra and tussock dominated tundra.

DNR will implement tundra opening for general cross country travel in wet sedge tundra when a minimum 15 centimeters (6 inches) of snow cover is available and ground temperature is -5°C at 30 centimeters (1 foot) depth in coastal areas and with 23 centimeters (9 inches) of snow in the foothills.

<u>Drilling and Production Discharges</u>: During exploration well drilling, muds and cuttings are stored on-pad, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site or reinjected into the subsurface at an approved injection well. All production muds and cuttings on the North Slope are reinjected into a Class II injection well. All produced waters are reinjected either into the producing formation to enhance recovery or into an injection well. The Underground Injection Control program is administered by AOGCC. Drilling and production discharges are expected to have no impact on tundra habitat.

<u>Effects of Construction and Gravel Infilling</u>: Effects of constructing production pads, roads, and pipelines include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth. Construction activity involving vehicular passage (see above, Effects of Seismic), such as a rollogon, may upset the thermal balance of the permafrost beneath the tundra, especially in non-winter months. Road construction, vehicular passage, and oil spills can alter surface albedo (reflectivity of sunlight off the earth’s surface) or water drainage patterns, resulting in thaw and subsidence or inundation. Such changes can affect regeneration and revegetation of certain species, and species composition may also change after disturbance from construction activities (Linkins, et al., 1984).

After an oil field is abandoned, rehabilitation will be required to restore areas impacted by oil and gas activities. Recovery of wetlands disturbed by gravel infilling varies depending on soil moisture content and amount of available soil organic matter (Kidd, et al., 1997, citing to Jorgenson and Joyce, 1994). Removal of gravel from pads and roads is the initial step in rehabilitation. At sites on the North Slope where gravel fill has been removed, problems have emerged associated with ponding, thaw subsidence, and nutrient cycling. One method preferred by the state is to remove all gravel and create pond habitat that resembles pre-construction conditions. In some cases, full gravel removal may not be the optimum recovery option. In most cases, plant cultivation is desirable with the use of plant species identified as important for waterbird habitat. While rehabilitation methods for gravel pad and roads vary depending on site-specific conditions, the overall goal of rehabilitation in the existing oil fields is to create a mosaic of moist meadows, sedge meadows, and grass marshes. Several plant cultivation treatments have been used on the North Slope, including fertilizer only, native-grass cultivation, Arctophila transplantation, and sedge-plug transplantation. Optimum recovery of the tundra marsh would include re-establishing vegetation, soil microbiotia, phytoplankton, aquatic invertebrate, and wildlife communities at the impacted site (Kidd, et al., 1997).

Ice roads and Pads: Ice roads and pads cause depressions in microtopography due to compaction. The thaw depth in summer increases beneath the impacted area after melt and there is an increase in wetness due to compression. Ice roads and pads also affect tundra regeneration, with certain species recovering faster after summer melt than others. Most vegetation should recover within three seasons following melt. Ice road thaw depths return to pre-impact levels after several years (Noel and Pollard, 1996).

Single season ice roads melt in spring and leave little if any trace. Multi-season ice pads can result in limited short-term impact, if tundra around the perimeter of the pad thaws and is blocked from sunlight. Insulated paneling held down by fabric and timbers at the perimeter of a multi-season pad can result in sun-blockage and impeded growth.

Gas Blowouts: If a natural gas blowout occurred, plants in the immediate vicinity could be destroyed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. Insects such as mosquitoes would also be affected or killed by a gas blowout. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but is not expected to be hazardous for more than one kilometer downwind or for more than one day. Natural gas development is expected to have little to no effect on lower trophic-level organisms (MMS, 1996b). Impacts to vegetation from pollutants would likely not substantially alter the plant communities in the sale area (BLM, 2005).

Oil Spills: Spilled oil will affect tundra depending on time of year, vegetation, and terrain. Oil spilled on the tundra will migrate both horizontally and vertically. This flow depends on many factors, including the volume spilled, type of cover (plant or snow), slope, presence of cracks or troughs, moisture content of soil, temperature, wind direction and velocity, thickness of the oil, discharge point, and ability of the ground to absorb the oil (Linkins, et al., 1984). The spread of oil is less when it is thicker, cooler, or is exposed to chemical weathering. If the ground temperature is less than the pour point of the oil, it will pool and be easier to contain. Absorption of the oil by the tundra itself will also limit flow and reduce the area contaminated. Experiments in Canada by MacKay, et al. (1974) revealed that mosses have high absorption capacity. Moss-covered tundra can absorb more than 13 gallons of oil per square meter, compared to less than a gallon for tundra not covered by moss (Linkins, et al., 1984). If there is a vertical crack through different soil horizons, oil will migrate down to the permafrost. If no cracks are present in the soil layers beneath the tundra, oil moves laterally in the organic material, does not penetrate the silty clay loam mineral soils beneath, and oil contamination would be restricted to the top few centimeters of the soil layer. Dry soils have greater porosity and the potential for vertical movement is greater (Linkins, et al., 1984, citing to Everett, 1978). If oil penetrates the soil layers and remains in the plant root zone, longer-term effects, such as mortality or reduced regeneration, would occur in following summers.

Fungi are important decomposers of organic material in tundra soil. Large numbers of fungi have been found in association with a natural oil seep at Cape Simpson. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the crude being spilled, bacteria assist in the breakdown of hydrocarbons in soils. Petroleum-contaminated soils are commonly treated with fertilization, raking, and tilling (bioremediation).

In the March 2006, severe corrosion in a BP transit pipeline caused more than 200,000 gallons of oil to leak onto almost 2 acres of tundra. The spill resulted in a $6 million cleanup (see Chapter Six, “Oil Spill Risk, Prevention and Response”). ADEC officials believe the environmental damage to the tundra was minimal (ADN, 2006a).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to land and habitat. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Wetland protection: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas.
- Habitat loss minimization: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Additionally, pipelines must utilize existing transportation corridors where conditions permit. Finally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Rehabilitation: Upon abandonment of material sites, drilling sites, roads, buildings or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the Director, unless the Director, in consultation with DMLW, ADF&G, ADEC, NSB, and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Drilling waste: The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands. Discharge of produced waters into open or ice-covered marine waters of less than ten meters in depth is prohibited.

b. Effects on Fish

Anadromous streams within the sale area include the Colville, Sagavanirktok, Shaviovik, and Kadleroshilik Rivers. The Canning River is adjacent to the eastern boundary of the sale area. Numerous other rivers and streams that flow through the sale area also support anadromous fish populations. Several species of anadromous fish spawn and overwinter in these rivers and during summer migrate to nearshore coastal waters of the sale area to feed. Migration patterns vary by species and within species by life stage (see Chapter Three). Potential effects include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal, facility siting, and water removal; impediments to migration; and fish kills due to oil spills.

Habitat Loss: Potential impacts at all phases include erosion. Erosion results in siltation and sedimentation, which in turn may result in a reduced or altered stream flow that may affect overwintering habitat availability and the ability of fish to migrate upstream. Protecting the integrity of stream bank vegetation and minimizing erosion are important elements in preserving fish habitat. Streambeds could be affected if stream banks are altered, such as in cases of damage from equipment crossings. Overwintering habitat may be limited; the Colville River provides the most consistently available overwintering habitat for anadromous fish in the sale area.

Withdrawal of water from lakes and ponds could affect fish overwintering habitat by entraining juvenile fish, lowering water levels, and increasing disturbance. The construction of roads across rivers and streams may also affect the ability of fish to reach overwintering areas by blocking movement and causing direct loss of overwintering habitat. Blockage of movement could also occur from the improper installation of culverts in streams for permanent roads.

During oil- and gas-related development, gravel removal from fishbearing streams to support oil and gas activities could adversely impact the habitat in these streams and the fish they support. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration.

Removal of water from lakes where fish are overwintering may affect the viability of overwintering fish, and longer-term effects of lake drawdown may impede the ability of fish to return to the lake in subsequent years. Removal of snow from lakes may increase the freeze depth of the ice, kill overwintering and resident fish, and adversely affect the ability of fish to utilize the lake in future years.

During development, unregulated gravel removal from fishbearing streams to support oil and gas activities could adversely impact anadromous fish they support. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration. Gravel removal from stream beds could also cause potential damage to overwintering fish populations. Alternatively, gravel mine sites can be restored as overwintering habitat and thus add to total available fish habitat.

Seismic Activities: Seismic activities are typically conducted during the winter months using drills and helicopters to minimize the effect on the environment. Seismic operations using high explosives could cause direct injury to fish resources in lakes and streams (Fink, 1996). Pressure waves from high explosives can potentially kill and injure fish near the explosion; however, the impulses dissipate to a non-lethal level within a short distance – less than 328 feet (MMS, 1996b). Overpressures of 30-40 pounds per square inch (psi) will kill fish with swim bladders. Overpressures of just 3 to 4 psi can kill juvenile salmonids. Shockwaves from explosions can also shock and jar fish eggs at sensitive stages of development. These types of impacts are mitigated by restricting the use of explosives in close proximity to fishbearing lakes and streams. Mitigation measures to protect fish eggs may include limiting the timing of seismic work and are considered by DO&G on a case-by-case basis as a condition for obtaining a geophysical exploration permit. Other restrictions include requiring that seismic activities be set back far enough from freshwater fish spawning areas that shockwaves are reduced to safe levels before reaching incubating eggs during sensitive stages of development (Fink, 1996). Seismic surveys are not expected to have any measurable effect on Arctic fish populations (BLM, 2005).

Causeways: The state discourages the use of continuous-fill causeways. Though remote, the possibility of needing a causeway into the nearshore Beaufort Sea to support development in portions of the sale area does exist. Placement of causeways, particularly continuous-fill causeways into the nearshore Beaufort Sea or in river deltas, can alter patterns of nearshore sediment transport, alter patterns of water discharge to the nearshore environment, and alter temperature and salinity regimes in areas near the causeway. The extent of alterations depends on the size or length of the causeway, its location relative to nearby islands and river mouths or deltas, and pre-causeway oceanographic characteristics. Minimizing alterations is accomplished by proper siting, minimal size, and by ensuring that breaches are sized and located to maximize goals. Changes to the physical environment may alter patterns of use of the deltaic area by anadromous and marine fishes. Changing marine current flow and circulation patterns result in physical changes to delta channeling and shorelines which could affect use by animals which feed on fish, such as shorebirds and waterfowl (Winters, 1996).

Any gravel structure that obstructs the natural migratory corridor near river mouths has the potential to adversely affect anadromous fish. Altering temperature and salinity in nearshore waters may affect the distribution and abundance of organisms upon which fish feed. For these reasons, solid-fill causeways are discouraged, and many designs, although ideal for field development, are unsuitable for the nearshore environment. Additionally, significant alterations of the shoreline or changes to natural temperature and salinity patterns are prohibited. Overall, the construction of causeways is not expected to have a measurable effect on fish populations in and adjacent to the sale area (BLM, 2005).

Oil Spills: Oil spills could range from small chronic leaks from equipment or facilities to catastrophic pipeline failures or drilling blowouts. The effects of oil spills on fish would depend on many factors, including the time of year, size of the spill, and waterbody affected. Potential adverse effects from an oil spill could include direct mortality from oiling of the gills, mortality of prey species, mortality from consumption of contaminated prey, and blockage of movement or displacement from important habitats. Mortality of egg and larvae could occur in spawning or nursery areas from the toxic effects of the oil. Sublethal effects may also reduce fitness and affect the ability to endure environmental stress. Effects of oil spills during the winter would be expected to be negligible but could potentially be major during the open-water season, depending on the site-specific conditions. Mitigation measures to protect fish and eggs from an oil spill include: siting facilities away from fishbearing streams and lakes, development of oil spill contingency plans, and providing adequate spill response training. Oil spills are not expected to have a measurable effect on freshwater or anadromous fish populations within and adjacent to the sale area (BLM, 2005)

Gas Blowouts: If a natural-gas blowout occurred, some fish in the immediate vicinity might be killed. Natural gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site but is not expected to be hazardous for more than 1 km downwind for more than one day (MMS, 1998).

Mitigation Measures

Title 41 of the Alaska Statutes requires protection of documented anadromous streams from disturbances associated with development. The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to fish. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Stream buffers: To the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses. In addition, no facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Shaviovik, and Kavik rivers.
- Obstructions to migration and movement: The State of Alaska discourages the use of continuous-fill causeways. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulations patterns and water quality characteristics that result in exceedances of water quality criteria, and must maintain free passage of marine and anadromous fish. Causeways and docks shall not be located in river mouths or deltas. To protect designated anadromous fish-bearing lakes and streams and to ensure the free and efficient passage of fish in all fish-bearing water bodies: alteration of

riverbanks may be prohibited; the operation of equipment, excluding boats, in open water areas of rivers and streams may be prohibited; bridges or non-bottom founded structures may be required for crossing fish spawning and important rearing habitats; and culverts or other stream crossing structures must be designed, installed, and maintained to provide free and efficient passage of fish.

- Protection from seismic activities: The lessee will consult with the NSB prior to proposing the use of explosives for seismic surveys. The Director may approve the use of explosives for seismic surveys after consultation with the NSB.
- Habitat protection: Removal of snow from fish bearing rivers, streams and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fish bearing waterbodies is prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice or snow bridges may be required. Water intake pipes used to remove water from fish bearing waterbodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed. Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean, R. F. 1993, North Slope Gravel Pit Performance Guidelines, ADF&G Habitat and Restoration Division Technical Report 93-9, available from ADF&G.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Production discharges: Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI and VIII wetlands, is prohibited. Additionally, unless authorized by an ADEC permit, surface discharge of reserve pit fluids and produced waters is prohibited. Also, if authorized by ADEC and EPA, disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques.

c. Effects on Birds

Some bird species, during periods of nesting, molting, and staging, are sensitive to activities associated with development. Generally, responses to industrial activities depend on species exposed, the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and possibly other factors (MMS, 1996). Potential impacts are more likely to occur after the exploration phase, as few resident species are present during winter when exploration occurs. Potential impacts include habitat loss, barrier to movement, disturbance during nesting and brooding, change in food abundance and availability, and oil spills.

<u>Habitat loss</u>: Siting of onshore facilities, such as drill pads, roads, airfields, pipelines, housing, oil storage facilities, and other infrastructure, could eliminate or alter some preferred bird habitats such as wetlands. Onshore pipeline corridors may include a road and associated impacts from traffic noise and dust may deter nesting in the immediate vicinity. The construction of offshore pipelines or re-supply activities could have temporary effects on the availability of food sources of some birds within a mile or two of the construction area due to turbidity and removal of prey organisms along the pipeline route. Impacts to waterfowl and shorebird populations are not likely to persist after development phase activities are completed (MMS, 1996b).

After facilities are built, some birds (individuals) can no longer nest in areas because the areas are covered by the new facility. Additional birds may avoid the area adjacent to the facility due to disturbance effects. However, these habitat changes do not translate into reduced numbers of birds in the area, as the displaced birds are found nesting in nearby areas and returned at rates similar to unaffected birds. There is no indication that displaced birds settled in habitat inferior to that from which they were displaced because they did not incur disproportionately lower nest success at their new nest sites. Habitat availability does not limit most bird populations at Prudhoe Bay. Nest predation by arctic foxes is proposed as the factor most likely limiting population levels (TERA, 1990). The USFWS disputes this conclusion, citing the small sample size (only one marked bird lost its nest site, and an additional seven had nest sites that were physically altered in some way). They note, however, the results lend no support to the hypothesis of habitat limitation (Sousa, 1997).

A five-year monitoring program to assess the effects of construction and operation of the Lisburne oil field on white-fronted geese, brant, snow geese, and tundra swans was conducted from 1985-1990. The purpose was to determine whether development-related disturbance and habitat loss have caused changes in the extent and nature of use of the Lisburne development area by geese and swans. The study concluded that the Lisburne development did not change the extent or nature of use of the area by geese and swans during construction and the first three years of operation of the oil field (Murphy and Anderson, 1993). This study synthesized the results from pre-construction studies conducted in 1983 and 1984. The pre-construction studies, however, did not investigate all aspects of goose and swan ecology and therefore a complete comparison with pre-development results was not possible (Murphy and Anderson, 1993).

Barriers to movement: Black brant populations have experienced periodic nesting failures in the Sagavanirktok and Kuparuk River deltas (Ott, 1993). Adults and young are flightless during the brood-rearing period, so roads, causeways, and other related structures may be barriers to brant movements (Sousa, 1992). There is no evidence that the Endicott road/causeway has been an obstruction to black brant movements (Johnson, 1994).

An initial concern expressed before construction began was that the Endicott road/causeway would act as a barrier to the movements of brood-rearing flocks of snow geese as they dispersed eastward from Howe Island after hatching in early July. Overall, 14 years of data show no indication that the Endicott development has impeded eastward movements of snow geese from their nesting colony on Howe Island. However, other studies document abandonment of brood-rearing areas near the Endicott road, and unsuccessful crossing attempts and failure of crossing the road for periods up to two weeks (Ott, 1997, citing to Envirosphere Co., 1986). Many negative behavioral reactions to the road/pipeline corridor were noted, although no population effect was detected (Sousa, 1997).

Seismic Activities: Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when birds are mostly absent from the sale area. 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 broodrearing periods would eliminate the potential for nest abandonment and loss of productivity (BLM, 2005).

Disturbance: Human activities such as air traffic and foot traffic near nesting waterfowl, shorebirds, and seabirds, could cause some species to temporarily abandon important nesting, feeding and staging areas. Birds have keen eyesight, and even slight movements may cause adults to abandon young hatchlings. A study of effects of aircraft on molting brant in the Teshekpuk Lake area (Derksen et al., 1992) concludes that helicopters, and to a lesser extent fixed-wing aircraft, cause serious disturbance. However, as pointed out in the Habitat Loss section, disturbance does not translate into a population reduction. Some species, such as tundra swans, are particularly sensitive to humans on foot, and may abandon their nests when humans approach within 500 m to 2000 m of the nest (MMS, 1996b).

Research has indicated that some birds may not be readily disturbed. A 1993 study, Bird Use of the Prudhoe Bay oil field, concluded that on the order of five percent of the birds in the Prudhoe Bay oil field may have been displaced by gravel placement and secondary alterations of adjacent areas, but that these birds most likely occupy nearby areas. Overall, there is rearrangement of birds but probably no net change in bird abundance within the oil field (TERA, 1993). The nesting of most local birds is widely dispersed over the coastal tundra and disturbance probably would have little effect on North Slope bird populations as a whole (MMS, 1996b).

In 1985, ARCO Alaska, Inc. initiated a five-year monitoring program to assess the effects of construction and operation of the Lisburne oil field on Canada geese, greater white-fronted geese, snow geese and tundra swans. Pre-construction studies were conducted in 1983 and 1984; however, they did not investigate all aspects of goose and swan ecology evaluated during construction and post-construction. In addition, the Lisburne field is located within the existing Prudhoe Bay oil field, where oil development activities have been ongoing since the early 1970s. The study encompassed the construction phase (1985-1986) and the first three years of operation (1987-1989). The final synthesis report concluded that the Lisburne development did not change the extent or nature of use of the development area by geese and swans during construction and the first three years of operation. No major shifts in the use of the sale area were detected when comparing survey results between construction and post-construction and the limited data on bird distribution from pre-development studies (ABR, 1993).

In 1983, Sohio Alaska stockpiled more than one million cubic meters of gravel on the western tip of Thetis Island. Operations also involved the installation of a temporary support camp, construction of helicopter landing pad, gravel berms to support two large conveyor belts, and a fleet of barges to haul the gravel. Sohio instituted a series of mitigation measures — the establishment of an aircraft flight corridor and buffer zone, a restricted access zone for camp personnel, and at the request of USFWS, a program to remove arctic foxes. The numbers of common eiders nesting on Thetis Island in 1983 were higher than had been recorded in any previous year. The mitigation program implemented by Sohio may have been at least partly responsible for the increase. Three eiders established nests and successfully incubated and hatched eggs at different sites within 300 m of the helicopter landing pad (LGL Associates, 1984).

The level of impacts is dependent on the location and extent of facilities. However, once exploration and development or production ceases in an area, bird populations could recover from the effects of disturbance, reducing overall effects in the sale area (BLM, 2005).

<u>Oil Spills</u>: Direct contact with spilled oil by birds is usually fatal, causing death from hypothermia, shock, or drowning. Oil ingestion from preening oily feathers or consumption of oil-contaminated foods may reduce reproductive ability, and could lead to chronic toxicity through the accumulation of hydrocarbon residues. Oil contamination of eggs by oiled feathers of parent birds significantly reduces egg hatching through toxic effects on chick embryo or abandonment of the nest by parent birds (MMS 1996). The presence of humans, aircraft, boat and vehicular traffic involved in cleanup activities is expected to cause displacement of nesting, molting, and feeding birds in the oiled areas and contribute to reduced reproductive success of the birds (MMS, 1996). The number of birds impacted by a spill would depend on the time of year and the density of local bird populations. Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe (BLM, 2005). Spill prevention and response are described in Chapter Six, and would apply to any new development in the sale area.

Gas Blowouts: In the event of a natural gas explosion and fire, birds in the immediate vicinity could be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect birds or their food sources except those very near to the source of the blowout (MMS, 1996).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to fish. For a complete listing of mitigation measures and lessee advisories, see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat protection: Permanent, staffed facilities must be sited to the extent practicable outside identified brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas. Additionally, to the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Lessees must comply with USFWS and NMFS requirements regarding the Endangered Species Act, Migratory Bird Treaty Act and the Marine Mammals Protection Act (See Lessees Advisories). Finally, lessees must comply with the provisions of Appendix B of the "Yellow-billed Loon Conservation Agreement," dated July 31, 2006 between the ADF&G, ADNR, USFWS, BLM and NPS.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- NSB municipal code: In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle, and vessel operations regulated by NSB code.

If oil development occurs, some alteration of bird habitat can be expected. However, with state and federal government oversight, any activities within the sale area should not prevent overall bird population levels from remaining at or near current levels.

d. Effects on Wildlife

i. Caribou

Since 1975, government and industry have conducted research on caribou biology and on various aspects of their interaction with North Slope oil and gas developments. Population characteristics (calf production and survival, and adult mortality), habitat use, movement and distribution, and behavioral responses of caribou to oil and gas developments have been studied, but there is disagreement regarding the interpretation of data with respect to the effects of oil and gas development. Some researchers attribute declines in caribou populations to oil and gas development, while others think populations (reproduction and viability) are subject to natural cycles in the ability of the land to support large numbers of caribou (carrying capacity). Still others think caribou numbers are influenced by many factors, such as disease, nutrition, predator abundance (including insects), and weather. Hunting pressure and loss of high-quality tundra from oil and gas development is not a primary factor in the rise and fall of caribou populations. Nonetheless, studies show that local distribution and behavior of caribou are affected by infrastructure and human activities within producing oil fields.

Potential impacts can occur at all phases, but most are likely to occur during development and production. Adverse effects are discussed below. Potential effects to caribou populations from the sale include displacement from insect relief and calving areas due to construction and operations, and from oil spills.

Disturbance: One source of disturbance to caribou is construction. During construction, small groups of caribou may be temporarily displaced; however, the disturbance reaction would diminish after construction is complete. Furthermore, construction will not take place over the entire sale area at the same time. If caribou are displaced from calving in a certain area due to construction, they are likely to calve in an area where construction is not taking place. The use of specific calving sites within the broad calving area varies from year to year. If calving caribou are displaced from high nutrition forage near a drill site or facility, they are likely to seek any protective area regardless of the forage. The cumulative effect of displacement from high value tundra could be lower calf survival. On the other hand, high populations would force the caribou into lower nutrition areas anyway (MMS, 1996b).

Cow and calf groups are most sensitive to human disturbance just prior to calving, and during the post-calving period (Cronin et al., 1994). Caribou may use portions of the coastal plain for calving, but most calves are born in the uplands (USFWS, 1987). Ground-vehicle traffic, aircraft, and human presence near cows with newborn calves also affect individuals as they migrate (MMS, 1996b). Caribou may be more affected by oil development than previously thought, particularly during calving, according to ADF&G (Smith and Cameron, 1991).

Motor-vehicle and aircraft traffic can also disturb caribou. Caribou can be briefly disturbed by low-flying aircraft. The response of caribou to potential disturbance is highly variable, ranging from no reaction to violent escape reactions. Reactions depend upon: distance from human activity; speed of approaching disturbance source; altitude of aircraft; frequency of disturbance; sex, age, and physical condition of the animals; size of caribou group; and season, terrain, and weather. Habituation to aircraft, vehicle traffic, and other human activities has been reported in several studies of hoofed-mammal populations in North America. The variability and instability of Arctic ecosystems dictate that caribou have the ability to adapt behaviorally to some environmental changes (MMS, 1996b).

Aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females can be displaced by road systems (Cameron, et al., 1992). After construction of the Milne Point road, caribou were significantly less numerous within one kilometer of roads and significantly more numerous five to six kilometers from roads. In addition to the locally perturbed distribution of caribou, researchers observed a decline in relative use of a portion of the sale area between Oliktok Point and Milne Point roads. However, the causes of reduced use of oil field tundra by calving caribou of the Central Arctic herd is difficult to determine by aerial observations, because of unpredictable random factors, such as weather. “Annual variation in the numbers of caribou observed near Milne Point is primarily an effect of spring snow conditions.” (Cameron, et al., 1992) Distribution of caribou tends to be skewed inland in years of late snow melt, and concentrated near the coast in years of early melt. In addition to snow conditions and resultant forage availability, relative occurrence of caribou in the Kuparuk River calving area is influenced by predator and insect avoidance behavior. Overall caribou use of an area could be greatly reduced if roads with moderate traffic are routed too closely (Cameron, et al., 1992). “[A]nd inaccessible habitat is habitat lost.” (Cameron, et al., 1995).

Some displacement of the Central Arctic herd caribou from a portion of the calving range near Prudhoe Bay and Milne Point facilities has been documented. Ground observations of caribou within the Kuparuk area from 1978 to 1990 indicate that caribou increasingly avoided zones of intense activity, especially during the calving period. Pregnant caribou could be delayed in reaching calving grounds because of delays in crossing roads or attempts to detour around oil fields. Calving en route to calving grounds could result in reduced calf survival (BLM, 2005).

In the absence of insect harassment, caribou within 1,640 feet of roads with no traffic spent more time feeding than did caribou 1,640 feet and farther from roads with traffic. Avoidance of roads during periods of high traffic in the post calving period was noted by Roby in 1978 and by Dau and Cameron in 1986. Some research indicates that roads that receive little use by humans need not be separated from pipelines (Curatolo and Reges, 1985). Pipelines elevated at least five feet allow for effective crossing, except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles per hour). The Alaska Caribou Steering Committee concludes the most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet (Cronin et al., 1994). Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee.

Disturbance of caribou associated with cumulative oil exploration, particularly by helicopter traffic, is expected to have minor effects on caribou, particularly large groups, with animals being briefly displaced from feeding and resting areas when aircraft pass nearby. Vehicle traffic associated with transportation corridors has the potential to affect habitat use in intensely developed areas of the Prudhoe Bay and Kuparuk oil fields. Acute disturbance effects may in combination result in a cumulative effect on habitat availability for those individuals with fidelity to the Kuparuk River calving area, but may have little or no effect on the Central Arctic herd population. It is expected these disturbances would be short term (BLM, 2005). Despite the fact that cumulative effects at the population level are difficult to quantify, measures should be incorporated into operations planning and facility design to avoid both direct and indirect impacts to caribou.

Habitat Loss and Displacement: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Caribou are subject to mosquito harassment from mid-to-late June through July, and to oestrid fly harassment from mid-July to late-August. In response, caribou move from inland feeding areas to windswept, vegetation-free coastal areas, where the insects are limited. Most mosquito relief areas are found within 4.5 miles of the coast (ADF&G, 1986b). Caribou use various coastal habitats such as sandbars, spits, river deltas, and some barrier islands for relief from insect pests. (MMS, 1987b). Caribou may use some of the barrier islands and adjacent areas for insect relief. If coastal habitat is unavailable for insect relief, caribou may use foothills south of the Coastal Plain for insect relief (USFWS, 1987). Insect relief zones not only include coastal areas, but mountain tops, river deltas, flood plains, and river bars.

In the absence of available insect-relief habitat, caribou gather into large groups or continue to move into the wind without feeding. A period of extensive insect harassment can result in weight loss. In addition, caribou lose up to 125 grams of blood a day to mosquitoes and suffer increased parasitism from skin warbles and nasal bot flies. If caribou are delayed or prevented from free access to insect-relief habitat, the result may be deterioration in body condition resulting in decreased growth, increased winter mortality, and lowered herd productivity (USFWS, 1987).

The frequency and duration of caribou movements to and from the coast depend on weather related changes in the number of mosquitoes, and caribou distribution on the coastal plain can change dramatically within a 24-hour period. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases (Shideler, 1986). Caribou that remain inland may move to river bars and bluffs to escape insects.

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. Biologists representing both industry and ADF&G have agreed that facilities built earlier in the development of the Prudhoe Bay oil field have created impediments to caribou movements. Flow and gathering pipelines were elevated only one to four feet above the surface, thus forming an effective barrier to caribou crossing. However, extensive research on the response of caribou to development has now shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field. Factors influencing the crossing success of caribou beneath elevated pipelines include group size or composition, topography, insect activity, traffic levels, the intensity of local construction, as well as road or pipeline configuration (Shideler 1986). The mere physical presence of a pipeline would probably have a minimal effect on behavior, movement or distribution of caribou, except perhaps when heavy snow prevented some animals from crossing under or over the pipeline (BLM, 2005).

In the Kuparuk field where all pipelines are elevated a minimum of five 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 (BLM, 2005).

If displacement from coastal insect-relief areas did occur during the construction of oil and gas facilities, it would be temporary and disturbance reaction would diminish after construction is complete, provided that road systems are not spaced too closely. Routes that caribou take as they migrate to and from the coast depend on their location at the beginning and end of the insect harassment season, and thus as weather phenomena are random, so are the resultant caribou movements (Cameron, et al., 1995). Whereas calving caribou are highly sensitive to development, “female caribou will tolerate considerable surface development in summer, especially when passage under (or over) pipelines is possible” (Cameron et al., 1995, citing to Smith et al., 1994).

The Central Arctic herd has grown considerably during the period of oil field development, but lack of pre-development data makes assessment of effects of oil field development difficult. Also, the understanding of the population dynamics of the North Slope caribou herds is incomplete and no firm conclusions about the effects of oil field development on reproductive success of the herd can be drawn. Based upon comparisons with other herds, there have been no apparent effects of oil field development on the growth of the Central Arctic herd. This does not suggest that there may not be effects in the future, or that other herds under different ecological conditions may not be affected (Cronin et al., 1994). The Central Arctic herd was estimated at approximately 5,000 caribou in 1975. The most recent photocensus conducted in 2002 documented approximately 32,000 caribou (BLM, 2005).

Post-sale activities have the potential to affect caribou of the Central Arctic herd, Teshekpuk Caribou herd, and the Porcupine Caribou herd. While the summer range of the Teshekpuk Caribou herd is outside of the sale area to the west of the Colville River, caribou of the herd may pass through the sale area during their annual migration from the Brooks Range (Philo, et al., 1993). Caribou of the Central Arctic herd migrate in a north-south direction along major river corridors of the sale area and thus could be affected year-round by oil and gas activities. Caribou of the Porcupine Caribou herd also can be found year-round in the far eastern portion of the sale area, although winter and summer populations are concentrated in the Arctic National Wildlife Refuge, and in Canada (Cronin, et al., 1994).

“Although new development within existing oil fields may increase cumulative effects, new technologies can reduce the infrastructure surface area (see figure 5.2). The use of directional drilling to maximize the number of wells at drill sites, the centralization of power plants and utility systems, and the joint use of roads, pipeline corridors, and airports all contribute to less area impacted by oil field infrastructure” (Cronin, 1994 citing to Senner, 1989).

Documenting positive effects of oil field development is as equally challenging as documenting adverse effects. Dust settling alongside roads in the spring leads to earlier snowmelt and green-up of vegetation. Caribou may feed in these areas in late May prior to calving (Cronin, et al., 1994, citing to Lawhead and Cameron, 1988). Caribou commonly congregate on gravel pads and roads, and in areas shaded by facilities, possibly for insect relief, particularly from oestrid flies (Cronin, et al., 1994, citing to Johnson and Lawhead, 1989; Lawhead, 1997). Caribou were observed using roads and gravel pads and the shade of pipelines and buildings as insect relief areas, which at other times they tended to avoid. Caribou were also observed using unvegetated gravel pads at more than twice the average number of those using vegetated pads of comparable size (BPX, 1990). Caribou have habituated to onshore facilities and have been observed using roads, gravel pads, and the shade provided by pipelines and buildings, for insect relief (USFWS, 1987). However, researchers have noted that use of existing oil field facilities as insect relief habitat may cause caribou to avoid preferred foraging areas thought to be further inland (Cronin et al., 1994, citing to Roby, 1978).

Measures can be taken in oil field facility design to reduce the potential for adverse effects on caribou, such as displacement. If pipelines must be elevated, they should be so at least seven feet above the tundra. Where possible, sections of pipeline should be buried, especially at key migration corridors, such as river and stream crossings. There is a correlation between crossing success and the presence and use of an adjacent road. Adverse effects caused by roads with heavy traffic adjacent to pipelines can be mitigated by increasing the distance between the road and the pipeline, and by restricting traffic flow. Roads should be separated from elevated pipelines by at least 500 feet. Installing ramps to facilitate crossings is another option; however, studies indicate the effectiveness of ramps is debatable. Ramps are not likely to play a significant role in facilitating direct and underlayed road and pipeline crossings, but may be important facilitators during large-scale post-calving movements. Construction and re-supply activities should be scheduled to not occur during calving periods or when significant caribou movements are anticipated. Other measures include horizontal and vertical aircraft flight restrictions; restricting unnecessary public access to the oil field road system; training of oil field employees; and caribou migration monitoring. Biologists should be included in initial field design and in making decisions regarding the placement of facilities and routing of roads and pipelines in key areas (Cronin, et al., 1994). Finally, to reduce the potential for adverse effects on caribou from direct habitat loss, facility pad size should be minimized. When possible, facilities such as processing units, drill pads, and airstrips should be consolidated. Multiple wells should be drilled from a single surface location when possible, and the use of extended-reach drilling techniques should be employed where feasible.

Oil spills: Caribou may also be impacted by oil spills. Caribou that become oiled could die from toxic-hydrocarbon inhalation and absorption through the skin. If caribou were to ingest oil-contaminated vegetation, the result would be significant weight loss and aspiration pneumonia, leading to death. In the event of an oil spill that contaminated tundra or coastal habitats, however, caribou probably would not ingest the oiled vegetation. Caribou are selective grazers and are particular about the plants they consume (MMS, 1996b). The majority of impacts would result from disturbance associated with spill clean-up activities, such as the presence of humans and boat, vehicle, and air traffic operating in the spill cleanup operations, rather than direct oiling (BLM, 2005). Such activity is expected to cause disturbance and displacement of caribou. (MMS, 1996b).

Gas Blowouts: Impacts of a gas blowout on caribou would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, caribou in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Therefore, toxic fumes would not affect animals, except those very near the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to terrestrial mammals. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- AS 38.05.035(e) provides the Director with the authority to impose conditions or limitations, in addition to those imposed by statute, to ensure that a resource disposal is in the state's best interests.
- Habitat loss: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important caribou or other large ungulate calving and wintering areas during the plan of operations approval stage.
- Disturbance: Pipelines shall be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-ground pipelines must be elevated 7 feet. ADNR may require additional measures to mitigate impacts to wildlife movement and migration. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 feet or a lateral distance of 1 mile from caribou and muskoxen concentrations.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee: Cronin, M. et al, 1994. "Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou." LGL Alaska Research Associates, Inc., July.

ii. Muskoxen and Moose

Muskoxen are present in low numbers in the Sagavanirktok drainage and other drainages west of the Canning River and are expanding their range. Little is known regarding the influence of roads, traffic, and pipelines on muskox movements (Ott, 1996).

Moose occur all across the North Slope with the largest concentration along the Colville River and its tributaries. Moose generally remain in the foothill portions of the sale area along river corridors. Post-sale activities are expected to have little effect on the North Slope moose population.

Habitat Loss: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure (Ott, 1996). Muskoxen have a high fidelity to particular habitat areas because of factors favorable to herd productivity and survival, such as food availability, snow conditions, or absence of predators. Displacement from preferred habitat could have a negative effect on muskoxen populations. The magnitude of the effect is difficult to predict, but would likely be related to the magnitude and duration of the displacement (USFWS, 1987). Muskoxen populations on the North Slope have been declining in recent years. Herds elsewhere in the state are healthy. Most of the losses have been in ANWR. Biologists are not certain why, but starvation, drowning in floods, and predation by grizzly bears may play a role. Hunting has not played a big role but state and federal managers have restricted hunting because herd numbers are so low (ADN, 2006d).

Moose prefer riparian habitat – stands of willow and brush. Very little if any of this habitat is expected to be lost as a result of post-sale activities because of mitigation measures that: prohibit alteration of river banks, except for approved permanent crossings; and except for approved stream crossings, prohibit equipment operation within willow stands (*Salix* spp.) and permanent facility siting is prohibited within one-half mile of major rivers in the sale area, including the Colville.

Disturbance: Muskoxen and moose may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Muskoxen remain relatively sedentary in the winter, possibly to conserve energy. The energetic costs associated with forced movements during winter may be as significant an impact as disturbance during calving. Mixed groups of muskoxen showed a greater sensitivity to fixed-wing aircraft in winter and during calving than in summer, fall, or during rut. Increased activity during exploration and development in muskoxen overwintering areas may have an adverse effect on muskoxen survival (Sousa, 1992). Muskoxen may be able to habituate to aircraft and seismic disturbance (USFWS, 1987).

Moose adapt readily, and habituate to the presence of human activity and are not easily disturbed (USFWS, 1987, citing to Denniston, 1956; and Peterson, 1955). However, they can become agitated and may be more sensitive to disturbance when calves are present from mid-May to early June. In the Kenai National Wildlife Refuge, moose distribution, movements or behavior were not affected by helicopter-supported winter seismic surveys using explosives (USFWS, 1987, citing to Bangs and Bailey, 1982). Moose generally do not venture as far north as the existing oil fields, however in the southern portion of the sale area, some moose-oil field interaction may become common. Some fencing may be appropriate around facilities. Moose mortality may occur as a result of collisions with vehicles (USFWS, 1987).

Oil Spills: In general, the effects of an oil spill on muskoxen and moose would be similar to that of other terrestrial mammals. An oil spill may result in oil contamination of individual animals in the immediate vicinity, contamination of habitats, and contamination of some local food sources. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of muskoxen or moose, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement during cleanup operations.

Gas Blowouts: Impacts on muskoxen and moose of a gas blowout would be similar to that of other terrestrial mammals. In the event of a natural gas explosion or fire, muskoxen or moose in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to muskoxen and moose. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat loss: To the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Disturbance: Pipelines shall be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-

ground pipelines must be elevated 7 feet. ADNR may require additional measures to mitigate impacts to wildlife movement and migration. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 feet or a lateral distance of 1 mile from caribou and muskoxen concentrations.

- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

iii. Brown Bear

Brown bears can be found throughout the Arctic region in varying densities. The lowest densities occur along the coastal plain; brown bears are at the northern limits of their range in the Arctic. The availability of food is limited and their reproductive potential is low (ADF&G, 1986a).

Habitat Loss: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Quantifying the number of animals involved is difficult. Brown bears travel along the major river corridors and feed in riparian areas of the sale area. Siting facilities outside these areas will reduce potential impacts on brown bears (USFWS, 1987).

Disturbance: Brown bears may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Seismic activity that occurs in winter may disturb denning bears. Studies have found that radio-collared bears in their dens were disturbed by seismic activities within 1.2 miles of their dens, demonstrated by an increased heart rate and greater movement within the den. However, no negative effect, such as den abandonment was documented (USFWS, 1987).

Interaction with Humans: During exploration and development, human activity may attract foraging bears, especially to refuse disposal areas. Omnivores are attracted to food and food odors associated with human activity, and may become conditioned to non-natural food sources (Baker, 1987). This may pose a threat to human safety and the potential need to shoot “problem” animals. Bears can also be displaced by human land use activities.

Oil Spills: The potential effects of oil spills on brown bears include contamination of individual animals, contamination of coastal habitats, and contamination of some local food sources. Bears feed on fish concentrations at overwintering and spawning areas. Bears may also feed on beached marine mammal carcasses along the coast (Ott, 1997). If an oil spill contaminates beaches along the coast, bears are likely to ingest contaminated food sources. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of brown bears, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of brown bears during cleanup operations.

Gas Blowouts: Impacts on brown bear of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, brown bear in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to brown bears. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Human-bear interaction plan: For projects in proximity to areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears.
- Habitat protection: Before commencement of any activities, lessees must consult with ADF&G to identify the locations of known brown bear den sites. Exploration and production activities must not be conducted within one-half mile of occupied brown bear dens. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.

iv. Furbearers

Wolves, Wolverines, and Foxes: Fox populations vary in response to fluctuations in their natural prey sources, but a constant food supply could maintain the fox population at artificially high levels. This could cause near total nest failure of all waterfowl and shorebirds in the development area because foxes prey on eggs and young birds. Foxes and wolves are also noted for their rabies outbreaks, which increase when population densities are high and create health risks to humans. Activity during exploration and development may attract foraging foxes and wolves, especially to refuse disposal areas. Wolverines apparently are not attracted to garbage (USFWS, 1986).

<u>Habitat Loss</u>: Winter arctic fox habitat is primarily along the coast and sea ice. Denning occurs up to 15 miles inland. Red foxes also may den within 10 miles of the coast but are generally found farther inland (Ott, 1996). Habitat destruction would primarily affect foxes through destruction of den sites. Placement of oil and gas infrastructure at or near den sites may either destroy den sites or cause foxes to den elsewhere (USFWS, 1986). However, foxes have been known to use culverts and other construction materials for denning. Wolverines occur exclusively in remote regions where human activity is unlikely; therefore, displacement of wolverines from local areas of development is unlikely (USFWS, 1987).

The effects of direct habitat loss on wolves would likely be negligible. The abundance of wolves is ultimately determined by the availability of prey. The ability of adults to provide food is the key determinant in wolf pup survival. Reduction in prey species, such as caribou, could reduce wolf populations (USFWS, 1987).

<u>Disturbance</u>: Wolves are unlikely to be disturbed by development because they readily habituate to human activity. During construction of the Dalton Highway and trans-Alaska oil pipeline, wolves readily accepted handouts from construction workers (USFWS, 1987). Primary sources of disturbance are seismic

activities and aircraft traffic. Helicopters generally invoke a stronger response from wolves and foxes than fixed-wing aircraft. Ice roads connecting well sites and supply areas would provide a source of disturbance from vehicles. Impacts of seismic exploration and drilling on wolves are unknown (USFWS, 1986).

Oil Spills: The general effects of an oil spill on wolves, wolverines, and foxes are similar to that of other terrestrial animals. The potential effects of oil spills include contamination of individual animals, contamination of habitats, and contamination of some local food sources. Furbearers, particularly foxes, may be attracted to dead oiled wildlife at a spill site. Foxes may be attracted to the human activity at a spill site by the possibility of finding food or garbage. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of wolves, wolverines, and foxes, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of these animals during cleanup operations, with the possible exception of foxes.

Gas Blowouts: Impacts on wolves, wolverines, and foxes of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, animals in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to furbearers. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat protection: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.

v. Polar Bear

On May 15, 2008, the USFWS published a *Final Rule* in the Federal Register listing the polar bear as a threatened species under the Endangered Species Act (ESA) See Chapter Three, Section 4.a.

Potential impacts to polar bears include disruption of denning, attraction to areas of activity, and adverse interaction with humans; in the case of an oil spill, potential effects could include ingestion of oil and oil contamination.

Habitat loss: Construction of offshore oil and gas facilities such as pipelines, gravel islands, causeways, and production platforms could have local effects on ice movements and fast ice formation around the structures. Construction activities could have a short-term (less than one year) effect on polar bear distribution (MMS, 1996b).

Disturbance: The primary sources of noise disturbance would come from air and marine traffic. Seismic activities and low-frequency noise from drilling operations would also be a source of noise. Disturbance from human activities, such as ice road construction and seismic work, could cause pregnant females to abandon dens early. Early abandonment of maternal dens can be fatal to cubs. However, a study of den disturbances found that most of the denned bears tolerated exposure to exceptional levels of disturbance (Amstrup, 1993). In addition, denning habitat is not limiting and the timing of denning is predictable (Amstrup and Gardner, 1994). Therefore, potential effects of disturbances can be mitigated by spatial and temporal management (Amstrup, 1993; Amstrup and Gardner, 1994).

Habitat Modification: Polar bears continually search for food. Once bears find a camp or industrial site, they will often enter to explore and search for food. If a bear receives a food reward, it is more likely to return. Polar bears often investigate not only things that smell or act like food, but also novel sights or odors. Subadults are more likely to be food-stressed and attracted to human activity more commonly than well-fed bears. Subadults are also less likely to leave if a potential food source is present. Attractants include kitchen odors, deliberate feeding, accessible garbage, sewage lagoons, carcasses, industrial materials, and alteration of habitat (MMS, 1993).

Oil contamination: Polar bears have been observed eating hydraulic fluid and other petroleum lubricants, and at least one bear in the Prudhoe Bay area died as a result of ingesting ethylene glycol antifreeze (Ott, 1990). In the case of a potential oil spill, bears could contact oil directly by swimming or wallowing in contaminated areas, or indirectly by scavenging oiled carcasses along the beach, by preying on oiled seals, or while maintaining their fur. In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of polar bears, the presence of humans (boat, vehicle, and aircraft traffic operating in the area) could cause disturbance and displacement of polar bears during cleanup operations. Conversely, polar bears could be attracted to a spill site by the presence of dead birds or other animals killed by the spill, or by the human activity previously associated with a food source (MMS, 1996b).

Amstrup et al. (2006) conducted a modeling study to predict the probability that polar bears on the North Slope would be exposed to hypothetical oil spills from two locations in the Beaufort Sea, one that is currently operating offshore (Northstar) and one that was proposed for offshore (Liberty). The model incorporated actual weather data such as wind, ice, and currents, and used NOAA methods for modeling oil spills. Data from studies of radio-collared polar bears from 1985-2003 were also used. The model examined the worst case scenario: the largest anticipated catastrophic spill; the largest anticipated chronic spill; the worst possible times, the maximum open water period (September), and the period of maximum polar bear density (October); no attempt at cleanup or other human intervention; and maximum effect (all bears touched by oil killed). The model did not take into account uncertainty in polar bear population estimates or oil weathering. Median numbers of polar bears oiled by a worst-case scenario spill at Liberty were 1 bear in September and 3 bears in October; median numbers oiled at Northstar were 3 bears in September and 11 bears in October. Based on this model, there is a very low probability that a large number of polar bears would be affected by an oil spill; and, if an oil spill were to happen, there is a large probability that a low number of bears would be affected (Amstrup et al., 2006).

The Amstrup et al. (2006) model did not take into account the risk of an oil spill in the first place. There have been no marine oil spills in the Beaufort Sea in more than 25 years of exploration and development and there has never been an oil spill from a platform blowout in Alaska. The Northstar pipeline is designed to operate without leaking even if all the potential sources of failure (ice gouging, strudel scour, settlement) occur at the same time and same location. This is an extraordinarily conservative design basis. MMS evaluated the design of the Northstar project and concluded the risk of an oil spill of 1,000 bbl or greater was on the order of 1 to 2 percent. From all approaches reviewed, zero was the most likely number of spills (MMS, 2000).

Interaction with humans: Some polar bears could be killed as a result of human-bear encounters near industrial sites and settlements associated with oil and gas development. Some of these losses might be unavoidable and would represent a small source of mortality on the polar bear population that would be replaced by reproduction within one year. The incidental loss of polar bears due to oil and gas development in the sale area is unlikely to significantly increase the mortality rate of the polar bear population above that which is occurring due to subsistence harvests and natural causes (MMS, 1996b).

Polar bears are protected under the MMPA of 1972, which prohibits the “taking” of marine mammals. By interpretation, taking is said to occur whenever human activity causes a polar bear to change its behavior. Disturbing a polar bear by trying to take a picture of it or scaring a bear away from a building are violations under the law (MMS, 1993). Taking a polar bear by individuals is legal under some circumstances, such as federal, state, or local government officials acting in the course of their official duties. Additionally, native Alaskans living on the coast are allowed to hunt polar bears for subsistence and handicraft purposes, provided it is not done in a wasteful manner.

In 1987, the North Slope Borough Fish and Game Management Committee and the Inuvialuit Game Council of Canada signed an agreement on polar bear management in the southern Beaufort Sea region. Among other measures, the agreement protects bears in dens and family groups with cubs, sets a hunting season, provides a framework for setting annual quotas for each country, and establishes a reporting system. The agreement is voluntary and has no regulatory backing (MMS, 1993).

In 1993, amendments to the MMPA made the USFWS responsible for the conservation of polar bears in Alaska. These amendments allowed for the incidental, but unintentional “take” of small numbers of polar bears. To comply with the requirements of the “take” regulations, oil and gas activities in Important Habitat Areas in the Beaufort Sea are subject to a Letter of Authorization (LOA) from the USFWS Regional Director of the Alaska Region. The northern coastal portion of the sale area has been identified as an Important Habitat Area. The decision to request a LOA is up to the individual operator, although the operators are liable for incidental takes in the absence of a LOA. LOA’s specify terms and conditions appropriate for the conservation of polar bears, such as interaction plans and detection efforts. Through the LOA, the USFWS has the authority to require and specify the type of interaction plans. LOA’s are tailored to the individual project and take into consideration factors including the time period and specific location where the activity is to take place.

Bear den and seal lair detection efforts are not required of operators, although these could be imposed at the plan of operations stage. Under terms of Letters of Authorization (LOAs) and the Mitigation Measures, industry is required to contact USFWS to identify the locations of known active polar bear dens (with industry activities) and must avoid known dens by one mile, withdraw immediately from any new dens, and report new dens to the USFWS (USFWS, 1995). Detection methods consist of reconnaissance by snow machine, and aerial surveys. Infrared radar locates animals by the heat their bodies give off. Infrared radar has successfully detected a 100-watt light bulb placed in a manmade den (Schliebe, 1997).

At the leasing phase, it is not possible to predict if, when, where, how or what kind of exploration, development or production might occur, but any activities that could occur subsequent to the lease sale will be subject to the mitigation measures in Chapter Seven. In addition, a host of other rigorous state, federal, and NSB permitting restrictions and regulatory mechanisms addressing polar bears, or applicable to them, are in place. Additional state regulatory mechanisms include large project planning (OPMP), ACMP, DMLW permits and approvals, ADF&G habitat and permitting, and SPCO mitigation measures and stipulations.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to polar bears. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Human-bear interaction plan: For projects in proximity to areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears.
- Habitat protection: Before commencement of any activities, lessees shall consult with the USFWS to identify the locations of known polar bear den sites. Operations must avoid known polar bear dens by one mile. A lessee who encounters an occupied polar bear den must report it to the USFWS and avoid the new den by one mile.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.
- Disturbance: In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle, and vessel operations regulated by NSB code.

vi. Other Marine Mammals

Despite protective measures, development of leases in the sale area could add to cumulative impacts on ringed, spotted and bearded seals, and walrus. The majority of the North Pacific walrus population occurs west of Barrow, although a few walrus may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open water season. Both ringed and bearded seals are commonly distributed throughout the coastal portion of the sale area, and populations vary considerably with seasonal weather changes. Spring and summertime oil and gas exploration and development activities in the sale area and elsewhere in the Beaufort Sea could disturb seals and walrus and depending on other human activity in the area, and could ultimately contribute to some limited displacement.

Bowhead whales traverse the NPR-A coast during the spring and fall migrations, although they generally travel several miles offshore. During the spring migration, the near shore waters are completely ice covered and the migration occurs far from shore (BLM, 2007).

Studies conducted in recent decades have shown that bowhead whales do respond to vessels by moving away, or altering their surfacing and diving patterns. However, evidence is not conclusive to support that permanent changes to feeding or migratory patterns have occurred (Fraker, et al., 1985: Green 1987). These biologists believe that little information is available showing that bowheads abandon an area, travel far, or remain disturbed for extended periods after a ship passes. In terms of displacement from areas with heavy traffic, past observations and studies demonstrate that various cetacean species react differently to long-term disturbances, and consequently, bowhead whale responses to repeated disturbances cannot be predicted accurately (LGL Limited, 1991).

Habitat Loss: Some pinnipeds could be temporarily displaced by construction activities associated with causeway construction or creating a gravel drilling/production is land. Onshore development near the coast could also disturb a small number of pinnipeds. However, the amount of displacement is likely to be very small in comparison with the natural variability in seasonal habitat use and is not expected to affect seal populations. Effects are likely to be one year or one season or less, with any disturbance of pinnipeds declining after construction activities are complete (MMS, 1996).

Disturbance: The primary sources of noise and disturbance of pinnipeds would come from marine traffic, air traffic, and geophysical surveys. A secondary source would be low frequency noises from drilling operations. Boat traffic could disturb some pinnipeds concentrations; however, such traffic is not likely to have more than a short-term (a few hours to a few days) effect. Helicopter traffic is assumed to be a source of disturbance to pinnipeds hauled out along the beaches of the Colville River Delta and other haulout areas. Such brief occasional disturbances are not likely to have any serious consequences. Noise and disturbance from island or causeway construction may also adversely affect pinnipeds in the area. Noise and disturbance from seismic operations could cause a brief disturbance response from seals and walrus. However the affected animals are likely to return to normal behavior patterns within a short period of time (MMS, 1996b).

Oil Spills: Direct contact with spilled oil by pinnipeds may result in mortalities. Newborn seal pups that come in contact with oil may lose their thermo-insulation capabilities and die from hypothermia. Adults may only suffer from temporary eye and skin irritations. The specific effects would depend on many factors, including the seal’s age and health. Seals are known to be capable of metabolizing as well as excreting and absorbing oil. In general, deaths from contact with oil among adult seals are most likely to occur during periods of high natural stress, such as during the molting season, times of inadequate food supply or if affected by disease (MMS, 1987). In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of pinnipeds, boat, vehicle, and aircraft traffic operating in the area is expected to cause disturbance and displacement of pinnipeds during cleanup operations. If operations occurred in the spring they would contribute to increased stress and reduced pup survival of seals (MMS, 1996b).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to marine mammals. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Obstructions to migration and movement: The State of Alaska discourages the use of continuous-fill causeways. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulations patterns and water quality characteristics that result in exceedances of water quality criteria, and must maintain free passage of marine and anadromous fish. Causeways and docks shall not be located in river mouths or deltas.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

4. Effects on Subsistence Uses

For centuries, survival in the Arctic has centered on the pursuit of subsistence foods and materials as well as the knowledge needed to find, harvest, process, store, and distribute the harvest. The development of Inupiat culture depended on passing on traditional knowledge and beliefs about subsistence resources. This knowledge included observations of game behavior, how to use those observations to successfully locate and harvest game, and how hunters and their families should behave to ensure successful harvests in the future. For the Inupiat, subsistence and culture continue to be inextricably intertwined. The process of obtaining, refining, and passing on subsistence skill is inextricably linked to the Inupiat culture, which is based on interdependent family groups, and a tradition of sharing harvested resources (BLM 2007).

Traditional subsistence uses include: bowhead and beluga whaling; walrus, polar bear and seal hunting; brown bear, caribou, musk ox, and moose harvesting; hunting and trapping of furbearers, such as wolf, fox, weasel, wolverine, and squirrel; hunting migratory waterfowl and collecting their eggs; fishing of whitefish, char, salmon, smelt, grayling, trout, and burbot; collecting berries, edible plants, and wood; and producing crafts, clothing, and tools made from these wild resources. Equally important, subsistence also includes social activities of consuming, sharing, trading and giving, cooperating, teaching and celebration among members of the community.

Direct effects on subsistence uses may include: increased access and land use limitations; less privacy; immediate effects of oil spills; and potential increase in wage earning opportunities to supplant subsistence activities. Indirect effects include: the potential reduction in local fish and wildlife populations due to development; increased travel distance and hunting time required to harvest resources; potential reductions in harvest success rates; increased competition for nearby subsistence resources; improvements in community transportation, trade, and utilities infrastructure; and increased revenues to local government through petroleum revenue taxes.

Alteration of the physical environment may affect migration, nesting, breeding, calving, denning and staging of animals that are sensitive to oil and gas development activities. For example, noise propagation from jet aircraft is known to affect the behavior of molting waterbirds. Above-ground pipelines can disrupt annual caribou migrations, if not elevated properly or buried. Vehicle traffic may adversely affect foraging caribou by displacing them from preferred forage areas. Such effects can be reduced or avoided by observing mitigation measures which restrict oil and gas activities.

Other physical alterations of the environment from post-sale activity could affect subsistence. For example, if a road adjacent to a pipeline was heavily traveled, as might occur during a project’s construction phase, caribou may avoid the area of higher vehicle activity. The result could be that a subsistence hunter may have to travel farther from the village in order to capture the affected caribou. Another example might be the industrial use of water, which could affect the drainage pattern of a river tributary, thereby affecting a particular anadromous fish run that are part of a subsistence fishery.

Any activity that has the potential to harm fish or wildlife has the potential to affect subsistence. Mitigation measures have been designed to avoid, reduce or minimize biological alterations to the sale area. Reducing impacts to subsistence resources from oil and gas development is a primary goal in lease sale planning. The objective of protecting subsistence uses lies in protecting cultural and biological resources.

The effects of an oil spill on marine mammals and fish is the most feared adverse impact from oil and gas development offshore. Residents are concerned that the technology does not exist to clean up a major spill, which, regardless of the time of year, would not be possible to fully clean up and which would have incalculable effects on subsistence resources. Residents, having witnessed decades of sea-ice activity, continue to question the structural integrity of drill rigs in the face of tremendous ice forces. An older resident observed sea ice suddenly rise up a 20-foot bluff, threatening homes in Barrow (MMS, 1996b).

Fish, such as arctic cisco or broad whitefish, which utilize portions of the sale area for migration and feeding, could also be affected by excessive disturbances from some oil and gas activities, such as causeways or oil spills. These fish could be directly damaged, or otherwise made less accessible to subsistence fishers. The inability to harvest seals or other marine mammals due to avoidance behavior or loss of supporting habitat could affect subsistence uses other than for food consumption, such as use of seal skins for covering umiaks, or skins and furs for clothing and handicrafts. Traditional whaling harvests are not expected to be affected by post-sale activities.

Community well-being depends on the continued use of subsistence resources because of their cultural and economical significance. The subsistence way of life, with its associated values of sharing food and influence on the extended family and traditional knowledge, is considered an integral part of being Inupiat (Kruse, et al., 1983). In addition to this cultural component, subsistence is the direct source of economic well being for NSB residents. Subsistence resources enter into household income as a food source that does not have to be purchased. A loss of subsistence resources would be a loss of income for the entire community (MMS, 1996b:).

While noise, traffic disturbance, and oil spills would produce chronic short-term impacts on subsistence species none of these impacts would lead to the elimination of any subsistence resource (BLM 2007). Most impacts to subsistence species associated with oil and gas exploration development and production 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 are present (BLM, 2005).

As new discoveries are made, the number of development-related facilities will increase, and portions of the developed areas could be closed to public access, reducing the area available for subsistence activities. If subsistence hunters are displaced from traditional hunting areas, they might have to travel greater distances and spend more time harvesting resources. At the same time, increased public access to hunting, fishing, and trapping areas, due to construction of new roads, could increase competition between user groups for subsistence resources. If competition for scarce resources, like moose, on the North Slope were to increase, game managers would restrict non-subsistence hunting and fishing. Management practices to restrict non-local resident hunting are in place for Game Management Unit 26. See Chapter Four for a description of sport hunting and fishing in the sale area.

Mitigation Measures

Previous subsections of this chapter describe the potential impacts to fish and wildlife populations due to habitat loss, disturbance, oil spills, and gas blowouts. They also discuss the mitigation measures that will be imposed on the sale to maintain fish and wildlife populations. Additional site-specific and project-specific mitigation measures may be required later if exploration and development take place. The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to subsistence activities. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Harvest disruption: Lease-related use will be restricted when the Director determines it is necessary to prevent conflicts with local subsistence, commercial and sport harvest activities. Restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the Director.
- Harvest conflict resolution: Prior to submitting a plan of operations for activities that have the potential to disrupt subsistence activities, lessees must consult with the potentially affected communities and the NSB. The lessee must make reasonable efforts to assure that activities are

compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests. Additionally, the lessee must notify the Director of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns

- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Unrestricted access: Traditional and customary access to subsistence areas shall be maintained unless reasonable alternative access is provided to subsistence users. The lessee shall make reasonable efforts to assure that activities are compatible with subsistence and will not result in unreasonable interference with subsistence harvests.
- Protection of prehistoric, historic and archaeological sites: Prior to construction or placement of any structure, road, or facility, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected. The inventory must include an analysis of the effects that might result from the activity. If a site or area could be adversely affected, the Director, after consultation with SHPO and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects. If a site, structure, or object of significance is discovered, the lessee must make reasonable effects to preserve and protect the site, structure, or object until directed as to the course of action to take for its preservation.
- Training: A plan of operations must include a training program to inform each person working on the project of environmental, social, and cultural concerns. The program must use methods to ensure that personnel understand and use techniques to preserve geological, archeological, and biological resources and increase their sensitivity and understanding of values, customs, and lifestyles in areas where they will be operating.
- Community participation: Lessees are encouraged to bring residents of communities in the area into their planning process. Local communities have a unique understanding of their environment. Involving residents in the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams can help communities understand permitting obligations and help industry understand community values and expectations.

5. Effects on Historic and Cultural Resources

Historic and cultural resources are those sites and artifacts that have significance to the culture of people in the state. Historic and cultural sites are identified by the National Register of Historic Sites, and include those identified in the NSB Traditional Land Use Inventory by the Commission on Inupiat History, Language, and Culture and sites identified in other published studies. Many places, such as ancient village locations along the distributaries of the Colville River, contain archaeologically important relics and continue to be used today.

a. Resources and Regulatory Framework

ADNR, Office of History and Archaeology maintains the Alaska Heritage Resources Survey (AHRS), which is an inventory of all reported historic and prehistoric sites within the state. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Historical and cultural resources identified within the lease sale area include: isolated Native villages, gravesites, cabins, fish camps, mine sites, and transportation and mining-related sites. Information regarding important cultural and historic sites can be obtained by contacting ADNR, Office of History and Archaeology and the North Slope Borough Planning Department. See also Hoffman, et al., (1988), Jacobson and Wentworth (1982), the Nuiqsut Cultural Plan (NSB, 1979), and the North Slope Borough Coastal Management Program (NSBCMP) Background Report and Coastal Resource Atlas (NSBCMP, 1984b) and the NSB Municipal Code (NSBMC) 19.70.050(E).

ADNR researched available sources and found 339 known historic and archaeological sites within the lease sale area. A high potential for discovery of additional sites also exists. State policy on these resources is reflected in AS 41.35.010, which says, “It is the policy of the state to preserve and protect the historic, prehistoric, and archaeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in those resources may pass undiminished to future generations.” Existing statutes, which apply to both known sites and newly discovered sites, are:

- **AS 41.35.200. Unlawful acts.** (a) A person may not appropriate, excavate, remove, injure, or destroy, without a permit from the commissioner, any historic, prehistoric, or archaeological resources of the state. “Historic, prehistoric, or archaeological resources” includes “deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of people in the state as well as to the natural history of the state.” (AS 41.35.230(2).)
- **AS 41.35.210. Criminal penalties.** A person who is convicted of violating a provision of AS 41-35.010 – 41.35.240 is guilty of a class A misdemeanor.
- **AS 41.35.215. Civil penalties.** In addition to other penalties and remedies provided by law, a person who violates a provision of AS 41.35.010 – 41.35.240 is subject to a maximum civil penalty of $100,000 for each violation.

Under North Slope Borough municipal code, proposed development shall not impact any historic, prehistoric, or archaeological resource prior to the assessment of that resource by a professional archaeologist (NSBMC 19.50.030(F)). Borough municipal code 19.70.050(F) says, “Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the Coastal Management Program.” These provisions give the NSB authority to protect cultural and historic resources and current subsistence uses of these sites.

b. Potential Impacts

Potential impacts could occur in the exploration, development, or production phases, but are more likely to occur if development occurs. Impacts include disruption of culture and disturbance of historic and archeological sites. Impacts could be associated with installation and operation of oil and gas facilities, including: drill pads, roads, airstrips, pipelines, processing facilities, and any other ground-disturbing activities. Damage to archaeological sites may include: direct breakage of cultural objects; damage to vegetation and thermal regime, leading to erosion and deterioration of organic sites; shifting or mixing of components in sites resulting in loss of association between objects; and damage or destruction of archeological or historic sites by crews collecting artifacts (USFWS, 1986).

Many sites along the coast are currently eroding into the sea. Storm surges during the summer and fall open water season have caused rapid coastline erosion. Sediments are reworked to varying depths by current transport and ice gouging, which makes the survival of any prehistoric sites offshore unlikely (MMS, 1996b).

Cumulative effects on archaeological sites from oil and gas exploration, development, and production are expected to be low. In the event that an increased amount of ground-disturbing activity takes place, state and federal laws and regulations should mitigate effects to archaeological resources. The expected effects on archaeological resources from an oil spill are uncertain, but data from the *Exxon Valdez* oil spill indicates that less than 3 percent of the resources within a spill area would be significantly affected (MMS, 1998).

Oil Spills: Oil spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon dating methods (USFWS, 1986). The most important understanding obtained from past, large-scale oil spill cleanups is that archaeological resources generally were not directly affected by the spilled oil. Following the *Exxon Valdez* oil spill, the greatest effects came from vandalism because more people knew about the locations of these archaeological resources and were present at the sites. The detrimental effects of cleanup activity on these resources were minor because the work plan for cleanup was constantly reviewed, and cleanup techniques were changed as needed to protect archaeological and cultural resources (Bittner, 1993). Various mitigation measures used to protect archaeological sites during oil-spill cleanups include: avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs.

Well Blowout or Explosion: Disturbance to historical and archaeological sites might occur as a result of activity associated with accidents, such as an oil or gas well blowout or explosion. Archaeological resources in the immediate vicinity of the blowout might be destroyed, and cleanup activities could result in disturbance by workers in the vicinity of the accident site.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to cultural resources. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Protection of prehistoric, historic and archaeological sites: Prior to construction or placement of any structure, road, or facility, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected. The inventory must include an analysis of the effects that might result from the activity. If a site or area could be adversely affected, the Director, after consultation with SHPO and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects. If a site, structure, or object of significance is discovered, the lessee must make reasonable effects to preserve and protect the site, structure, or object until directed as to the course of action to take for its preservation.
- Training: A plan of operations must include a training program to inform each person working on the project of environmental, social, and cultural concerns. The program must use methods to ensure that personnel understand and use techniques to preserve geological, archeological, and biological resources and increase their sensitivity and understanding of values, customs, and lifestyles in areas where they will be operating.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Community participation: Lessees are encouraged to bring residents of communities in the area into their planning process. Local communities have a unique understanding of their environment. Involving residents in the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams can help communities understand permitting obligations and help industry understand community values and expectations.