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

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

A. Introduction

This chapter considers and discusses reasonably foreseeable effects that lease sales and subsequent activities could have on the habitats, fish and wildlife populations, and their uses of the sale area, and potential effects on historic and cultural resources, fiscal effects, and effects on local communities as required by AS 38.05.035(g).

The director has limited the scope to considering and discussing those effects on the important subsistence, sport, personal use, and commercial species and uses described in Chapters Four and Five (AS 38.05.035(e)(1)(B)). As explained in Chapter Two, the director has established and limited the administrative review for lease sales in this area to the disposal and exploration. Even though the lease sale itself is not expected to have any effects other than to provide initial revenue to the state, DNR possesses a body of knowledge covering oil and gas activities in Alaska and around the world which demonstrates the potential cumulative effects that could occur in the sale area as a result of subsequent activity. As a result, these effects are considered and discussed below as required by AS 38.05.035(g).

Alaska statutes specify that speculation about possible future effects is not required (AS 38.05.035(h)). However, many studies, much of which are applicable to the sale area, are available on the effects of oil and gas development for arctic and northern marine habitats, fish, and wildlife, as well as concerning industrial development in boreal forests of Canada. Although the lease sale area may differ from these areas in some respects, it shares much in common with these environments, thus much of this body of knowledge is applicable to the sale area.

B. Habitats

1. Potential Activities and Cumulative Effects

a. Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Habitats

Activities such as seismic surveys related to exploration and development; environmental and other studies; excavation of gravel material sites; construction and use of support facilities such as 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 may impact or alter landscapes and habitats.

For example, the ocean substrate 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). However, research is lacking on the specifics of these potential effects, especially specific to the sale area. Recovery time for substrate disturbances can vary from a few days or months to decades depending 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).

Blasting in particular can harm sensitive habitats such as anadromous fish streams, lagoons, estuaries, and shallow coastal waters (LaRoche and Associates 2011). All of the above activities may disturb the environment and contribute to behavior changes in terrestrial and marine wildlife and birds. They would also temporarily impact various vegetation by soil compaction, damage or destruction of tussocks, disturbance to wetlands, and accelerate the erosion of stream banks and lake shores. However, long term impacts to soil resources would not be widespread because of modern oil and gas construction and operation practices (BLM 2007).

More specifically, direct loss of habitat, degradation of habitat quality, degradation of water quality, habitat fragmentation, and reduced access to vital wildlife habitats may result with the building and maintenance of roads, trails, highways, and railways. Fish and wildlife may avoid these areas, experience increased exploitation by humans, the splitting and isolation of populations, and disruption in their social structure and the processes that maintain regional populations (ADF&G 2006 citing Jackson 2000). Invasive species may also displace native species as roads can act as travel conduits (ADF&G 2006).

Other threats to habitats include oil spills or persistent discharges from marine transport, drilling platforms, transfer facilities, or pipelines (ADF&G 2006; BLM 2006). Coastal habitats with large concentrations of floating debris are especially vulnerable to oil pollution. Intertidal vegetation like eelgrass and rockweed can be killed by oil coating. Wetlands and tideflats are highly susceptible to all forms of oil pollution (LaRoche and Associates 2011).

In addition, waters produced and discharged during oil and gas production activities may contain toxic levels of heavy metals, radioactive particles, and brine and persist for longer periods of time. When these production waters are discharged to land they can be more devastating to plants and animals than crude oil. Where they are discharged into marine waters, the toxic components are distributed differently than oil which floats to the surface (LaRoche and Associates 2011). They may have acute effects on the sea floor flora and fauna, reducing both their abundance and diversity in the immediate area of discharge (Arctic Council 2009). Leaky underground storage containers are another potential source of contamination to ground waters which in turn may contribute to surface water contamination (BLM 2007).

Because freshwater, terrestrial and marine environments are so interdependent, fish and wildlife may contact spilled oil on the water's surface, in water columns, and on or along shorelines, marshes, or tidelands. The number and type of species affected depends on several variables. Some of these include: location and size of spill, characteristics of oil, weather, prevailing currents and water conditions, types of habitat affected, and time of year the spill occurs (ADF&G 2006).

Sensitive use areas and habitats are especially important to wildlife. Depending on the species, time of year, location of disturbance in relation to the sensitive use habit, wildlife populations will differ greatly in their sensitivity to an activity. The most sensitive habitats are generally discrete locations such as seabird colonies, sea lion haulouts and rookeries, and harbor seal haulout areas. Waterfowl nesting areas are not restricted to such discrete locations (LaRoche and Associates 2011).

Since the early 1980s, better governance, regulations, international standards and practices, evolving advances in technology and best practices have lessened the effects of oil and gas activities. However, accidents do happen and best practices are not always followed. Some resources are sensitive to acute or continuous discharges/ emissions, even at sub-lethal concentrations. Both types may directly or indirectly have effects on local biological communities through effects on the ecosystems (Arctic Council 2009).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on terrestrial, freshwater, and marine habitats, measures in this best interest finding, along with other regulatory protections, are expected to mitigate those potential effects.

For example, administration of the federal Clean Water Act (32 USC § § 1251-1376) and state water quality statutes (18AAC75, AS 46.03, AS 46.15) are expected to avoid, minimize, and mitigate potential effects. Therefore, additional DO&G mitigation measures are not included in the finding; water quality regulations are under DEC's jurisdiction.

Further, standard DNR 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 DEC.

Mitigation measures included in this best interest finding address habitat loss avoidance, protection of wetland, riparian, and aquatic habitats, and restrictions on other important habitats. A complete listing of mitigation measures is found in Chapter Nine.

C. Birds and Terrestrial Wildlife

1. Potential Activities and Cumulative Effects

a. Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Birds

As stated in Chapter Four, the Alaska Peninsula is host to millions of migrating birds each year. Whether they be waterfowl, seabirds, shorebirds, raptors, or landbirds, the sale area supports a vast and diverse array of birds. They may be adversely affected in various ways. Some of these include displacement, increased predation, oil spills, loss of habitat and disturbance.

Seismic surveys may create noise disturbance and the impact it may have on wildlife, particularly birds and their habitat has been studied for several species, locations, and aircraft but produced varying results. Behavioral effects have been fairly well described, but the larger ecological context issues, and the potential for drawing conclusions regarding the effects on populations, has not been well developed (Wyle 2008).

For example, in a 4-year study, Ward et al. (1999) observed the effects of aircraft overflights on Pacific brant and Canada geese in Izembek Lagoon. The findings showed that 75% of the Pacific brant and 9% of the Canada geese flew in response to overflights. The Pacific brant were more reactive to helicopter rotary wing aircraft (51%) and louder aircraft (49%), as compared to fixed-wing (33%) and low-noise aircraft (40%). The Canada geese were more reactive to helicopter rotary wing aircraft (41%) and louder aircraft (43%), as compared to fixed-wing (20%) and low-noise aircraft (31%). The greatest response was to flights at intermediate altitudes of about 1000 to 2300 ft. Lateral distance from the birds was also a critical factor in determining the amount of disturbance to the birds (Ward et al. 1999). Although this study provides a great deal of behavioral detail, it shows that because responses to aircraft are influenced by many variables, it is difficult to generalize responses to noise disturbance across species (Wyle 2008).

Similarly, in a 1980's study, black brant in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the

disturbances. Yet, humans, eagles, and boats caused a greater percentage of brant to take flight (Wyle 2008).

Loss of habitat can occur when gravel mining and placement used to construct roads and pads cover tundra and other habitat. It is possible that habitat used for nesting, brood-rearing, or foraging would no longer be available. This could negatively affect tundra nesting migratory waterfowl (BLM 2007). Loss of habitat could result in lower reproductive rates.

If oil and gas facilities are built in or near the proposed lease disposal area, human built structures can provide nesting and denning habitats for species that prey on eggs and nestlings. Even with strict policies that discourage lax garbage handling and feeding of wildlife, predatory species may not be deterred. This could result in displacement of migratory birds from feeding areas along with a reduction of the reproductive success of prey species. This could be especially significant for at risk bird species (ADF&G 2006 citing Truett et al. 1997).

Birds are particularly vulnerable to oil spills. If birds become coated with oil, their feathers lose insulating qualities resulting in death by exposure or drowning. If they try to clean their feathers, they may ingest the oil and in turn die from its toxic effects. Many times, the damage to a bird colony from oil spills is seen in the reduction of reproductive output. Also, if the eggs become contaminated, less may hatch and those that do may result in a larger numbers of deformities that again lead to death. Areas that are extremely sensitive to oil pollution are seabird nesting sites, resting locations, and pelagic feeding areas. Likewise, waterfowl feeding, nesting, molting, and staging areas are just as affected (LaRoche and Associates 2011).

b. Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Terrestrial Wildlife

Terrestrial mammals found in or near the proposed lease disposal area include caribou, brown bears, moose, and various furbearers. They may experience effects related to oil and gas activities. The types and severity of potential adverse effects experienced by mammals vary across the state and by season. For most species, these effects would be most harmful during the short summer breeding season (ADF&G 2006).

i. Caribou

The National Research Council (NRC 2003) identified the incremental expansion of industrial structures and activity as a particular concern for caribou. Research has shown that caribou, especially cows and calf pairs in the weeks following birth, avoid or are less likely to cross infrastructure, such as roads and pipelines (ADF&G 2006 citing Nellemann and Cameron 1998; Griffith et al. 2002). However, more recent analysis suggests that calving and adult caribou distribution is not strongly influenced by the presence of the Milne Point Road on the North Slope (Noel et al. 2004).

Extensive research on caribou response to development has 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 on Alaska's North Slope, elevating pipelines and separating pipelines from roads with traffic has allowed caribou to easily move through the oil field.

Other research has shown that caribou are attracted to oil field infrastructure for insect relief (Ballard et al. 2000; Murphy and Lawhead 2000). Joly et al. (2006) support that oil development on Alaska's North Slope has not adversely affected caribou. However, effects to individual animals may or may not represent impacts to the overall herd population, and those impacts may be positive or negative.

Caribou responses to low flying aircraft range from none to violent escape. Their reactions depend on their distance from human activity; speed of approaching aircraft; altitude of aircraft; frequency of the disturbance; sex, age, and physical condition of the animals; size of caribou group; and season, terrain, and weather. One negative effect of caribou running and avoiding aircraft is increased expenditure of

energy. During harsh winter conditions, caribou may not be able to eat enough to counteract this calorie expenditure (Wyle 2008).

ii. Brown Bears

Incidental observations of brown bears exposed to fixed wing aircraft and helicopters in northern regions showed they had the greatest response of any animals observed (Wyle 2008). Brown bears may also be affected by seismic activity. Radio-collared bears, while in their dens, were affected by seismic activities taking place within 1.2 mi of their dens. This was demonstrated by increased heart rate and greater movement within the den. However, no negative effect, such as den abandonment, was documented (Reynolds et al. 1986).

Additionally, human activity may cause bears to avoid and area and can eventually displace the bears. A study conducted in British Columbia and Montana found that bears used areas within 100 m of roads significantly less than areas further away from the roads. This behavior didn't appear to have an effect on the overall population (McLellan and Schakleton 1988).

Of greater concern is the potential for increased bear-human interactions and potential high non-hunting deaths of bears resulting from those interactions (Suring and Del Frate 2002). For example, bears may become habituated to humans and their food and trash. Food conditioned bears become more aggressive, putting people at greater risk and the bear may need to be killed (DP&R 2014). In 2001, five brown bears were shot in the Prudhoe Bay fields (NRC 2003).

iii. Moose

Transportation systems, such as roads, by their nature increase the risk that wildlife, mainly species that are hunted or trapped may be overexploited (ADF&G 2006). Moose are in danger of not only overexploitation, but death by moose-vehicle collisions. This is especially true where human population and vehicle traffic continues to grow. Land clearing activities associated with road construction is responsible for an increase in moose browse, thus attracting moose to roadways (ADF&G 2012j).

iv. Furbearers

Furbearers such as foxes readily habituate to human activity which can lead to human-animal encounters, foxes using human structures, and an attraction to human food sources. Where fox to human contact is common, foxes show little fear and can thrive close to humans though they prefer wild settings. Foxes experience periodic rabies outbreaks where population densities are high, such as development areas, and this adds risks to human health (ADF&G 2012k).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on birds and wildlife, measures in this best interest finding, along with other regulatory protections, are expected to mitigate those potential effects. Some mitigation measures included in this best interest finding address free passage and movement of wildlife protect birds, caribou, moose, and brown bears. Other measures and regulatory protections address siting of facilities, pipelines, and oil spill prevention. A complete listing of mitigation measures is found in Chapter Nine.

D. Fish and Marine Wildlife

Potential post-lease activities that could have cumulative effects on fish and marine wildlife of the 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.

One of the primary concerns about oil and gas development in marine waters is the potential effects that noise from man-made sounds can impact marine life. For example, noise from seismic surveys, construction activities, and ongoing boat, drilling, and aircraft activities (Genesis 2011; Hofman 2003). It should be noted however, that much of the material published on sound produced by oil and gas activities has not necessarily gone through the scientific peer-review process (Genesis 2011).

1. Potential Activities and Cumulative Effects

a. Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Fish

Fish can be adversely affected by oil and gas exploration, development, production, and transportation in a variety of ways. Among these are seismic testing, blasting, spills, noise, loss or degradation of habitat such as stream blockages, unauthorized takings, exposure to contaminants, or even vehicular injury (BLM 2006).

Seismic testing affect fish differently depending on the type of methods used. Non-explosive testing techniques such as water or air guns are commonly used in marine environments and tend to be used in open water. This technique is less harmful to fish than using explosives, especially if the explosives are used in shallow water. Explosives in shallow water are generally lethal to nearby fish. If over-pressure from terrestrial seismic explosions occurs in or near lakes and streams, it too can kill fish. In fact, using explosives as a sound source in seismic testing has the same impact on fish as blasting and significantly increases the chances of harming vulnerable fish populations (LaRoche and Associates 2011).

Blasting can occur during construction projects, the removal of navigation hazards, excavation, and trenching activities for pipelines. High explosives used in blasting in and out of the water can harm fish. Blasts occurring in the water usually have the greater impact. The major cause of death and injury to fish from blasting, results from ruptured swim bladders. A “kill zone” for fish is created from within-water explosions. It can extend a considerable distance away from the actual blast site. Fish dying in the “kill zone” are also dependent on location and magnitude of the blast, water depth, and species and life history stages of those fish (LaRoche and Associates 2011).

Salmon and herring are more sensitive to blasting than groundfish species such as halibut. And salmon eggs are extremely sensitive to the shock caused from blasting. Eggs exposed to shock or movement from around the fifth day after fertilization until the yolk plug is closed and embryos become more tolerant to shock (Kolden and Aimone-Martin 2013). Blasting criteria have been developed by ADF&G and are available upon request. The location of known fish bearing waters can be obtained from the Division of Habitat.

All types of channel blockage can affect fish. The severity of the impact depends on the fish species and time of year. For example salmon, Dolly Varden, and steelhead are particularly affected when their streams are blocked because it is crucial they move unrestricted to their spawning areas (LaRoche and Associates 2011).

b. Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Marine Wildlife

As discussed in Chapter Four, a variety of marine mammals can be found in and near the proposed lease disposal area. Some of the ways they may be impacted by oil and gas activities is through oil spills, loss of habitat, and disturbance.

i. Harbor Seals

For example, harbor seals are very sensitive to disturbance or destruction of haulout sites. Noise from low flying airplanes may cause harbor seals to abandon haulout sites (LaRoche and Associates 2011). Because they move awkwardly on land, harbor seals are quick to return to the water when feeling threatened, even if aquatic predators are present (ADF&G 2012j). If the mother-pup bond is disrupted at this time, it is not uncommon for the pups to be left behind or lost (LaRoche and Associates 2011).

ii. Walruses

Seismic surveys may be a potential threat to walruses by interfering with their communications, masking important natural sounds, causing physiological damage, or avoidance behaviors that keep them from biologically important areas. Pacific walrus are also known to be particularly sensitive to changes in engine noise and more likely to stampede when aircraft turn or bank overhead. Many times juveniles are trampled and killed. Pacific walrus populations are becoming more dependent on coastal haulouts. Interactions with human activities along the coast (aircraft over-flights, tourism, and hunting) are expected to increase. These identified sources of disturbance have resulted in walrus mortalities in recent years (USFWS 2011).

iii. Sea Otters

Human caused threats to sea otters are oil spills, pollutants, disturbance from recreational and industrial activities, and entanglement in fishing nets. (USFWS 2012d). A catastrophic oil spill would probably result in high mortalities of sea otters. 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. However, through study of the Southcentral Alaska sea otter stock, there is no evidence that other effects associated with routine oil and gas activities has had any direct impact on the sea otters (Allen and Angliss 2012).

Sea otters aren't the only mammal affected by oil pollution. Any mammal using haulout areas are susceptible. If adults are contaminated during a time pups are being nursed, the young may ingest the oil while nursing. The females may also have trouble recognizing their young which could lead to abandonment and starvation (LaRoche and Associates 2011).

iv. Whales and Other Marine Mammals

Likewise whales and other marine mammals can suffer impacts from exposure to oil. For example, the ingestion of oil leads to both lethal and sublethal effects. Before the *Exxon Valdez* oil spill, little was known about the effects of oil on marine mammals. In the early 1980's researchers observed gray whales swimming through oil seeps off California and captive bottlenose dolphins initially avoiding but eventually swimming through oiled areas in their tanks (Matkin et al. 2008).

While whales and dolphins may not experience hypothermia due to skin contact with oil, they are highly vulnerable to oil spills (NOAA 2013b). They are susceptible to inhalation of vapors and/or oil, and, especially in the case of mammal-eating transients, to ingestion. Also small, isolated and threatened populations are in more danger of a hastened decline in population (Matkin et al. 2008).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on fish and marine wildlife, measures in this best interest finding, along with other regulatory protections, are expected to mitigate those potential effects.

For example, because of the potential effects discussed above, effluents discharged by the oil and gas industry into marine and fresh surface waters within the sale area and within state boundaries, are regulated through the state's APDES program (see Chapter Seven, Section B5). This program ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the state's waters (DEC 2014).

Mitigation measures also address disturbance avoidance, seismic activities, siting of facilities, pipelines, and oil spill prevention and control. Steller's eiders, Steller sea lions, fin and beluga whales are provided additional protection under the Endangered Species Act. A complete listing of mitigation measures and other regulatory protections is found in Chapter Nine.

E. Air Quality

1. Potential Activities and Cumulative Effects

Oil and gas exploration, development, and production activities may produce emissions that have the potential to affect air quality. Degradation of air quality may be caused by the following equipment and activities (BLM 2006, 2007; Arctic Council 2009; BOEMRE 2011).

- Rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, and incinerators used during drilling operations
- Engines, turbines and heaters used for production, fluids, and heat processing and transport
- Aircraft, supply boats, personnel carriers, mobile support modules, as well as intermittent operations such as mud processing and well testing
- Blowouts and evaporation and burning of spilled oil
- 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.

More effects of reduced air quality include possible damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts (BLM 2006, 2007).

Greenhouse gas (GHG) emissions contribute to reduced air quality. DEC analyzed GHG emissions for Alaska and found that the industries with the highest greenhouse gas emission estimates are Alaska's oil and gas companies and the energy utilities providing power to Alaskan households (DEC 2008). There are significant uncertainties associated with estimates of Alaska's greenhouse gas emissions from the oil and gas sector as there are no regulatory requirements to track carbon dioxide or methane emissions.

Alaska's emissions account for 0.7% of all U.S. emissions. Of the 52 million metric tons of carbon dioxide equivalent emissions generated in Alaska, 15 million metric tons of carbon dioxide equivalent are related to the oil and gas industry (AMAG 2009). The Alaskan overall oil and natural gas industry historical trend projection for emissions was an estimated 3.0 million metric tons of greenhouse gases statewide in 2005, contributing about 6 % of the state's total greenhouse gas emissions (Roe et al.

2007). This is a projected decrease from 1990 and 2000, and continued decreases are expected through 2020. These estimates are for fugitive emissions, including 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 2008, improvements were made to the Alaska Greenhouse Gas Emission Inventory. DEC broke down 2005 GHG emissions data by source category and refined it. By applying these refinements with the 2007 Center for Climate Strategies (CCS) updates, it was estimated that Title V oil and gas sources contributed to 29% of GHG emissions in Alaska. In 2008, using the same data, DEC estimated oil and gas development sources were responsible for 73% GHG emissions of all Title V sources (see Table 8.1). In other words, industries in Alaska combusting, refining, storing, and transporting fuel had the highest GHG emission estimates (DEC 2008).

However, in 2005, according to the EPA's Energy CO2 Emissions by state, emissions from the combustion of fuel in Alaska were about the same as Connecticut, Nevada, and North Dakota. And Alaska's fuel combustion emissions were about half of Washington's emissions even though Washington had 10 times the population of Alaska (DEC 2008).

Table 8.1 Title V GHG Emissions & Percentages by ADEC Source Category

ADEC Source Category	Total GHG Emissions (MMtCO2e)	% Total Title V GHG Emissions
Electricity Production	2.18	11%
Military	0.97	5%
Mining	0.017[a]	1%
Municipal	0.012[b]	1%
Oil & Gas	15.26	73%
Other	1.76	8%
Seafood	0.16	1%
Totals	**20.63**	**100%**

Notes: Million Metric Tons of CO2 equivalents (MMtCO2e). Source: (DEC 2008)

2. Mitigation Measures and Other Regulatory Protections

Administration of the federal Clean Air Act (42 USC § § 7401-7671) and state air quality statutes (18 AAC 50, AS 46.03, AS 46.14) are expected to mitigate potential effects. Therefore, additional DO&G

[a] Totals were taken directly from the source document. It appears 0.017 is a transcription error when cross checked against the source document's Table 2. An extra 0 was added. DEC was contacted February 2014. The error was confirmed and changes will be made to the source document.

[b] Totals were taken directly from the source document. It appears 0.012 is a transcription error when cross checked against the source document's Table 2. An extra 0 was added. DEC was contacted February 2014. The error was confirmed and changes will be made to the source document.

mitigation measures are not included in the finding; air quality regulations are under DEC's jurisdiction.

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 Seven, Section B2.

F. Subsistence Uses

1. Potential Activities and Cumulative Effects

Subsistence uses of the lease sale 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 transportation may have potential effects on subsistence fishing and hunting. Potential post-lease activities that could have potential effects on subsistence uses of the sale area include seismic surveys, discharges from well drilling and production, construction of roads and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. Potential effects on subsistence uses may also include: increased or decreased access to hunting and fishing areas; concerns about safety of subsistence foods; and increased competition for nearby subsistence resources (EVOSTC 2010). If access to areas is restricted, subsistence users may have to travel greater distances and spend more time away from home in order to harvest resources. This applies whether subsistence activities are land or marine based.

On the other hand, roads and transportation corridors built by industry during exploration and development could lead to increased access to hunting, fishing and trapping areas and increased hunting pressure. Access to both public use and subsistence areas may become easier and faster, but it may also lead to more competition between users groups for resources. In Unit 9, difficult access limits hunting opportunity of moose. In easily accessible areas, moose may be exploited and reduce harvest rates for hunters (Butler 2010b). A reduction in fish and wildlife populations could lead to reductions in harvest success rates. If fewer resources are available, game managers could restrict both subsistence and non-subsistence hunting and fishing (ADF&G 2013k, 2013l, 2013n ; SWAMC 2012a).

Oil and gas development may potentially benefit a subsistence lifestyle by providing a potential increase in wage earning opportunities to supplement subsistence activities. Historically though, few Alaska Natives are employed in the oil and gas industry (NRC 2003). For example, on the North Slope, Alaska Natives living in the area hold a disproportionately lower number of the jobs there. Thirty years ago when the TAPS pipeline was built, most jobs were filled by nonresidents. Since then the state has been working on ways to encourage hiring of local residents (DOLWD 2009).

Some reports suggest that traditionally, cash employment has subsidized and acted more as a means to an end for rural Alaskans to maintain their subsistence based lifestyles (Lowe 2007). This is regardless of whether employment is in the oil and gas industry or some other area. This would work best if scheduled works hours or job duration do not interfere with the seasonal nature of subsistence. Other reports suggest participation in a cash economy would limit and create a loss of opportunity to participate in subsistence activities (BLM 2007).

Major oil spills may negatively impact subsistence resources. For example, studies undertaken since the 1989 *Exxon Valdez* oil spill suggest decreases in resource availability and accessibility, and

increased concerns about food safety. After the oil spill, subsistence harvests declined, diversity of uses shrank, fewer people participated in subsistence activities, and there was a disruption in the transmission of skills and values to young people (Fall 2006).

By 2003, harvest levels had generally increased in many communities, but harvest survey results were varied. In general they were higher than pre-spill levels in some areas and lower in others (Fall 2006). In a 2004 survey of spill area communities, 83% of respondents felt their "traditional way of life" had been injured by the spill and 74% felt recovery had not occurred. Harvest levels from villages in the spill area compare to other Alaskan communities but many subsistence resources have still not recovered from the spill. Because many subsistence resources affected by the spill are not yet healthy, productive, and existing at pre-spill levels, subsistence in areas affected by the *Exxon Valdez* spill was still not considered to be fully recovered as of 2010 (EVOSTC 2010).

It should be noted that publicly available, quantitative, controlled studies that document cumulative effects of an oil spill on subsistence land or in freshwater are lacking. There is limited information available on whether spatial redistribution of a species, such as caribou, affects subsistence harvest and the time required for a successful hunt (NRC 2003).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially affect subsistence uses, primarily as secondary effects from effects on habitat, fish, and wildlife. Measures in the best interest finding, along with other regulatory protections, are expected to mitigate those potential effects. DO&G mitigation measures address harvest interference avoidance, public access, road construction, and oil spill prevention. A complete listing of mitigation measures is found in Chapter Nine.

G. Commercial Fishing and Sport Fishing and Hunting

1. Potential Activities and Cumulative Effects

In addition to subsistence uses, other important uses of fish and wildlife populations in the sale area include commercial fishing and sport fishing and hunting. Potential activities that could have cumulative effects include seismic surveys, discharges from well drilling and production, construction of road and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Therefore, potential cumulative effects from oil and gas activities on the area's terrestrial and freshwater habitats and fish and wildlife populations could also affect commercial fishing and sport fishing and hunting uses. Potential effects to the area's habitats and fish and wildlife populations are discussed in the preceding sections.

As stated above, increased public access to hunting and fishing areas due to construction of new roads could increase competition between user groups for wildlife and fish resources.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities could potentially have cumulative effects on uses of wildlife and fish populations, such as commercial fishing, sport and hunting, primarily as a result of secondary effects from effects on habitats, wildlife or fish. Mitigation measures in this best interest finding, along with other regulatory protections, are expected to mitigate those potential effects. DO&G mitigation measures address access and harvest interference avoidance. A complete listing of mitigation measures is found in Chapter Nine.

H. Recreation and Tourism

1. Potential Activities and Cumulative Effects

Recreation and tourism are important to the culture and economies of communities in the sale area. 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 activities on fish, wildlife, and their habitats could affect recreation and tourism. Possible effects from oil and gas activities on fish and wildlife populations and habitats are discussed in the preceding sections. Other potential effects on recreations and tourism are discussed below.

Oil and gas activities could decrease an area's visual quality and attraction to tourists. It could likewise restrict local access to an area. For example, after the *Exxon Valdez* oil spill, access to visibly oiled areas was limited to recreational users such as kayakers. Some unoiled areas were used more heavily because activities were displaced from the oiled areas. Because some species had not completely recovered from the spill and oil remained in some localized areas, recreation and tourism were considered to be recovering, but not yet recovered as of 2010 (EVOSTC 2010).

Alternatively, oil and gas activities could result in increased access to recreational areas due to the construction of new roads. In 2010, the percentage of seasonal, recreational, or occasional purpose housing varied across the sale area. Communities with more roads had a higher percentage of this type of housing. As more roads are built, the cost of housing construction goes down (SWAMC 2012a). More housing may lead to more recreational and visitor users to the sale area.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially affect recreation and tourism, primarily as secondary effects from effects on habitat, fish, and wildlife. Measures in the best interest finding, along with other regulatory protections, are expected to mitigate those potential effects. DO&G mitigation measures address harvest interference avoidance, public access, road construction, and oil spill prevention. A complete listing of mitigation measures is found in Chapter Nine.

I. Historic and Cultural Resources

1. Potential Activities and Cumulative Effects

Potential naturally occurring impacts to historic and cultural resources may result from earthquakes, tree falls, stream erosion, and other erosive processes. If development occurs, impacts and disturbances to the historic and cultural resources 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 the 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 oil spill cleanup crews collecting artifacts (BLM 2007; USFWS 1986).

Spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon C-14 dating methods (USFWS 1986). The detrimental effects of cleanup activity on these resources are minor because the work plan for cleanup is constantly reviewed, and cleanup techniques are changed as needed to protect archaeological and cultural resources (Bittner 1996).

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. 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 2010).

2. Mitigation Measures and Other Regulatory Protections

Historic and cultural resources can be affected by oil and gas activities. Various mitigation measures used to protect archaeological sites during spill cleanups include avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs (Bittner 1996). Measures in this best interest finding, along with other regulatory protections, are expected to mitigate those potential effects.

Because historic and cultural resources are irreplaceable, caution is necessary in order to not disturb or impact them. AS 41.35.200 addresses unlawful acts concerning cultural and historical resources. It prohibits the appropriation, excavation, removal, injury or destruction of any state-owned cultural site. In addition, all field based response workers are required to adhere to historic properties protection policies that reinforce these statutory requirements, and to immediately report any historic property that they see or encounter (AHRS 2012). A complete listing of mitigation measures is found in Chapter Nine.

J. Fiscal Effects on the State, affected Municipalities, and Communities

1. Fiscal Effects on the State

Alaska's economy depends heavily on revenues related to oil and gas production and government spending resulting from those revenues. The related revenue sources include bonus payments, rentals, royalties, production taxes, income taxes, and oil and gas property taxes. In FY 2014, (through February 2014) the state received approximately $1.27 billion from these sources (DO&G 2014). Oil revenue contributes over 92% of all unrestricted revenue to the state. Such revenues finance the state's education funding, operating budget, and capital budget. State revenues are sensitive to oil prices and oil production. In FY 2013, total oil revenue to the state was $6.4 billion. The Alaska Department of Revenue (DOR) forecasts FY 2014 oil revenue at $4.4 billion and the forecast for FY 2015 is $3.9 billion (DOR 2013).

a. Revenue

Bonus payments are the amounts paid by winning bidders for the individual tracts leased. Since 1959, 6,912 tracts have been leased statewide, generating more than $2 billion in bonus income and interest to the state (DNR 2013).

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 (DO&G 2013). Other rental schedules are also possible under AS 38.05.180(w).

Royalties represent the state's share of the production as the mineral interest owner. Royalties, including bonuses, rents, and interest provided about $2.0 billion in revenue to the state in FY 2013. Royalty rates can vary depending on the area (DOR 2013).

Production taxes. Since 2007, when the state adopted the Alaska's Clear and Equitable Share (ACES), the tax rate has been 25%. For FY 2012 statewide production taxes were $6.1 billion; for FY

2013 they are forecast to be $4.3 billion. In May of 2013, the More Alaska Production Act (MAPA) was signed into law. Transitioning from ACES to MAPA the state expects to see a revenue reduction of about $250 to $300 million in FY 2014. It is forecast that in FY 2015, the two tax systems will generate similar revenues at the forecasted price, expenditure, and production levels (DOR 2013).

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 2013, oil and gas corporation taxes were $435 million (DOR 2013).

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 $99.3 million in FY 2013 (DOR 2013).

In addition, tax settlements to the Constitutional Budget Reserve Fund amounted to approximately $618 million and National Petroleum Reserve-Alaska (NPR-A) royalties, rents, and bonuses amounted to $3.6 million (DOR 2013).

b. Alaska Permanent Fund

Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund (PFD), which pays dividends each year to eligible state residents. In 1976 Alaska voters approved a constitutional amendment creating the Alaska Permanent Fund. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund which is expected to exceed $47 billion in FY 2014 (APFC 2013a, 2013b). Eligible Alaskans who apply may receive an annual PFD from the earnings of the fund. In 2012, the PFD was $878 per person, and 610,633 dividends were paid totaling over $536 million (DOR 2012). The PFD is an equitable benefit transfer because it can reach every eligible Alaskan regardless of income or socioeconomic status. The PFD, with its large annual infusion of cash, contributes to the growth of the state economy, like any other basic industry.

c. Current and Projected Production

Alaska North Slope production peaked at 2.2 million barrels per day in FY 1988 and has declined steadily since then (DNR 2011). ADOR projects Alaska North Slope oil prices will average $105.68 per barrel for the fiscal year ending June 30, 2014 and $105.06 for FY 2015 (DOR 2013). Alaska North Slope crude production averaged 531.6 thousand barrels of oil per day for FY 2013.This is an 8.2% decline from FY 2012. Production for FY 2014 is projected to decrease to 508.2 thousand barrels per day (DOR 2013).

Part of the sale area is located in the North Aleutian Basin. As of 2006, the U.S. Minerals Management Service (MMS) estimated the North Aleutian Basin contained 753 million barrels of technically recoverable oil and natural gas liquids and 8.6 trillion cubic feet of technically recoverable natural gas (Reifenstuhl 2008; GAO 2010). While recent work by DNR geologists indicate a more promising oil and gas potential exists in the sale area than initially believed, more exploration is needed (Decker 2008; Reifenstuhl 2008).

2. Fiscal Effects on Affected Municipalities and Communities

Local communities and municipalities in the sale area may benefit directly from oil and gas activities through property taxes. For example, in 2010, the Municipality of Anchorage collected $3.5 million in oil and gas property taxes; the Fairbanks North Star Borough collected $9.2 million; the Kenai Borough collected $6.8 million; and the North Slope Borough collected $271 million. In FY 2010, $334 million in taxes was paid to the state and then distributed to local governments in which the property was located. This made up 23% of all local tax revenue collected in Alaska (McDowell Group 2011).

Alaska's petroleum industry also has significant indirect impacts on local communities through state and local government spending of oil and gas revenues. Money was spent on capital projects, support of basic government operations (including payroll for state government employees), revenue sharing and municipal assistance, education funding, and Permanent Fund dividends. 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 (McDowell Group 2011).

The oil and gas industry is Alaska's largest industry, directly spending $764 million in payroll in 2010. Including all direct, indirect, and induced employment and wages, the oil and gas industry spends just under $2.65 billion in annual payroll to Alaska residents. Overall, this spending generated 44,800 jobs. For each dollar earned by employees through direct pay, a total of three and a half payroll dollars are generated in Alaska. The oil and gas industry also accounts for 13% of private sector jobs and 18% of all private sector payrolls (McDowell Group 2011).

In 2010, the oil and gas industry had the highest average wage in Alaska. An average of 12,752 workers earned $1.52 billion in total annual payroll, about $9,951 a month (McDowell Group 2012).

K. Effects of Oil and Gas on Affected Municipalities and Communities

1. Oil and Gas Industry Expenditures and Employment

A lease sale may create new employment opportunities in the oil and gas, service, transportation, utilities, and retail sectors of the local economy (MOU 2004). Short-term job opportunities could arise during exploration. The long-term benefits of a lease sale on the above areas and the local communities will depend on the subsequent production of commercial quantities of oil and gas.

For example, an economic analysis study described the economic benefits to the State of Alaska and local communities if Alaska's Outer Continental Shelf (OCS) were to be developed. Scenarios for the Beaufort and Chukchi Seas and the North Aleutian Basin were presented regarding potential exploration, development, production, employment, population, revenue, and fiscal effects. In the North Aleutian OCS development scenario, employment was predicted to be highest in 2018. During production employment usually declines. Although most of the direct jobs may be located in local areas, most would be taken by workers living in urban areas and commuting to the sites. Local population growth was still predicted resulting from employment of local residents in direct and support jobs (Northern Economics 2009).

Another example of how a community has benefitted from oil and gas activities can be found for Anchorage. Anchorage is the primary headquarters for Alaska's oil and gas industry. In 2013, 3,600 workers were employed by the oil and gas industry in Anchorage, an increase of 300 jobs from 2012. Employment is predicted to increase by another 150 new oil and gas jobs in 2014 (AEDC 2013). From October 2009 to September 2010, a total of $345 million was spent on payroll for 2,040 direct oil and gas jobs in Anchorage. Another $413 million in goods and services and 5,800 jobs were recorded for the same time period (McDowell Group 2011). Indirect impact of the oil and gas industry was estimated to be 7,943 jobs and $667 million in payroll, and other indirect and induced impact were estimated to be 15,417 jobs and $550 million in payroll.

Also, the Southwest Alaska Vocational and Education Center (SAVEC) provides career and workforce development training to residents of Bristol Bay and rural residents from around the state (McDowell Group 2012; SAVEC 2013). Lessees are encouraged to coordinate with SAVEC, State of Alaska employment services, various corporations, and local communities to train and recruit local employees to the extent they are available and qualified.

Statewide, in 2011, the number of nonresident oil and gas industry workers rose 1.5% while the number of resident oil and gas industry workers decreased by 0.9%. Wages for nonresident workers increased by 6% to $495 million while those for residents increased by 3.6% to $1.2 billion. Oil and gas extraction is generally a high-wage industry for both residents and nonresident, but nonresidents earned more in 2011. By comparison, the seafood processing industry employed the greatest number of nonresidents (DOLWD 2013).

2. Energy Needs of Southwest Alaska

Local governments and Alaska Native corporations are seeking alternative means to support the economic needs of the area (DMLW 2005; MOU 2003a; MOU 2003b; MOU 2004; SWAMC 2012a). Oil and gas development could supplement commercial fishing to diversify the local economy (DMLW 2005). Oil and gas development in and near the lease sale area may provide an opportunity for low cost energy in the region (MOU 2003b; MOU 2004; SWAMC 2012a).

3. Access

If oil and gas development occur, an improved transportation network would be necessary. A transportation network might make oil and gas prospects more accessible and interconnect communities in the region (MOU 2003a; MOU 2003b; MOU 2004). The Southwest Alaska Transportation Plan (SWATP) attempts to define and present project recommendations for the regions (SWATP 2004). General concerns and issues suggest any transportation improvements should be able to support the region's economy, including potential oil and gas activities. As of 2013, the Cook Inlet to Bristol Bay corridor project is being reevaluated because of changing levels of state and federal funding for transportation projects (DOT&PF 2014; SWATP 2014).

4. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have effects on boroughs and communities in the sale area, measures in this best interest finding, along with other regulatory protections, are expected to 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 address protection of streams, siting of facilities, public access, and navigable waters. A complete listing of mitigation measures is found in Chapter Nine.

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