# Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

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Until leases are sold and discoveries are made, DO&G cannot predict whether and when any oil and gas activity might occur, or the type, location, duration, or level of those potential activities. In addition, methods to explore for, develop, produce, and transport petroleum resources will vary depending on the area, lessee, operator, and discovery. Best interest findings are not required to speculate about such possible future effects (AS 38.05.035).

However, AS 38.05.035(g) specifies that the following shall be considered and discussed in a best interest finding: reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas on the lease sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources; reasonably foreseeable fiscal effects of the lease sale on the state and affected municipalities and communities; and reasonably foreseeable effects of exploration, development, production, and transportation for oil and gas on municipalities and communities within or adjacent to the lease sale area. This chapter discusses these potential effects.

Potential effects of oil and gas lease sales can be both positive and negative. Most potentially negative effects on fish and wildlife species, habitats, and their uses, on subsistence uses, and on local communities and residents can be avoided, minimized, or mitigated through mitigation measures. A full listing of mitigation measures can be found in Chapter 9.

This final best interest finding does not speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined (AS 38.05.035). The effects of future exploration, development, or production will be considered at each subsequent phase, when various government agencies and the public review permit applications for the specific activities proposed at specific locations in the lease sale area.

It is important to note that all post-leasing activities are also subject to local, state, and federal statutes, regulations, and ordinances, many of which are listed as other regulatory requirements (lessee advisories) in Chapter 9 (see also Chapter 7 and Appendix B). Additional project-specific and site-specific mitigation measures will be required by permitting agencies as appropriate if exploration and development proposals are submitted.

Leasing activities alone are not expected to have any effects, other than initial revenue to the state. Post-lease activities could affect the terrestrial, freshwater, and marine habitats, and fish and wildlife of the lease sale area. These activities could include seismic surveys related to exploration, development, and production; environmental and other studies; excavation of material sites; construction and use of support facilities such gravel pads, staging areas, roads, airstrips, pipelines, and housing; transportation of machinery and labor to the site; and construction of drill sites and ongoing production activities. Unintended occurrences such as oil spills could have effects as well.

# A. Terrestrial and Freshwater Habitats, Fish, Wildlife, and Birds

## 1. Potential Activities and Cumulative Effects

Potential post-lease activities that could have cumulative effects on terrestrial and freshwater habitats, fish, wildlife and birds of the Cook Inlet lease sale area include seismic surveys, construction of support facilities, and drilling and production activities. Some potential effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; habitat change; behavior changes of fish, wildlife and birds; drawdowns and contamination of groundwater; and contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, or oil spills.

BLM conducted an environmental impact statement in 2006 that included potential oil and gas exploration, development, and production. The EIS concluded that these activities would have negligible effects, or that potential significant effects could be mitigated through appropriate measures and permitting procedures (BLM 2006).

### a. Seismic Surveys, Construction, and Other Activities

In Arctic environments, the largest effects of oil and gas activities are from physical disturbances (Huntington 2007). Activities such as seismic surveys, construction activities, and ongoing vehicle and human movements may alter landscapes and habitat; and disturb and contribute to behavior changes in fish, wildlife and birds. However, there is little information on these effects specific to the Cook Inlet lease sale area. There are studies on effects of oil and gas activities on Arctic habitats and wildlife, but the habitats of the forested Cook Inlet area differ in many respects from those of the Arctic tundra. Some studies are also available of industrial development in boreal forests of Canada that may be applicable to the Cook Inlet lease sale area.

Below is a discussion of potential effects from activities such as seismic surveys, construction activities, and similar development, on terrestrial and freshwater habitats, fish, wildlife, and birds of the Cook Inlet area. Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Activities such as seismic surveys that require creation of linear corridors may affect habitat and behavior of wildlife. Traditional seismic lines leave a long-lasting footprint in boreal forests. Plant communities on seismic lines are significantly different from adjoining forests, and seismic lines show little change for up to 30 years (MacFarlane 2003). The slow recovery rate may be due to factors such as damage to root systems by bulldozers and competition from grass species (Schneider 2002). Heavy equipment may result in soil compaction and erosion, and cratering may occur from improperly filled shot holes (Schneider 2002). Increased access for all-terrain vehicles, snow machines, and off-road trucks, and continued use of the lines by these vehicles may also contribute to extended recovery times (Schneider 2002). Studies have shown that low impact lines do not recover any faster, and the length of time for natural plant communities to be restored on low impact lines is unknown (MacFarlane 2003). Regeneration of alpine tundra, found at higher elevations in the Cook Inlet area, is slow following mechanical disturbance, and can take up to 60 years for full recovery for some lichen species (UAA-ISER 2008). Bog habitats that have been disturbed may take many years to return to their pre-disturbance state naturally (ADF&G 2006).

Loss of forest habitat that occurs when seismic lines are cleared is magnified by fragmentation, which reduces the usefulness of the habitat, and by avoidance of intact habitat in the area of the seismic lines by some species such as caribou (Schneider 2002). For example, use of habitat within 100 m of seismic lines during late winter by woodland caribou (*Rangifer tarandus caribou*) was about half the expected use, and use was also less than expected during calving, summer, rut, and

early winter (Dyer et al. 2001). Habitat fragmentation, which could create "island populations", displacement, reduction of habitat quality, and potential increased frequency of high energy-cost flight responses are also concerns for brown bear populations of the Kenai Peninsula (ADF&G 2002; ADF&G 2007).

Several species of landbirds that have been identified by ADF&G as species of conservation concern may be negatively affected by habitat alterations to boreal forests and wetlands of the Cook Inlet lease sale area (ADF&G 2007). These species include olive-sided flycatcher, rusty blackbird, blackpole warbler, gray-cheeked thrush, and Townsend's warbler. Bald eagle populations could be affected by disturbance or removal of their nesting habitat, and by disturbances to their nests (ADF&G 2003). Disturbances by floatplanes, sport anglers, and other recreationists could force loons to abandon their nests, allowing the chicks to chill and die (ADF&G 1994). There is little direct research concerning effects of oil and gas development activities on these or other similar bird species. However, one study found that, with the exception of ovenbirds, abundance of 41 species of songbirds, and location and size of their territories, were unaffected by seismic lines in boreal forests of the Northwest Territories (Machtans 2006).

Seismic lines may alter predator-prey interactions. In boreal forests, tracked radio-collared wolves were significantly closer to linear corridors, and they traveled faster along linear seismic corridors than in the forest (James 1999). Travel speed was unrelated to whether the seismic line was packed or unpacked, so it is suspected that the visual stimulus of a long distance influences wolves to stay and follow the corridor when they intersect it. Caribou mortalities from wolf predation were closer to linear corridors relative to locations of live caribou, but the sample size of tracked caribou was only 5 animals (James 1999). Researchers speculate that creation of linear corridors may increase caribou mortality by facilitating wolf movement, but this has not been proven conclusively through research (James 1999).

Clearing operations to prepare seismic lines, and explosions that occur during seismic surveys, may disturb wildlife. Birds and wildlife are particularly sensitive during nesting and calving periods (Schneider 2002). Repeated disturbances can result in increased movement rates of wildlife and subsequent significant energy losses, which can be particularly problematic during winter when food supplies may be scarce (Schneider 2002).

A study of the effects of seismic airgun use on the hearing of fish in freshwaters of the Mackenzie River Delta concluded that substantial impacts on several freshwater species not likely (Popper et al. 2005).

Development and production may require the construction and continued use of support facilities such as roads, production pads, pipelines, and other facilities. In addition to clearing of trees, these may also require gravel infilling, and impoundment and diversion of water. Support facilities may result in many of the same effects as seismic lines, except that human activity, vehicle traffic, and aircraft activity associated with support facilities continue for the life of the field. On the other hand, activity on seismic lines may be limited to the duration of the seismic survey, although other recreational uses may continue, including use of snow machines, all-terrain vehicles, and hunting.

B. Havelock, DO&G

Lewis River C-Pad.


S. Schmitz, DO&G

Caribou cows and calves crossing road, North Slope.

Some limited information is available concerning effects of support facilities. For example, in one study, caribou used habitat near roads less than habitat farther away, ranging from 0 percent of expected use in closed coniferous wetlands in late winter to about 34 percent during summer in open coniferous wetlands (Dyer et al. 2001). Caribou also avoided well sites at some distances and seasons, although expected use was greater than 100 percent for others (Dyer et al. 2001). Cumulative effect of avoidance of all industrial development was a potential loss of 48 percent of the 617,204 ha study area (Dyer et al. 2001). However, studies of caribou in northern Alaska before and after construction of a road showed no significant differences in densities of caribou near the road (Noel et al. 2004), and pipelines elevated ≥1.5 m were found to not cause changes in caribou use or delay migrations (Noel et al. 2006). In addition, despite concerns that oil and gas development and infrastructure such as roads may displace caribou, sizes of caribou herds in northern Alaskan oilfields have increased from 5,000 to 32,000 animals since oilfield development began, and recent studies indicate that negative effects from displacement are absent or negligible (Noel et al. 2004; Haskell et al. 2006).

Extension of development into brown bear habitat is of concern to wildlife managers (ADF&G 2007) but little direct research is available on the effects of industrial development on brown bear populations of the Cook Inlet lease sale area. However, a study of frequency and distribution of highway crossings by brown bears on the Kenai Peninsula found that highways affected brown bear travel patterns (Graves et al. 2006). A study of the effects of roads on brown bears in British Columbia and Montana found that bears used areas within 100 m of roads significantly less than areas farther from the roads, but this behavior change did not translate into a demonstrable effect on the population (McLellan and Shackleton 1988). However, of greater concern to wildlife managers in the Cook Inlet area is the potential for increased bear-human interactions and potential subsequent high non-hunting mortality of bears resulting from those interactions (ADF&G 2007; Suring and Gino 2002).


ADF&G

Incorrectly positioned culvert, Tyonek Creek.

If activities associated with oil and gas exploration and development, such as gravel removal, heavy equipment operations, and siting of support facilities, are unregulated, they could increase stream sedimentation and erosion, impede fish passage, alter drainage patterns, and have other negative effects on freshwater habitats, fish, and other aquatic organisms (Schneider 2002). Erosion can increase sedimentation and turbidity of aquatic habitats, which can cause decreased primary production, resulting in depleted food for zooplankton, insects, freshwater mollusks, and fish. This can lead to direct mortality, reduced physiological function, and depressed growth rates and reproduction in aquatic organisms (Henley et al. 2000). Excess turbidity and sedimentation can also decrease recreation value (USGS 2008).

Secondary effects of new road construction and use could include dust deposition, which may reduce photosynthesis and plant growth, and downstream siltation and sedimentation, which can affect plant viability. Road construction and vehicular traffic 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).

Section A2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

## b. Discharges from Exploration, Development, and Production

Discharges from well drilling and production may be intentional, such as permitted discharges regulated by the NPDES, or unintentional, such as gas blowouts, leakages, and spills. However, in the circumpolar Arctic, 80-90 percent of petroleum hydrocarbons entering the environment originate from natural seeps (Huntington 2007). Excluding oil spills, activities related to oil and gas exploration, development, and production are minor contributors of petroleum hydrocarbons to the environment (Huntington 2007).

Below is a discussion of possible effects from potential activities such as well drilling and production on terrestrial and freshwater habitats, fish, wildlife, and birds of the Cook Inlet area. Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Discharges from oil and gas activities could affect freshwaters of the area, including surface waters and groundwater. Some water bodies in the Cook Inlet do not meet water quality standards but none of the identified waters showed impairments from oil and gas exploration, development or production activities. Fourteen waters in the Anchorage area have high fecal coliform levels from urban runoff, and Eagle River Flats has high white phosphorous levels caused by munitions from military base operations (DEC 2008a). The Kenai River does not meet water quality standards because of high total aromatic hydrocarbons from motorized watercraft. Four additional waters in the Cook Inlet area are listed as impaired waters under Section 305(b) of the Clean Water Act, but not from oil and gas industry activities: Big Lake, for total aromatic hydrocarbons from motorized watercraft; Cottonwood Creek, for foam and debris from urban runoff and urban development; the Matanuska River, for debris from a landfill; and Ship Creek, for petroleum products from urban runoff (DEC 2008a).

Source: USGS 2005

Chester Creek in Anchorage, monitored by USGS.

USGS monitors water quality at eight fixed sites in the Cook Inlet area (Brabets and Whitman 2004). Sites studied included the Ninilchik River, two sites on the Kenai River, South Fork of Campbell Creek, Chester Creek, the Deshka River, Moose Creek near Palmer, and Johnson River near Tuxedni Bay. Of the sites that had human activities, only urbanization affected water quality. The Chester Creek basin was found to have volatile organic compounds, pesticides, an increased number of tolerant species, and changes in physical habitat, all related to urbanization (Brabets and Whitman 2004). Some sites near leaking fuel-storage tanks, fuel-storage facilities, and petroleum refineries have been documented to contain organic-compound contaminants (Glass 1999).

Potential effects of oil spills on terrestrial habitats depends on size of the spill, type of oil spilled, time of year, type of vegetation, and terrain. Spilled oil spreads both horizontally and vertically depending on the volume spilled, type of ground cover (plant or snow), slope, presence of cracks or troughs in the ground, moisture content of the 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). Oil spreads 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 pools and is easier to contain. Because dry soils are more porous, the potential for spilled oil to seep downward into the soil 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 could occur in following summers. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the spilled oil, bacteria may assist in the breakdown of hydrocarbons in soils.

Oil leaks or spills in boreal forests can have a range of potential effects, including killing plants directly, slowing growth of plants, inhibiting seed germination, and creating conditions in which plants cannot receive adequate nutrition (Robertson et al. 2007). Although a single addition of PHCs does not appear to limit microbial communities in the long term, species richness often decreases. Oil spills and leaks can create changes in the physical and chemical properties of soil that disturb supplies of water, nutrients, and oxygen (Robertson et al. 2007). The persistence of chemicals in the soil depends on several factors, including the type and quality of clay particles, type and concentration of solutes, organic content and composition, pH, and temperature (Robertson et al. 2007).

At low concentrations, petroleum hydrocarbons can actually stimulate plant growth (Robertson et al. 2007). Heterotrophic bacteria and fungi in most natural microbial communities apparently have an inherent ability to degrade organic pollutants, and usually, biological processes eventually degrade or transform most organic compounds. Although mycorrhizal ecosystems may be harmed by oil spills or leaks, they are also used for bioremediation (Robertson et al. 2007).

The reproductive success of bald eagles can be affected by pesticides in its prey, and although bald eagles in Alaska appear to be reproductively healthy, contaminants have been recorded in some fish populations and in bald eagles (ADF&G 2003).

Section A2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

### c. Groundwater Uses

Industrial use of groundwater could draw down the elevation of the water table in the vicinity of the industrial well or wells, and could affect nearby domestic well water depths. These effects are usually insignificant and temporary as other hydraulically connected groundwater sources replace pumped volume. In streams that are hydraulically connected to groundwater systems, industrial pumping may cause a reduction in surface flow or alteration of drainage pattern. This disruption in stream flow may be more pronounced during winter months when surface-flow is minimal (Zenone and Anderson 1978). Declines in lake levels are also associated with fluctuations in precipitation, making it difficult to discriminate effects of industrial pumping from natural causes (Nelson 1981).

Section A2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate potential effects to groundwater uses.

## 2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on terrestrial and freshwater habitats, fish, and wildlife, measures in this best interest finding, along with

regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

For example, standard ADNR land use permit conditions serve to protect habitat and water quality from potential negative effects of 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 of. 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 must be consistent with the ACMP. In addition, permits may include measures to ensure that activities are consistent with the ACMP and local district plans. Permit stipulations include setbacks for lakes and rivers, and permit applicants must seek permission from landowners to enter private property.

Permits may contain stipulations on the use and quantity drawn of water in order to meet water quality standards including protection of recreation activities; navigation; water rights; or any other substantial public interest. Water use permits may also be subject to conditions, including suspension and termination of exploration activities, in order to protect fish and wildlife habitat, the public health or to protect the water rights of other persons. Before a permit to appropriate water is issued, ADNR considers local demand and may require applicants to conduct aquifer yield studies. Generally, water table declines associated with the upper unconfined aquifer can be best mitigated by industrial users tapping confined (lower) layers or searching for alternate water sources.

Mitigation measures included in this best interest finding address habitat loss avoidance; protection of wetland, riparian, and aquatic habitats; prohibitions and restrictions on surface entry into designated state game refuges and critical habitat areas, as well as restrictions on other important habitat areas; disturbance avoidance; and free passage and movement of fish and wildlife. Specific mitigation measures also protect trumpeter swan nesting areas and bald eagles. Sets of comprehensive measures protect brown bears and their habitat, and the Kenai Lowlands caribou herd. Other measures and regulatory protections address drinking water, and address seismic activities, siting of facilities, pipelines, drilling waste, oil spill prevention and control, and rehabilitation. A complete listing of mitigation measures is found in Chapter 9.

DO&G

Revegetation plantings at the Theodore River.

# B. Marine Habitats, Fish, Mammals, Birds, and Other Organisms

Potential post-lease activities that could have cumulative effects on marine habitats of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as boat and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Potential effects of oil and gas development have been discussed previously for the federal Cook Inlet Outer Continental Shelf Area located in lower Cook Inlet. In that 2003 environmental impact statement, MMS found that lease sales, and potential subsequent exploration and development, would have no measurable negative effects on the Cook Inlet area (MMS 2003).

# 1. Potential Activities and Cumulative Effects

## a. Seismic Surveys, Construction, and Other Activities

### *i. Noise*

One of the primary concerns about oil and gas development in marine waters is the potential effects that noise from seismic surveys, construction activities, and ongoing boat, drilling, and aircraft activities could have on marine mammals and other marine animals (Hofman 2003).

Below is a discussion of potential effects from activities such as seismic surveys, construction activities, and similar development, on marine habitats, fish, mammals, birds and other organisms of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

In 2005, MMS found that a proposed geophysical (seismic) survey would have no significant effect on the lower Cook Inlet area (MMS 2005). Other attempts have been made by scientists, the oil and gas industry, and by environmental groups to compile and draw conclusions about the effects of these activities from existing research, but these reports draw on few experimental studies, relying rather on anecdotal observations, unpublished reports, and non-peer reviewed research (OGP/IAGC 2004; WDCS 2004; Gordon et al. 2003). The lack of experimental research on the effects on marine animals of noise from oil and gas development, and the lack of conclusive results, particularly at the population level, is frequently highlighted by scientific, industry, and environmental organizations alike (Jasny et al. 2005; Gordon et al. 2003; OGP/IAGC 2004; WDCS 2004).

Hofman (2003) reviewed available studies of the effects of industrial noise on whales, finding that some effects on activity patterns of some whales were documented, but that research was insufficient for understanding which species are affected, how many animals are affected, distances at which various species are affected, and the biological significance of the effects. Although some studies found distribution and behavior changes for some whales, the changes were negligible and no harmful effects were documented (Hofman 2003). Research is also lacking on whether or not some species may become habituated to, and stop being affected by, certain kinds of sounds, or on whether certain species may become more sensitive to sounds with increased exposure (Hofman 2003).

Researching these effects on marine mammals and other marine animals is a difficult undertaking. Hofman (2003) explained the many variables that influence the effects of noise on animals in the marine environment:

> The nature and significance of acoustic effects are dependent on a number of variables. They include the intensity, frequency, and duration of the sound; the location of the sound source relative to the potentially affected animals; water depth, bottom reflectivity and other features of the environment; the distance between the animal and the sound source; whether the sound source is stationary or moving; the species, age, sex, reproductive status, activity and hearing ability of the animals exposed to the sound; whether the animals use similar sounds for communicating, locating and capturing prey, etc.; and whether and how frequently the animals in question are exposed to the sound.

However, there are a few published, peer-reviewed studies of the effects of noise from oil and gas activities on marine animals, although not specific to the Cook Inlet lease sale area. For example, a study in the Beaufort Sea found that ringed seals were not affected by noise from pipe-driving and construction sounds, except for helicopters, concluding that seals were likely habituated to the industrial sounds and visual activity (Blackwell et al. 2004). Another study in the Beaufort Sea found that the proportion of long-tailed ducks detected in areas with seismic surveys was not significantly different from control areas without the surveys; the study also found that there was no difference in

diving behavior of ducks in the seismic and non-seismic areas (Lacroix et al. 2003). Several additional studies measured sound levels from drilling and operations in the Beaufort Sea, but these studies did not measure the effects of the sounds on marine life (Blackwell and Greene 2004, 2006). An experimental study of the effects of seismic surveys on cod and haddock in the Barents Sea, located north of Norway and Russia, found that fish distribution, abundance, and catch rates were significantly affected, decreasing by up to 50 percent during and after seismic shooting, compared to rates just previous to commencement of the seismic survey (Engas et al. 1996). In one of the few controlled experiments on the response of whales to noise, a four-year study examined responses of whales to airguns used in seismic surveys in the Gulf of Mexico. This study found no horizontal avoidance to seismic airgun sounds by sperm whales (Jochens et al. 2008).

In Cook Inlet, beluga whales appear to exhibit site fidelity, returning to estuary areas even after a disturbance, including adults with calves (Moore et al. 2000). They continue to occupy upper Cook Inlet despite oil and gas development, vessel and aircraft traffic, and dredging operations, and based on a review of available information, Moore et al. (2000) concluded that belugas appear to have become habituated to offshore oil and gas activities in central Cook Inlet. There is no evidence that routine oil and gas development and transport activities have a direct impact on the sea otter stock of Southcentral Alaska (Angliss and Outlaw 2008).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

### *ii. Other Disturbances*

The ocean substrate (ocean bottom) may be physically disturbed from activities such as anchoring or from sedimentation from discharges, potentially resulting in destruction of the organisms living there (Lissner et al. 1991). Below is a discussion of potential effects from disturbances such as these on marine habitats and animals of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

Research is lacking on the specifics of these potential effects, especially for the Cook Inlet lease sale area. Recovery time for substrate disturbances can vary from a few days or months to decades, depends on the type and frequency of the disturbance, and the type of organisms inhabiting the substrate (Lissner et al. 1991). Eelgrass beds are vulnerable to increased turbidity, sediment disturbances, and eutrophication that could occur as a result of development activities; these could, in turn, promote growth of epiphytic algae on eelgrass, decrease eelgrass photosynthesis and growth, and smother or uproot eelgrass (ADF&G 2006).

Oil and gas activities such as exploration, transportation and support vessels, production, product and waste removal could potentially damage important Steller's eider habitat, force birds to relocate to alternate habitats of lower quality, or cause loss of birds directly. Awareness and avoidance of Steller's eider concentration areas and times when birds tend to congregate in those areas may prevent or reduce these potential negative effects (ADF&G 2007.) Disturbances during critical periods of use are also a concern for shorebirds (DO&G 2000).

Human intrusions into seabird colonies can result in reduced reproductive success. Eggs, hatchlings, and fledglings are particularly vulnerable to activities that may result in loss of eggs or young, dispersion from the nesting site or rookery, and disruption of vital parent-offspring bonds (Boesch et al. 1987).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate the potential effects discussed above.

## b. Discharges from Exploration, Development, and Production

In addition to noise and physical disturbances, discharges into the water may result from activities associated with exploration, development, and production of oil and gas. Below is a discussion of potential effects from discharges such as these on marine habitats and animals of the Cook Inlet area. Section B2 of this chapter discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate these potential effects.

In the Arctic, oil spills pose the greatest environmental effect (Huntington 2007). Drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production, as well as oil spills, can have short- and long-term negative effects on aquatic life, including fish and benthic organisms (Olsgard and Gray 1995). Lethal or sub-lethal effects may subtly reduce or impair physiological and reproductive fitness (Davis et al. 1984). Sedentary animals, such as oysters, clams, and mussels, are more susceptible to releases of petroleum products than fish and shellfish such as crabs and shrimp, which are capable of active avoidance (Davis et al. 1984). Oil spills or impairments to water quality could have detrimental effects on mariculture industries (ADF&G 2007). Type and extent of effects depends on a myriad of factors including habitat involved, species, life history stage, migration patterns, nursery areas, season, type of chemical, amount and rate of release, time of release, duration of exposure, measures used for retaining of the chemical, and use of counteracting or dispersing agents (Davis et al. 1984).

Comprehensive water quality data for the entire Cook Inlet area are not available, but data that are available for several specific sites have not indicated water quality effects from oil and gas development. An assessment of water quality for a proposed Knik Arm crossing project found that dissolved oxygen and pH levels were well within water quality standards, and that levels of most substances were well below water quality limits and some were even below detection limits (Kinnetic Laboratories 2004). Substances below the water quality limits included dissolved metals, overall total metal concentrations, cyanide concentrations, total aromatic hydrocarbons, and total aqueous hydrocarbons (Kinnetic Laboratories 2004). Turbidity and suspended sediments exceeded water quality criteria because of naturally occurring, high suspended sediment concentrations from glacial runoff flowing into Cook Inlet from the Knik, Matanuska, Susitna, and other smaller rivers (Kinnetic Laboratories 2004). For other sites that do not meet water quality standards, the causes have been identified as urban runoff, military base operations, motorized watercraft, and a landfill (DEC 2008a; Brabets and Whitman 2004).

Oil spills as well as low-level exposure to toxins could have deleterious effects on populations of birds such as rock sandpipers (ADF&G 2007, citing to Stenhouse and Senner 2005) as well as populations of other shorebirds (Gill and Tibbitts 1999) and other marine animals. However, despite the relatively high level of development in the Cook Inlet area, including the oil and gas industry, Becker et al. (2000) found that concentrations of PCBs and other contaminants were much lower in belugas of Cook Inlet than in belugas of other Alaskan and circumpolar populations, and that there was no evidence to indicate that the low levels found in Cook Inlet belugas pose a health risk to the population or for human consumption.

Courtesy Exxon Valdez Oil Spill Trustee Council

Oil slick from the *Exxon Valdez*, Prince William Sound, 1989.

A study of sediments in Cook Inlet detected no contamination that might have originated from oil and gas production activities in upper Cook Inlet (MMS 2000). The study also found that concentrations of metals and organics in sediments have not increased since oil and gas development began in Cook Inlet, that the composition of hydrocarbons has changed subtly over time but uncorrelated to petroleum production activities or spills, and that concentrations of metals and PAHs were not linked to either oil and gas development in Cook Inlet or to the *Exxon Valdez* oil spill (MMS 2000). In addition, there is no evidence that routine oil and gas activities have affected the Southcentral sea otter stock (Angliss and Outlaw 2008).

A catastrophic oil spill would probably result in high mortalities of sea otters (Angliss and Outlaw 2008). Contamination with oil drastically reduces the insulative value of the pelage, and consequently, sea otters are among the marine mammals most likely to be detrimentally affected by contact with oil. It is believed that sea otters can survive low levels of oil contamination (<10 percent of body surface) but that high levels (>25 percent) will lead to death (Angliss and Outlaw 2008). Direct contamination of shorebirds is also a concern, as is direct or indirect contamination and elimination of benthic food supplies (DO&G 2000).

Section B2 of this chapter, below, discusses mitigation measures and other regulatory protections that are expected to avoid, minimize, and mitigate the potential effects discussed above.

## 2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on marine habitats, fish, and wildlife, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

For example, because of the potential effects discussed above, effluents discharged by the oil and gas industry into marine waters of Cook Inlet are regulated through EPA's NPDES program (see Chapter 7, Section F3). This program, which covers a broad range of pollutants, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the nation's waters (EPA 2008b). NPDES permits specify the type and amount of pollutant, and include monitoring and reporting requirements, to ensure that discharges are not harmful to water quality and human health (EPA 2008a). NPDES general permit AKG-31-5000 (EPA 2007a), issued in 2006, covers oil and gas exploration, development, and production facilities located in state and federal waters of Cook Inlet through June 2012. Therefore, marine fish, mammals, and other aquatic organisms are not expected to be impacted by drilling muds, cuttings, produced waters, and other effluents associated with oil and gas exploration, development, and production.

In addition, mitigation measures specifically address beluga whales and Steller's eiders. Mitigation measures also address disturbance avoidance, particularly in several state game refuges and critical habitat areas; seismic activities; siting of facilities; pipelines; oil spill prevention and control; and discharges and waste from drilling and production. Steller's eiders, Steller sea lions, and fin, beluga, and humpback whales are provided additional protection under the Endangered Species Act. A complete listing of mitigation measures and other regulatory protections is found in Chapter 9.

# C. Air Quality

## 1. Potential Activities and Effects

Oil and gas exploration, development, and production activities may produce emissions that have the potential to affect air quality. Equipment that could produce pollutants includes boilers, diesel engines, drilling equipment, flares, glycol dehydrators, natural gas engines and turbines, and fugitive emissions which are leaks from sealed surfaces associated with process equipment (MMS 2004a, b).

Loading operations may also result in emissions caused when vapor space in the receiving cargo hold is displaced by the liquid product. Emissions may include carbon monoxide (CO); nitrogen oxides ($NO_x$); sulfur dioxide ($SO_2$); particulate matter-10 ($PM_{10}$), $PM_{2.5;}$ volatile organic compounds (VOC); ozone; and greenhouse gases including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_20$) (MMS 2004b).

Oil and natural gas industries emitted an estimated 3.0 million metric tons of greenhouse gases throughout Alaska in 2005, which was about 6 percent of the total greenhouse gas emissions in Alaska (Roe et al. 2007). This is a decrease from 1990 and 2000, and continued decreases are expected through 2020. There are significant uncertainties with these estimates. These estimates are for fugitive emissions, which are released during the production, processing, transmission, and distribution of oil and gas. Fugitive emissions include methane and carbon dioxide released from leakage and venting at oil and gas fields, processing facilities, and pipelines. Estimates of emissions resulting from fuel combustion are only available for residential, commercial, and all industries combined, and are not available for the oil and gas industry separately (Roe et al. 2007). In Cook Inlet, 1.07 bcf of gas was flared or vented during 2004, a decrease of 11.3% from 2003 (AOGCC 2004).

MMS modeled possible effects of Outer Continental Shelf oil and gas exploration and development activities in Cook Inlet and concluded that for most emissions and scenarios, effects would be minor (MMS 2003).

## 2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially affect air quality, federal and state air quality regulations, particularly the Clean Air Act (42 U.S.C. §§ 7401-7642), 18 AAC 50, and AS 46.14, are expected to avoid, minimize, and mitigate those potential effects. Therefore, additional mitigation measures are not included.

Because industrial emissions such as those listed above can have negative environmental effects, the federal Clean Air Act of 1970, and its subsequent 1990 revision and expansions, regulates air quality across the U.S., including Alaska (EPA 2007b). Although the EPA is the primary federal agency responsible for controlling air pollution, monitoring air quality, and inspecting facilities (EPA 2007b), many of these authorities in Alaska have been delegated to ADEC under a federally-approved State Implementation Plan (DEC 2008b). State and federal regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit: new facilities are required to obtain a permit before construction (Title I, NSR permit); existing facilities must have an operating (Title V) permit. Permits are legally binding and include enforceable conditions with which the operator must comply. The permit establishes limits on the type and amount of emissions allowed, requirements for pollution control devices and prevention activities, and monitoring and record keeping requirements (EPA 2008a).

ADEC also operates ambient air quality monitoring networks to assess compliance with the National Ambient Air Quality Standards (NAAQS) for carbon monoxide, particulates, nitrogen dioxide, sulfur oxide, and lead; assesses ambient air quality for ambient air toxics level; provides technical assistance in developing monitoring plans for air monitoring projects; and issues air advisories to inform the public of hazardous air conditions (DEC 2008b).

Operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 23.235(c)). Operators must report monthly to AOGCC any flaring event lasting over an hour. AOGCC investigates these incidents to determine if there was unnecessary waste (AOGCC 2004).

Additional information about air quality regulations and permits is found in Chapter 7, Section B1.

# D. Subsistence Uses

## 1. Potential Activities and Cumulative Effects

Potential post-lease activities that could have cumulative effects on subsistence uses of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. A 2003 MMS environmental impact statement found that federal lease sales on the Outer Continental Shelf of lower Cook Inlet would have no measurable negative effects on the Cook Inlet area (MMS 2003).

Subsistence uses of the Cook Inlet area depend on the area's fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's fish, wildlife, and habitats could also affect subsistence uses. Potential cumulative effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below.

Oil and gas exploration, development, and production could result in increased access to hunting and fishing areas. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for Tyonek and Beluga residents, who travel to subsistence areas primarily by truck (Braund 2007). However, increased public access to hunting, fishing, and trapping areas due to construction of new roads could also increase competition between user groups for fish and wildlife resources. Roads can also raise concerns among subsistence users that increased traffic is affecting distribution of wildlife (Braund 2007).

Oil and gas activities can raise other concerns among subsistence users. For example, Tyonek and Beluga residents have expressed concerns that disturbance from oil rigs has contributed to decline in beluga and seals; that pollution from oil rigs has resulted in fish diseases and declines in clam abundance; and that oil development has changed bear distribution and waterfowl habitat (Braund 2007). However, as discussed in the preceding sections, research about these effects on fish and game is lacking.

One study conducted by EPA is available (EPA 2003). The study analyzed concentrations of 161 chemicals in seven fish species, eight invertebrates, and three plant species traditionally used by members of four Alaskan tribal villages, Tyonek, Seldovia, Port Graham and Nanwalek. Only Tyonek is within the Cook Inlet Areawide sale area. Comparisons were made to published contaminant data for market basket food, and to Columbia River (in Washington, Oregon) Chinook salmon. The study concluded that, with few exceptions, contaminant concentrations in Cook Inlet area species were similar or lower than comparison samples (EPA 2003). Although this study provides important baseline information about contaminants in wild food sources of the Cook Inlet area, its usefulness in discussing potential effects of oil and gas development on wild foods is limited. The study compared Cook Inlet samples to contaminated samples from elsewhere, which only allowed a conclusion of whether the Cook Inlet samples were more or less contaminated than contaminated samples from elsewhere; and more importantly, the study did not attempt to determine the source of contaminants in the Cook Inlet samples. This is an important weakness of this study relative to potential effects from oil and gas development in Cook Inlet, because there are many other potential sources of contaminants in the Cook Inlet area in addition to oil and gas development, and also because many of the chemical compounds analyzed in the study occur naturally (EPA 2003). Another limitation of the EPA study is that contaminants found in salmon harvested in Cook Inlet may reflect conditions on the high seas where they spend a large portion of their life span, rather than conditions in Cook Inlet through which they migrate en route to and from spawning grounds.

Although the oil and gas industry has the potential to provide jobs and income to subsistence users, work in the oil and gas industry may reduce the time available for subsistence activities (Stanek et al. 2007).

Courtesy Exxon Valdez Oil Spill Trustee Council

Clam covered in oil from the *Exxon Valdez* oil spill, Prince William Sound, 1989.

A major oil spill could decrease resource availability and accessibility, and create or increase concerns about food safety which could result in significant effects on subsistence users, effects which could linger for many years. For example, subsistence harvests of fish and wildlife by residents of fifteen predominately Alaska Native communities, as well as by residents in larger rural communities, declined by as much as 70 percent after the 1989 *Exxon Valdez* oil spill (Fall 1999). Within two years of the spill, subsistence harvests and participation had returned to pre-spill levels, although communities closest to the spill lagged behind. However, concerns remained about food safety, availability of many species was reduced, efficiency was reduced, and opportunities to teach subsistence skills to young people were lost (Fall 1999). By 2003, harvest levels were higher than pre-spill levels, or were within the range of other rural communities. However, harvest composition remained different from the pre-spill composition, and concerns about the safety of some shellfish species remained (Fall 2006). Additional complex factors may confound effects of an oil spill, including demographic changes in communities, ocean warming, increased competition for fish and wildlife resources by other user groups, predators, and increased awareness about paralytic shellfish poisoning and other contaminants (Fall 2006). Because many subsistence resources affected by the spill had not fully recovered, subsistence in areas affected by the *Exxon Valdez* oil spill was still not considered to have fully recovered in 2006 (EVOSTC 2006).

## 2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially affect subsistence uses, primarily as secondary effects from effects on habitat, fish, or wildlife, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address harvest interference avoidance, public access, road construction, and oil spill prevention. A complete listing of mitigation measures is found in Chapter 9.

# E. Fish and Wildlife Populations and Their Uses

## 1. Potential Activities and Cumulative Effects

In addition to subsistence uses, other important uses of fish and wildlife populations in the Cook Inlet include sport hunting and sport, commercial, personal use, and educational fishing. Potential post-lease activities that could have cumulative effects on these uses of the Cook Inlet lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. A 2003 MMS environmental impact statement found that federal lease sales on the Outer Continental Shelf of lower Cook Inlet would have no measurable negative effects on the Cook Inlet area (MMS 2003).

Sport hunting and sport, commercial, personal use, and educational fishing in the Cook Inlet area depend on the area's fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's fish, wildlife, and habitats could also affect these uses. Potential effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on hunting and fishing uses are discussed below.

K. Lingofelt

Sport hunter with moose taken on Ft. Richardson.

Oil and gas exploration, development, and production could result in increased access to hunting and fishing areas. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for Tyonek and Beluga residents (Braund 2007), which would likely be true for user groups in other areas as well. However, increased public access to hunting and fishing areas due to construction of new roads could also increase competition between user groups for fish and wildlife resources.

Interference with commercial fishing operations is a potential effect of oil and gas exploration, development and production in Cook Inlet. A 2004 study of the drift gillnet fishery in Cook Inlet found that subsurface obstructions were generally not of concern as a hazard to fishing gear because most oil and gas infrastructure is quite deep and generally out of the range of fishing gear (Petterson and Glazier 2004). Areas with infrastructure in shallower locations are generally avoided by gillnet fishers to prevent grounding. Surface obstructions, such as platforms, are a concern, because unobstructed waters maximize navigational safety and time for harvest, but reports of actual interactions between infrastructure and gillnet operations appear rare. Non-permanent structures pose more of a hazard for fishers than permanent ones because permanent structures are predictable and fishing strategies can be adapted to account for them (Petterson and Glazier 2004).

Oil pollution could result in harmful effects to fisheries through direct lethal or sub-lethal effects to fish stocks (Davis et al. 1984). In addition, fishing operations may be directly affected by the presence of oil, and fisheries products may be unacceptable to the consumer. In the case of blowouts, fishers could be forced to change fishing locations (Davis et al. 1984).

An oil spill could result in decreased sport fishing. The number of anglers fishing in areas affected by the *Exxon Valdez* oil spill decreased by 13 percent in the year after the oil spill and harvest decreased by 10 percent, while the number of anglers had been increasing by 10 percent per year and harvest by 14 percent per year in the previous five years; increasing trends continued in areas outside the spill area (Mills 1992). The economic loss from this decrease in sport fishing for the two years following the oil spill was estimated to be $31 million (Carson and Hanemann 1992). Similar information is unavailable for personal use and educational fisheries, but oil spills or other pollution would likely create similar effects as with sport and subsistence fisheries.

The 1989 *Exxon Valdez* oil spill injured commercial fishing through direct impacts to commercial fish species and because of emergency closures of fisheries that led to dramatic declines in income of commercial fishers (EVOSTC 2006). Disruptions to the commercial fishing industry in the area of the oil spill continued many years after the spill in the form of changes in average earnings, ex-vessel prices, and values of fishing permits (EVOSTC 2006). Although pink salmon and sockeye salmon were considered recovered from the spill by 2002, Pacific herring were still listed as "not recovering" in 2006 and therefore the fisheries that depend on them were considered to be in the process of recovery but not fully recovered (EVOSTC 2006). Closures of commercial fisheries can

result in over-escapements of salmon stocks. In sockeye salmon systems, this may lead to changes in abundance, size, and age structure of juveniles, and may adversely affect productivity in subsequent years (Schmidt et al. 1995). Direct cause-effect relationships between oil spills and negative changes in fisheries are difficult to demonstrate because many other complex factors also affect commercial fishing, including world supply of fishery products, regulatory and allocation changes, effects of management of other species such as sea lions, and increased competition with other user groups (EVOSTC 2006).

## 2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on uses of fish and wildlife populations such as sport hunting and sport, commercial, personal use, and educational fishing. Most of these potential effects would likely occur as secondary effects from effects on habitat, fish, or wildlife. Measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address harvest interference avoidance. A complete listing of mitigation measures is found in Chapter 9.

# F. Historic and Cultural Resources

## 1. Potential Activities and Cumulative Effects

Historic and cultural resources could be affected by oil and gas exploration, development, and production activities. For example, historic and cultural resources may be encountered during field-based activities, and these resources could be affected by accidents such as an oil spill. Following the *Exxon Valdez* oil spill, 24 archaeological sites experienced adverse effects including oiling of the sites, disturbance by clean-up activities, and looting and vandalism (EVOSTC 2006; Reger et al. 2000). Monitoring of the sites over a seven-year period indicated that vandalism continued to be a minor problem, and that although some sites were initially badly damaged by oiling, residual oil does not appear to be contaminating known sites, and sites are now considered to be recovered (EVOSTC 2006).

## 2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on historic and cultural resources, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

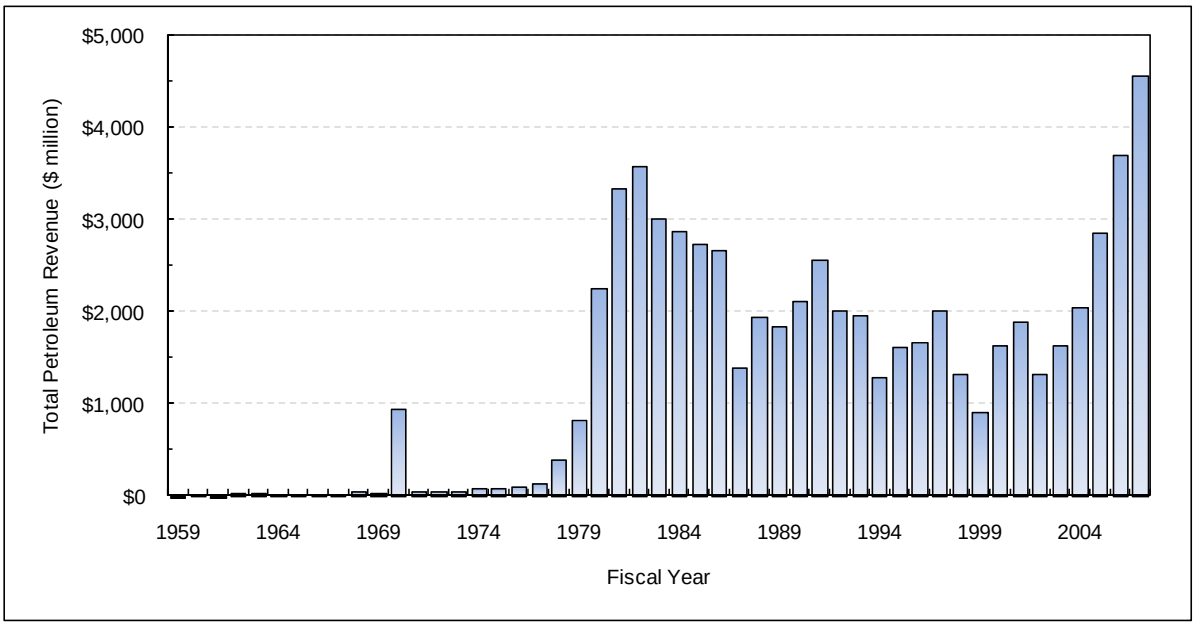
Because historic and cultural resources are irreplaceable, caution is necessary if these resources are encountered in order to not disturb or impact them. AS 41.35.200 addresses unlawful acts concerning cultural and historical resources. In addition, all field-based response workers are required to adhere to historic properties protection policies that reinforce that it is unlawful to collect or disturb, remove, or destroy any historic property or suspected historic property and to immediately report any historic property that they see or encounter (AHRS 2008).

Mitigation measures address education and protection of historic and archeological sites. A complete listing of mitigation measures is found in Chapter 9.

# G. Fiscal Effects on the State, Municipalities, and Communities

## 1. Fiscal Effects on the State

Alaska's economy depends heavily on revenues related to oil and gas production and the government spending resulting from those revenues. Oil and gas lease sales generate income to state government through bonus payments, rentals, royalties, production taxes, income taxes, and oil and gas property taxes. Petroleum revenues totaled $4.57 billion in FY 2007 (ADOR 2007b; Figure 8.1).




Source: ADOR 2007b.

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 8.1. Historical petroleum revenue to the State of Alaska, 1959-2007.**

### a. Revenue

***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 2008a).

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 FY 2007 (July 2006 through June 2007) was approximately $7.4 million. Rentals from federal leases were approximately $2 million (ADNR 2008b).

***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 Cook Inlet Areawide Oil and Gas Lease Sale held in May 2008, the royalty rate was 12.5 percent (ADNR 2008c).

***Production taxes***. In 2007, the state replaced the Petroleum Profits Tax (PPT) with the Alaska's Clear and Equitable Share (ACES). The revision increased overall rates and narrowed allowances for cost deductions and investment credits. For FY 2007 statewide production taxes were $2.29 billion; for FY 2008 they are forecast to be $3.40 billion (ADOR 2007b).

***Corporate income taxes*** must be paid by all corporations in the state 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 2007b).

***Petroleum property taxes*** are annual taxes 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 2007b).

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 2007b).

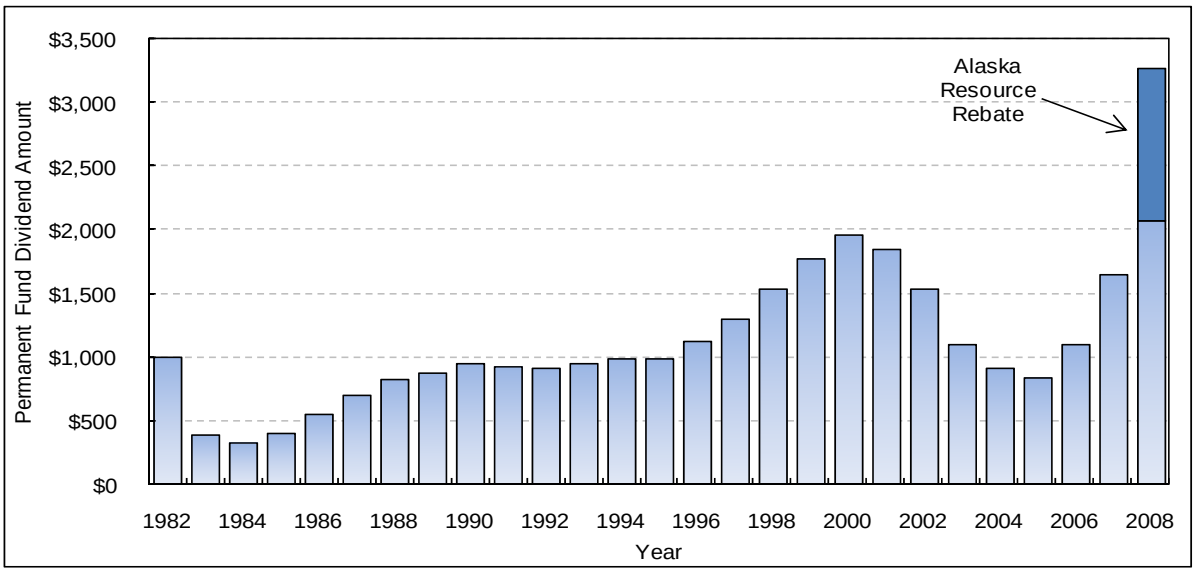
Together these revenues comprised approximately 87 percent of the state's general fund unrestricted revenue in FY 2007 (ADOR 2007b). Such revenues finance the state's education funding, operating budget, and capital budget. State spending supports nearly one out of every three jobs, and $3 of every $10 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 (Goldsmith 1991). Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to eligible state residents.

## b. Alaska Permanent Fund

The Alaska Permanent Fund, established by ballot proposition in 1976, is also funded with oil and gas revenues. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund, which is forecast to exceed $40 billion in FY 2008 (APFC 2008). All eligible Alaskans who apply receive an annual Permanent Fund Dividend (PFD) from the earnings of the fund. In 2008, the PFD was $2,069 per person, and 610,768 dividends were paid totaling $1.2 billion (ADOR 2008; Figure 8.2). 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.

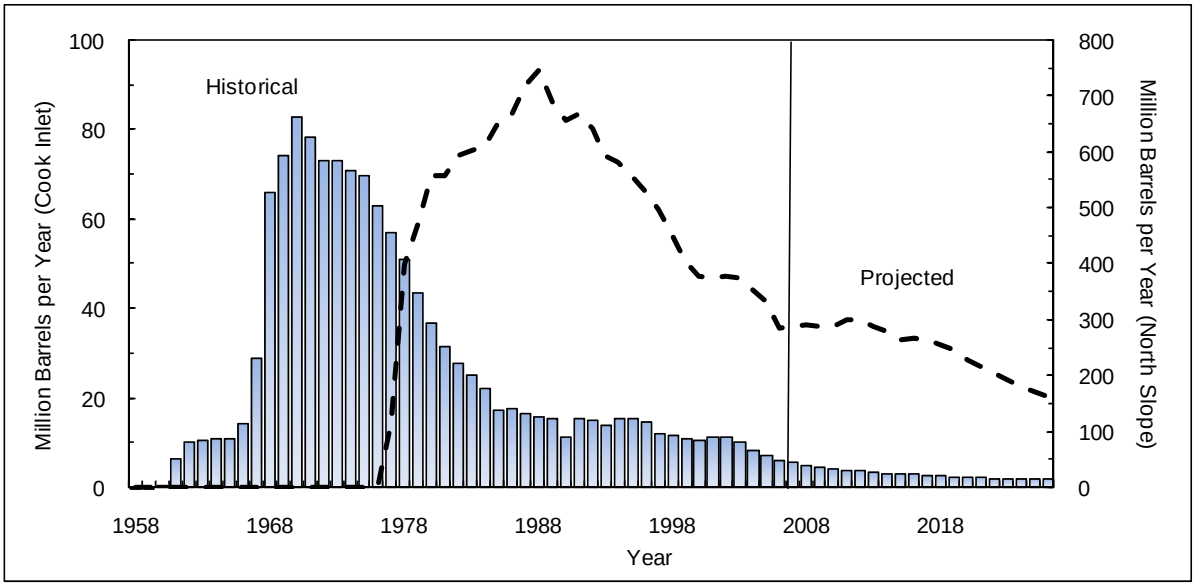
## c. Current and Projected Production

Cook Inlet oil production peaked in 1970 at 82.9 million barrels, and declined to about 5.7 million barrels in FY 2007. Alaska North Slope production peaked at 2.006 million barrels per day in FY 1988 and has also declined steadily since then (Figure 8.3). 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.




Source: ADOR 2007a; ADOR 2008.

**Figure 8.2. Amount of the Alaska Permanent Fund Dividend, 1982-2008; includes Alaska Resource Rebate in 2008.**




Source: ADNR 2007.

Notes: Note different scales for Cook Inlet (gray bars) and North Slope (dashed line).

**Figure 8.3. Historical and projected oil production in Cook Inlet (blue bars) and the North Slope (dashed line), 1958-2026.**

## 2. Fiscal Effects on Municipalities and Communities

Local municipalities and communities benefit directly from the oil and gas industry through property taxes. The Kenai Peninsula Borough collected over $7 million in oil and gas property taxes in 2007; the Municipality of Anchorage collected over $4 million, and the Matanuska-Susitna Borough collected about $27,000 (ADOL 2008a, b, c).

Alaska's petroleum industry also has significant indirect impacts on local communities through state and local government spending of oil and gas revenues. 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 (Information Insights and McDowell Group 2001). Furthermore, the total economic effect of any spending, including state government 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 (Goldsmith 1991).

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 (Information Insights and McDowell Group 2001).

Statewide, 14,597 workers were employed in the oil and gas or oilfield services industries in 2006, with wages totaling $1,141.6 million (ADOL 2008d). The number of workers employed increased by 2,969 workers and wages increased 27.7 percent during 2005 (ADOL 2008d).

In 2008, the state legislature passed, and Governor Palin signed into law, Senate Bill 4002, a $910.1 million energy package addressing the state's high revenue from record high oil prices. The bill gave each PFD recipient a one-time Alaska Resource Rebate of $1,200 (Figure 8.2); increased the maximum loan amount for bulk fuel bridge and bulk fuel revolving loan funds to communities and cooperatives to $750,000; suspended the state's motor fuel tax on gasoline, marine fuel, and aviation fuel for a year, and strengthened the Power Cost Equalization Program. An additional $60 million was allocated to the Home Energy Rebate Program operated by the Alaska Housing Finance Corporation, and $50 million in supplemental funds was allocated to the Renewable Energy Fund bringing the total available for renewable energy projects in FY 2009 to $100 million (SOA 2008).

# H. Effects of Oil and Gas on Municipalities and Communities

## 1. Oil and Gas Industry Expenditures and Employment

Although only limited oil and gas exploration and production occur in the Matanuska-Susitna Borough (Wells and Hanson 2006), 353 Mat-Su residents were employed by the oil and gas industry with an average monthly wage of $8,382 in 1999, the most recent estimates available (Information Insights and McDowell Group 2001). The economic impact of the oil and gas industry in the Mat-Su Borough was an additional 2,105 jobs for Mat-Su residents who commuted to Anchorage or other locations, with a payroll of $84 million; the induced impacts were 1,558 jobs and $38 million in payroll. Total economic impact was estimated to be 4,016 jobs and $158 million for the Mat-Su Borough in 1999 (Information Insights and McDowell Group 2001). It is important to note that these statistics are for oil and gas activity statewide, including the North Slope, and not just the Cook Inlet lease sale area; for example, the 353 Mat-Su residents employed by the oil and gas industry include residents working in jobs connected with the North Slope as well as the Cook Inlet area.

Anchorage is the primary headquarters for Alaska's oil and gas industry. In 2007, 2,400 workers were employed by the oil and gas industry in Anchorage, an increase of 9 percent over 2006 (AEDC 2008). In 1999, the most recent year for which economic impact estimates are available, a total of $239 million was spent on payroll and an additional $845 million in goods and services in the Anchorage economy (Information Insights and McDowell Group 2001). Indirect impact of the oil and gas industry was estimated to be 11,600 jobs and $431 million in payroll, and the induced impact was estimated to be 2,320 jobs and $69 million in payroll.

The oil and gas industry has been important to the economy of the Kenai Peninsula for over 40 years, and five of the top 10 employers are connected to the oil industry (Information Insights and McDowell Group 2001). In addition to the support service industry, several important processing facilities are also located on the Kenai Peninsula. Direct impact of the oil and gas industry was 674 jobs with a payroll of $63 million in 1999. The indirect economic impact was an additional 2,822 jobs and $94 million in payroll; and the induced impacts were 777 jobs and $20 million in payroll. Total economic impact on the Kenai Peninsula was 4,273 jobs and $177 million in payroll, which was 26 percent of the area's employment and 36 percent of the area's payroll (Information Insights and McDowell Group 2001). Additional current statistics are available for the Kenai Peninsula Borough. In 2006, oil and gas extraction, production, and manufacturing industries employed 1,334 workers who earned $659 million; this accounted for 7.4 percent of total Kenai Peninsula Borough employment and 18.3 percent of earnings (KPB 2008). Taxable properties for the oil and gas industry were reported at $607 million (KPB 2008), and 8 of the top 10 property tax payers in the borough were oil and gas industry companies (KPB 2006).

In 2006, nonresidents accounted for 30.8 percent of the statewide oil industry's workforce (major oil companies and oilfield services), an increase of 1.2 percentage points over 2005 (ADOL 2008d). Earnings paid to nonresidents working in the oil industry increased from $242.9 million in 2005 to $327.6 million in 2006. The nonresident share of earnings in the oil industry was 28.7 percent, a figure much higher than the statewide private sector average of 12.9 percent. By comparison, Alaska's seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2006; 76.4 percent of workers were nonresidents (ADOL 2008d).

## 2. Natural Gas Needs in Southcentral Alaska

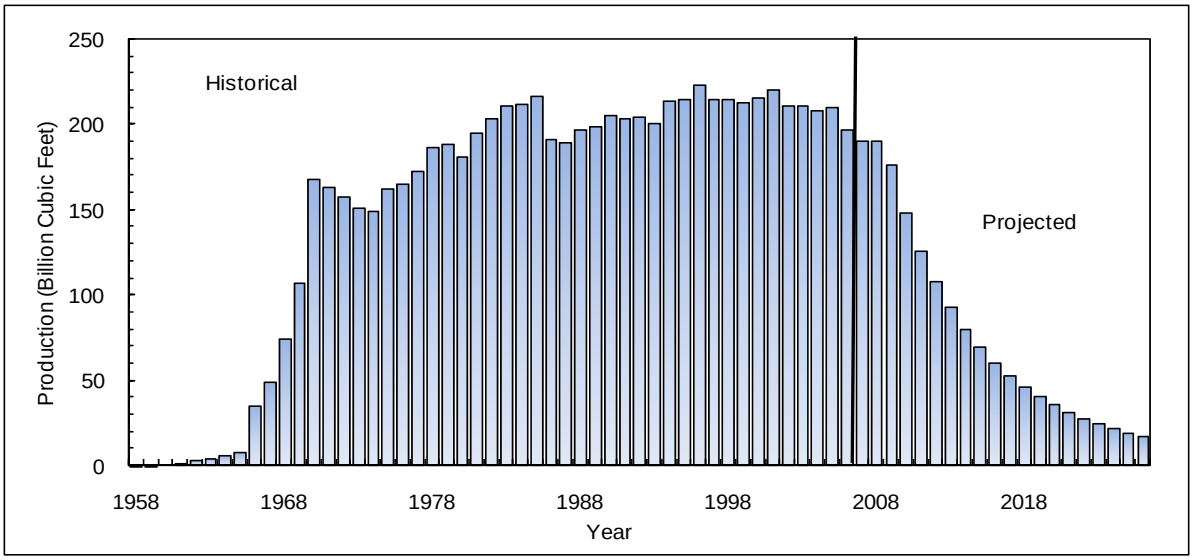
Natural gas is a major source of energy for Southcentral Alaska, and all natural gas used in the area comes from Cook Inlet. This includes residential and commercial uses, and industrial facilities which include the ConocoPhillips/ Marathon LNG plant in Nikiski, and until September 2007, Agrium's fertilizer plant that is also located in Nikiski. Electricity for Southcentral is generated primarily from natural gas.


B. Havelock, DO&G

Agrium fertilizer plant, Nikiski (closed in 2007).

Historically, the supply of natural gas exceeded demand, resulting in an abundant supply of low-cost gas that was consistently below prices in the Lower 48 and benefited residential gas customers and electric utilities along the railbelt from Homer to Fairbanks (Thomas et al. 2004). Abundant, low-priced local natural gas also enabled the industrial developments of the LNG and fertilizer plants on the Kenai Peninsula.

In 2006, the National Energy Technology Laboratory forecast dry gas consumption and Cook Inlet supply (NETL 2006). Taking into account proposed new industrial projects, they projected that demand for natural gas would exceed proven supplies by 110 MMcf/d (million cubic feet per day) by 2015, 250 MMcf/d by 2025, and 300 MMcf/d by 2035 unless new reserves are discovered and developed, natural gas is transported to the area by a spur line from the proposed North Slope pipeline, or LNG is imported (NETL 2006). Decreasing supply of Cook Inlet natural gas and resulting wholesale price increases (Figure 8.4) led to the closure of the Agrium plant in 2007, resulting in the loss of 250 jobs in the Kenai Peninsula Borough. The LNG export license and supply contract with Tokyo Electric and Tokyo Gas was extended to 2011, but continued operation of the LNG plant may be jeopardized without long-term proven supplies of natural gas (Thomas et al. 2004). Without increased Cook Inlet natural gas supplies, prices for residential and commercial natural gas and for electricity will continue to increase (Thomas et al. 2004). In fact, between 2000 and 2006, the price of natural gas increased 91 percent for Anchorage households and the cost of electricity increased 28 percent (Saylor and Haley 2006). Further, in September 2008, Enstar Natural Gas Co., which serves about 128,000 homes and businesses in the Anchorage area, announced plans to raise rates for home heating by at least 22 percent in January 2009 (Holland 2008).




Notes: Projected production represents the DO&G's current estimate of proved producing and probable reserves. Actual produced volumes may be greater than those projected if new reserves are discovered, developed, and produced to meet demand.

**Figure 8.4. Historical and projected production of natural gas in Cook Inlet, 1958-2026.**

## 3. Access

If platforms were constructed offshore, some recreational marine boaters may have to avoid or navigate around them. Temporary roads for exploration drilling may be built, and some permanent roads may be constructed as a result of proposed activities. Roads could increase access to previously inaccessible areas, which could improve recreational opportunities, but could also create community development, land use planning, or fish and game management problems. If a development project were proposed and a plan of operations approved, detours could affect some roads or trails during construction.

## 4. Recreation and Tourism

Recreation and tourism are important to the culture and economies of Cook Inlet communities. They are closely tied to fish and wildlife populations and the habitats that support them through activities such as fishing, hunting, wildlife viewing, hiking, camping, boating, and other outdoor activities. Therefore, effects from oil and gas development on fish, wildlife, and their habitats could have direct effects on recreation and tourism. Possible effects from oil and gas exploration, development, and production on fish and wildlife population and habitats are discussed in the preceding sections. Other potential effects on recreation and tourism are discussed below.

Oil and gas exploration, development, and production could affect recreation and tourism in the lease sale area if the aesthetics of the area were changed. However opinions regarding aesthetic quality vary widely, and the sight of a production platform in Cook Inlet, for example, could be distasteful to some, add to the appeal of the area for some, and be unnoticed by others.

An oil spill could result in significant negative effects to recreation and tourism. Recreation and tourism declined dramatically in Prince William Sound, Cook Inlet, and the Kenai Peninsula following that 1989 *Exxon Valdez* oil spill (EVOSTC 2006). Access to hunting and fishing areas was limited, and oiled areas were closed to kayakers. Some unoiled areas were used more heavily because activities were displaced from oiled areas. Because some species had not completely

recovered from the spill and oil remained in some localized areas, tourism and recreation were considered to be recovering, but not yet recovered, in 2006 (EVOSTC 2006).

If oil and gas activities reduced access to towns, fishing grounds, campgrounds, and other tourist or recreational areas, users' enjoyment of the area could be negatively affected. If users' perceptions, travel, and spending were negatively affected, decreased revenues to local businesses could result. If oil and gas activities reduced access to services such as gas stations, hotels, restaurants, shops, supply stores, grocery stores, and guides, adverse consequences on businesses and local economies could result. However, oil and gas activities could provide a source of business for local vendors during the slow season, and could attract new businesses.

## 5. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have effects on municipalities and communities in the Cook Inlet area, measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, or mitigate potentially negative effects. Positive effects are expected on local governments and economies, employment, personal income, reasonable energy costs, and opportunities for industrial development.

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. Mitigation measures also address critical habitat areas and state game refuges, protection of streams, siting of facilities, public access, navigable waters, and public water supplies. A complete listing of mitigation measures is found in Chapter 9.

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