November 26, 2014

ALASKA PENINSULA AREAWIDE OIL AND GAS LEASE SALES (CORRECTED 12/01/14)

Written Finding of the Director

Alaska Department of NATURAL RESOURCES DIVISION OF OIL & GAS

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ERRATA

The Complete Table of Contents page iii has been corrected to properly reflect the title of Section D. Stages of Oil and Gas Resource Development (page 6-6).

The Chapter Six Table of Contents page i has been corrected to properly reflect the title of Section D. Stages of Oil and Gas Resource Development (page 6-6).

December 1, 2014

ALASKA PENINSULA AREAWIDE OIL AND GAS LEASE SALES (CORRECTED 12/01/14)

Written Finding of the Director

Prepared by:
Alaska Department of Natural Resources
Division of Oil and Gas

November 26, 2014

List of Abbreviations

Agencies		Other	
ADCRA	Alaska Division of Community and Regional Affairs	2-D	2-Dimensional
ADEED	Alaska Department of Education and Early Development	3-D	3-Dimensional
ADF&G	Alaska Department of Fish and Game	AAC	Alaska Administrative Code
ADGGS	Alaska Division of Geological & Geophysical Surveys	ACIAC	Alaska Climate Impact Assessment Commission
AOGCC	Alaska Oil and Gas Conservation Commission	ACRC	Alaska Climate Research Center
BLM	Bureau of Land Management	ANCSA	Alaska Native Claims Settlement Act
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement	ARRT	Alaska Regional Response Team
CF	Alaska Department of Fish & Game, Division of Commercial Fisheries	AS	Alaska Statute
COE	U.S. Army Corp of Engineers	AVO	Alaska Volcano Observatory
DCCED	Alaska Department of Commerce, Community, and Economic Development	C-plan	Oil Discharge Prevention and Contingency Plan
DEC	Department of Environmental Conservation	DRR	Dismantlement, Removal, and Remediation
DMLW	Division of Mining, Land and Water	ERD	Extended Reach Drilling
DNR	Department of Natural Resources	FOSC	Federal On-Scene Coordinator
DO&G	Division of Oil and Gas	FLIR	Forward-Looking InfraRed
DOLWD	Department of Labor and Workforce Development	FY	Fiscal Year
DOT&PF	Department of Transportation and Public Facilities	GMU	Game Management Unit
EPA	Environmental Protection Agency	ICS	Incident Command System
GAO	U.S. Government Accountability Office	ILI	In-Line inspection
Habitat	Alaska Department of Fish & Game, Division of Habitat	IR	Infrared
MMS	Minerals Management Service	LNG	Liquefied Natural Gas
NMFS	National Marine Fisheries Service	LOSC	Local On-Scene Coordinator
NOAA	National Oceanic and Atmospheric Administration	MWD	Measurements While Drilling
NPDES	National Pollutant Discharge Elimination System	MCH	Mulchatna
NPS	National Park Service	NAP	Northern Alaska Peninsula
NRHP	National Register of Historic Places	NGL	Natural Gas Liquid
OHA	Office of History and Archaeology	NGO	Non-Government Organization
PHMSA	Pipeline and Hazardous Materials Safety Administration	OCS	Outer Continental Shelf
PSIO	Petroleum Systems Integrity Office	PERP	Prevention and Emergency Response Program
SF	Alaska Department of Fish & Game, Division of Sport Fish	RRO	Risk Reduction Options
SPCO	State Pipeline Coordinator's Office	SAP	Southern Alaska Peninsula
USCB	U.S. Census Bureau	SOSC	State On-Scene Coordinator
USFWS	U.S. Fish and Wildlife Service	SWAMC	Southwest Alaska Municipal Conference
USGS	United States Geological Survey	UIC	Underground Injection Control

List of Abbreviations

Measurements	
in	inches
ft.	feet
mi	miles
sq. mi	square mile
mm	millimeters
m	meters
km	kilometers
lb.	pounds
gal	gallons
bbl.	barrel(s) (42 gallons)
%	percent
º	degrees
F	Fahrenheit
C	Celsius
MMSTB	Million Stock Tank Barrels
BCF	Billion Cubic Feet

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Executive Summary

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Executive Summary

The director of the Division of Oil and Gas (DO&G), with consent of the State of Alaska Department of Natural Resources (DNR) commissioner , determines whether issuing oil and gas leases serves the state's best interests (AS 38.05.035(e)). This document presents the director's written final finding and decision for the disposal of interest in state oil and gas through lease sales in the Alaska Peninsula areawide lease sales area. All relevant facts and issues within the scope of review that were known or made known to the director were reviewed. The director limited the scope of the final finding to the disposal phase of oil and gas activities and the reasonably foreseeable significant effects of issuing oil and gas leases (AS 38.05.035(e)(1)(A)). Conditions for phasing have been met under AS 38.05.035(e)(1)(C). The content of best interest findings is specified in AS 38.05.035(e), and topics that must be considered and discussed are found in AS 38.05.035(g).

A. Director's Final Decision

After weighing the facts and issues known at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections in place, the director finds the potential benefits of lease sales outweigh the possible negative effects, and the director finds that Alaska Peninsula areawide oil and gas lease sales will be in the best interests of the state of Alaska.

B. Public Process

The process of developing a best interest finding includes opportunities for input from a broad range of participants, including: the public; state, federal and local government agencies; Alaska Native organizations; resource user groups; non-government organizations (NGOs); and any other interested parties. More information on public comments is found in Chapter Two.

C. Description of Lease Disposal Area

The Alaska Peninsula areawide lease disposal area (hereafter referred to as the sale area) includes approximately 4 million gross acres onshore and 1.75 million gross acres of offshore state waters. There are 1,047 tracts ranging in size from 640 to 5,760 acres. The lease sale area is located on the north side of the Alaska Peninsula. The state owns the majority of land in the sale area. The rest consists of a mixture of Native, federal, and private holdings. The Aleutians East Borough, Bristol Bay Borough, and the Lake & Peninsula Borough are also major land owners. Only free and unencumbered state-owned oil and gas mineral estates within the tracts will be included in any leases issued. More detailed discussion of the sale area is found in Chapter Three.

D. Habitat, Fish, and Wildlife

The Alaska Peninsula sale area exists in two ecoregions, mainly the Bristol Bay-Nushagak Lowlands and some portions of the Alaska Peninsula Mountains. The wide variety of terrestrial, freshwater, and marine habitats in the area include estuaries and lagoons; wetlands and tideflats; rocky islands and seacliffs; coasts; rivers, streams, and lakes; boreal forests/taiga; alpine and low arctic tundra; glaciers; and barren alpine.

A number of designated habitat areas, both state and federal, are found in or near the sale area. These include the Bristol Bay Fisheries Reserve; Izembek State Game Refuge; State of Alaska Critical Habitat Areas: Egegik Bay, Ugashik Bay (Pilot Point), Cinder River, Port Heiden, and Port Moller; Alaska Peninsula National Wildlife Refuge; Izembek National Wildlife Refuge; Becharof National

Wildlife Refuge; Aniakchak National Monument and Preserve; and Katmai National Park and Preserve.

Freshwater and anadromous fishes are found in the area's waters. Numerous freshwater habitats provide expansive, nearly continuous fisheries habitat. All five species of Pacific salmon are found in the area. Up to 100 million salmon return to Southwest Alaska annually.

The terrestrial habitats support caribou, brown bear, moose, and furbearers. Marine mammals include Pacific walrus, beluga and gray whales, Steller sea lions, harbor seals, and sea otter. Some species are listed as threatened or endangered under the federal Endangered Species Act such as the Steller sea lion, the spotted seal and the southwest Alaska Distinct Population Segment of the northern sea otter. The above listed species are not included on the State Endangered Species List. The sale area is seasonally inhabited by migratory birds, providing staging, feeding, and nesting habitat for hundreds of species of shorebirds and waterfowl, numbering in the millions of birds. Additional information on the area's species and habitats is found in Chapter Four.

E. Current and Projected Uses

Subsistence fishing, hunting, and gathering is the most consistent and reliable economic component for local communities. Commercial fishing, sport fishing and hunting, trapping, recreation, and tourism also take place in the proposed sale area. The largest sockeye salmon fishery in the world occurs in Bristol Bay. Sport fishing and hunting are also important to the area's culture and economy. Although recreation and tourism are not as popular as fishing and hunting, local communities are benefitting as more visitors are coming to view the scenery and wildlife, especially bears and birds. These uses are discussed in more detail in Chapter Five.

F. Oil and Gas in the Lease Sale Area

Significant new information regarding the petroleum resource potential of the Alaska Peninsula has become available since the last best interest finding issued in 2005. A list of the information and documents considered and relied upon is included in a References listing at the end of each chapter. This information is the result of several years of integrated field and subsurface research led by DNR geologists. Based on available information, DNR has determined that the area offers reasonable hydrocarbon potential. Although past exploration has not yielded commercial production, there are indications that the necessary components of active petroleum systems may be present. Recent industry focus appears to be on natural gas as a more likely product than oil, and much of the gas potential is offshore beneath the federal waters of Bristol Bay. When informed by a robust, regionally extensive grid of modern scientific data that will be developed through this phased leasing process, DNR anticipates that much higher estimates of undiscovered oil and gas will likely result, than previously estimated by the U.S. Geological Survey. Petroleum potential and phases of exploration, development, production, and transportation are discussed in Chapter Six.

G. Governmental Powers to Regulate Oil and Gas

All oil and gas activities are subject to numerous federal, state, and local laws and regulations. These government agencies have broad authority to regulate and condition activities related to oil and gas. Agencies include the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game; the Alaska Oil and Gas Conservation Commission; the U.S. Environmental Protection Agency; the U.S. Army Corp of Engineers; the U.S. Fish and Wildlife Service; and local boroughs. Many of the regulatory and statutory authorities are discussed in Chapter Seven.

H. Reasonably Foreseeable Effects of Leasing

Potential activities to be permitted under future phases of the leasing process that could have cumulative effects on the area's habitats and fish and wildlife populations include seismic surveys, construction of support facilities, and drilling, production, and transportation activities. Some potential cumulative effects of these activities include physical disturbances that could alter the landscape, lakes, rivers, and wetlands; habitat change; behavioral changes of fish, wildlife and birds; drawdowns and contaminations of groundwater; and contamination of terrestrial, freshwater, or marine habitats from well drilling and production, gas blowouts, or spills of hazardous substances.

Oil and gas development could result in increased access to recreation, hunting, and fishing areas due to construction of new roads. This could also increase competition between user groups. Exploration and development could decrease the area's visual quality and attraction to tourists and could restrict local access to the area. However, increased access could benefit recreational and visitor uses by increasing the area available for those uses. Other potential benefits from oil and gas development include a potential increase in wage earning opportunities to supplement subsistence activities.

If unregulated, oil and gas activities could potentially affect local landowners and surface users, habitats, fish, and wildlife, air quality, subsistence, viewshed, recreational, and sport and commercial uses. Local residents' use of the area requires access to it. Any activity, facility, or structure that restricts access could have an adverse impact on local residents, especially if private property is involved. However the terms of each individual oil and gas lease require that public access to the leasehold area may not be restricted, except immediately around facilities. Mitigation measures included in this written finding and those developed through permitting in future phases, along with laws and regulations imposed by state and federal agencies, are expected to mitigate these potential effects.

Oil and gas activities may also have effects, including fiscal, on communities. Positive potential effects are job creation, a small initial contribution to state revenues, and the potential to local use of oil and gas to lower energy costs. If local and Alaska residents and contractors are hired for work in the lease area, to the extent they are available and qualified, the multiplier effect may benefit local and state economies. More information about potential effects is found in Chapter Eight.

I. Mitigation Measures

Mitigation measures address protection of private property; water quality and aquifers; air quality; facilities and operations; habitat, fish, and wildlife; subsistence, commercial, and sport harvest activities; management of fuels, hazardous substances, and wastes; potential spills of hazardous substances; and access. Mitigation measures are found in Chapter Nine.

Chapter One: Director's Final Findings and Decision

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Chapter One: Director's Final Findings and Decision

The State of Alaska offers oil and gas leases through a program known as areawide lease sales. The state's areawide lease sale program provides several significant benefits. Every 10 years, it allows a thorough consideration and discussion of topics required by AS 38.05.035(g) for an entire area. Areawide sales reduce redundant administrative processes that multiple smaller area sales would require, improve government efficiency, and allow the Alaska Department of Natural Resources (DNR) and the public to focus on substantial new information that has become available for each lease disposal area since the previous lease sale. By conducting areawide lease sales at a set time each year, companies are provided with a stable, predictable schedule that allows them to plan and develop their exploration strategies and budgets years in advance. The public is also afforded a consistent process and timeline by which to provide new information that might affect mitigation measures through the annual Call for New Information. The result is more efficient public input, earlier exploration and development, government efficiency, and mitigation measures that reflect current information.

The State of Alaska is proposing to offer all available state-owned acreage in the Alaska Peninsula Areawide oil and gas lease sales to be held from 2015-2024. The gross acreage is in excess of 5 million acres (4 million onshore and 1.75 million offshore within state waters).

The director of the Division of Oil and Gas (DO&G) has made a finding that this disposal is in the best interest of the state. All relevant facts and issues within the scope of review that were known or made known to the director were reviewed. The director established the scope of the administrative review and finding to the reasonably foreseeable significant effects of the uses proposed to be authorized by the disposal (AS 35.05.035(e)(1)(A)). Conditions for phasing have been met under AS 38.05.035(e)(1)(C). Disposals of interests in state oil and gas resources through leasing are governed by AS 38.05.035(e), and matters that must be considered and discussed are found in AS 38.05.035(g).

A. Director's Written Finding

In making this finding, the director considered and discussed facts and agency information received during review that address the matters required by AS 38.05.035(g). The discussion of these matters is set out in the accompanying chapters of this written finding. Based on consideration and discussion of the information contained herein, the director finds:

1. The Alaska constitution directs the state "to encourage … the development of its resources by making them available for maximum use consistent with the public interest" (Alaska Constitution, art. VIII §§1,2).
2. The people of Alaska have an interest in developing the state's oil and gas resources and maximizing the economic and physical recovery of those resources (AS 38.05.180(a)).
3. Cooperative development of oil and gas resources between the State of Alaska and the Federal government may lead to increased interest in the lease sale area. Subsequently, the State of Alaska will be poised to quickly move forward in developing those resources.
4. AS 38.05.035(e)(1)(A) allows the director to establish the scope of the administrative review and the scope of the written finding supporting that determination.
5. AS 38.05.035(e)(1)(B) allows the director to limit the scope to a review of applicable statutes and regulation, facts, and issues material to the determination, and known or available to the director during the administrative review.

6. AS 38.05.035(e)(1)(C) allows the director to limit a written finding to the disposal phase, which is the issuance of an oil and gas lease.
7. Under AS 38.05.035(h) the director may not be required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use for which a written best interest finding is required is more specifically defined.
8. Oil and gas activities conducted under oil and gas leases are subject to laws and regulations.
9. Potential effects of activities subsequent to disposal can be both positive and negative.
10. Alaska Peninsula fish and wildlife species that could be affected by activities subsequent to the disposal include salmon, caribou, brown bears, waterfowl and migratory birds, walrus, and other marine mammals. Birds such as black brant may experience displacement, increased predation, oil spills, loss of habitat and disturbance. Seabird nesting sites, resting locations, and pelagic feeding areas are extremely sensitive to oil pollution. Appropriate lease specific mitigation measures will address these issues to preserve free passage and movement and protect fish and wildlife.
11. Several important subsistence, sport, personal use, and commercial uses of fish and wildlife could be affected as well. The worlds' largest sockeye salmon run occurs in Bristol Bay and an estimated 49% of all working age adults living in the region directly participate in the commercial seafood industry. It is also estimated that subsistence harvests between 40 and 90% of the protein consumed by the region's residents. Mitigation measures addressing harvest interference avoidance, public access, road construction, and oil spill prevention can mitigate impacts.
12. Discharges of oil, gas, and hazardous substances into Alaska Peninsula land, water, and air can harm habitats and fish and wildlife populations. Improved design, construction, operating techniques, proper handling, storage, spill prevention measures, and disposal of such substances can mitigate impacts. The fixed location of loading facilities at marine terminals on the southern coast of the peninsula improves spill response and contingency planning.
13. Increased use of the area for oil and gas activities could affect subsistence uses. However, potential negative effects may be outweighed by potential positive effects such as higher incomes that offset costs of equipment and other subsistence activities. Roads and transportation corridors may also lead to increased access for hunting, fishing, and trapping.
14. Communities located in the Aleutians East, Bristol Bay, and Lake & Peninsula Boroughs and the Dillingham Census Area could benefit through economic opportunity such as the collection of property taxes, state and local government spending of oil and gas revenues, and lower fuel prices if oil or gas is developed in paying quantities.
15. Potentially negative effects of oil and gas activities on fish and wildlife species, habitats, and their uses; on local uses, residents, and property owners; and on local communities, if not adequately addressed and mitigated by federal and state law and terms and conditions of the lease, will be mitigated through permit requirements as determined and imposed during review and approval of subsequent exploration and development phases of this areawide leasing process.
16. At this lease sale (disposal) phase it is unknown whether any leases will be sold, whether exploration, development and production, or transportation will be proposed, and if it is, the specific location, type, size, extent, and duration of any proposal.

17. Methods to explore for, develop and produce, and transport petroleum resources may vary depending on the location, lessee, operator, and resource discovered. It would therefore be premature for DNR to address now possible effects from future activities that will not be permitted until more information is known.
18. The locations and characteristics of the specific tracts that may receive bids in future lease sales will provide information to DNR to allow a focused review to determine requirements and impacts directly associated with proposed operations. DNR will also determine additional requirements necessary to protect the state's interest in approval of later phase activities.

B. Disposal Phase Decision

The director has weighed the facts and issues known at this time and has set out findings. The director considered applicable laws and regulations and balanced the potential positive and negative effects given the mitigation measures and other regulatory protections. Therefore, the director finds that the potential benefits of the lease sales outweigh the possible negative effects, and that the Alaska Peninsula areawide oil and gas lease sales will best serve the interests of the state of Alaska.

The state is sufficiently empowered through constitutional, statutory, and regulatory regimes; terms of the lease sale; lease contract; and plans of operations to ensure that lessees conduct their activities safely and in a manner that protects the environment and maintains opportunities for existing and anticipated uses.

A person is eligible to file a request for reconsideration and any subsequent appeal to the Superior Court only if the person has meaningfully participated in this process by submitting written comment during the public comment period.

Director, Division of Oil and Gas

11/26/14

Date

Chapter Two: Introduction

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Chapter Two: Introduction

The Alaska Constitution provides that the state's policy is "to encourage….the development of its resources by making them available for maximum use consistent with the public interest" and that the "legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State… for the maximum benefit of its people" (Alaska Constitution, article VIII, §§1 and 2). To comply with this provision, the legislature enacted Title 38 of the Alaska Statutes and directed DNR to implement the statutes.

The legislature found the people of Alaska have an interest in the development of Alaska's oil and gas resources to maximize the economic and physical recovery of the resources; maximize competition among parties seeking to explore and develop the resources; and maximize use of Alaska's human resources in the development of the resources (AS 38.05.180(a)(1)).

AS 38.05.180(a)(2) further states it is in the state's best interest to encourage an assessment of its oil and gas resources, allow the maximum flexibility in the methods of issuing leases, and to offer acreage for oil and gas leases or gas only leases. DNR has identified five areas of moderate to high potential for oil and gas development and designated these areas for leasing through competitive bid sales.

The State of Alaska is proposing to offer all available state-owned acreage in the Alaska Peninsula Areawide oil and gas lease sales to be held from 2015-2024. The lease disposal area is located on the north side of the Alaska Peninsula. It stretches from the Nushagak Peninsula in the north, then south and west to the vicinity of Cold Bay (Map 2.1). The gross acreage is about 5 million acres (3.5 million onshore and 1.75 million offshore within state waters). Only free and unencumbered state-owned oil and gas mineral estates will be included in any leases issued.

This is the director's final finding and decision, under AS 38.05.035(e), which discusses whether the interests of the state will best be served through the disposal of leases in the Alaska Peninsula areawide lease sale. Because it is understood that the lease sale is a disposal and for ease of reading, the lease disposal area will be called the "sale area" throughout the best interest finding.

A. Written Findings

Alaska statutes govern the disposal of state-owned mineral interests. Under AS 38.05.035(e), the DNR director may, with the consent of the commissioner, dispose of state land, resources, property, or interests after determining in a written finding that such action will serve the best interests of the state. As required by AS 38.05.035(e)(1)(A)(B)and(C), these written findings:

- establish the scope of the administrative review and the scope of the written finding supporting that determination;
- address the reasonably foreseeable, significant effects of the uses proposed by the disposal; and,
- limit the scope to a review of applicable statutes and regulations, facts and issues material to the determination, and known or available to the director during the administrative review.

1. Matters Considered and Discussed

The director must also consider and discuss in the written finding the matters set forth in AS 38.05.035(g). For ease of reading, reviewing, and commenting upon, this document does not necessarily follow the order as found in AS 38.05.035(g)(1)(B) (Table 2.1).

Table 2.1 Locations of topics required by AS 38.05.035(g)(1)(B)

AS 38.05.035(g)(1)(B) subsection number	Description	Location in this document
i	Property descriptions and locations	Chapter Three
ii	Petroleum potential	Chapter Six
iii	Fish, wildlife, and habitat	Chapter Four
iv	Current and projected uses; uses and value of fish and wildlife	Chapter Five
v	Governmental powers	Chapter Seven
vi	Reasonably foreseeable effects on subsistence; fish, wildlife, and habitat and their uses; and historic and cultural resources	Chapter Eight
vii	Mitigation measures	Chapter Nine
viii	Oil or gas transportation	Chapter Six
ix	Reasonably foreseeable fiscal effects	Chapter Eight
x	Reasonably foreseeable effects on municipalities and communities	Chapter Eight
xi	Bidding method	Chapter Two

2. Scope of Administrative Review

The scope of this administrative review and finding addresses only reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)). The director does not speculate about possible future effects that are subject to AS 38.05.035(h).

The director interprets “reasonably foreseeable” to mean there must be:

- some cause/result connection between the lease sales and the effect to be evaluated;
- a reasonable probability that the effect will occur as a result of the lease sale; and
- the effect will occur within a predictable time after the lease sale.

A reasonably foreseeable effect must also be “significant.” The director interprets “significant” to mean a known and noticeable impact on or within a reasonable proximity to the sale area.

The director shall establish and may limit the scope of an administrative review and finding for a proposed disposal (AS 38.05.035(e)(1)(A)(B)). The director cannot determine with specificity at the disposal phase if, when, where, how, or what kind of exploration, development and production, or transportation will ultimately occur as the result of a lease sale and exploration (AS 38.05.035(h)). Therefore, the director established the scope of review in this finding to address the reasonably foreseeable, significant effects of the uses to be authorized by the lease sale, the applicable statutes and regulations, the material facts and issues known to the director that pertain to the lease sale, and issues that the director finds are material to the determination of whether the lease sales will best serve the state's interest.

3. Phased Review

The director may, if the project for which the proposed disposal is sought is a multi-phased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes and regulations, facts, and issues identified above that pertain solely to the disposal phase of the project (AS 38.05.035(e)(1)(C)) under the following conditions:

- (i) the only uses to be authorized by the disposal are part of that phase;
- (ii) the disposal is a disposal of oil and gas, or of gas only, and, before the next phase of the project may proceed, public notice and the opportunity to comment are provided under regulations adopted by the department;
- (iii) the department's approval is required before the next phase may proceed; and
- (iv) the department describes its reasons for a decision to phase.

This best interest finding satisfies these requirements for phased review.

Condition (i) is met because the only uses authorized are part of the lease sale phase. The lease gives the lessee, subject to the provisions of the lease, the right to conduct geological and geophysical exploration for oil, gas, and associated substances within the leased area. It also gives the lessee the conditional right to drill for, extract, remove, clean, process, and dispose of any oil, gas, or associated substances that may underlie the lands described by the lease. While the lease gives the lessee the right to conduct these activities, the lease itself does not authorize any exploration or development activities by the lessee on leased tracts.

Condition (ii) is met because the proposed lease sale is of oil and gas or gas only, and before the next phase may proceed, public notice and the opportunity to comment will be provided Condition (iii) is met because DNR's approval is required before the next phase may proceed.

Condition (iv) is met because at this time specific information is unavailable as explained in Chapter One numbered findings 16, 17, and 18.

Therefore, this document includes the director's approval of the disposal phase.

4. Process

The process of developing a best interest finding includes opportunities for input from a broad range of participants, including: the public; state, federal and local government agencies; Alaska Native organizations; resource user groups; non-government organizations (NGOs); and any other interested parties.

a. Request for Agency Information and Preliminary Finding

The process for receiving public input begins with a request for information from state resource agencies, local governments, and Alaska Native corporations. DO&G requests information and data about the region's property ownership status, peoples, economy, current uses, subsistence, historic and cultural resources, fish and wildlife, and other natural resource values. Using this information and other relevant information that becomes available, DO&G develops a preliminary best interest finding and releases it for public comment (AS 38.05.035(e)(7)(A)).

On January 26, 2011, DO&G issued a Request for Agency Information to initiate the process of gathering information on the proposed lease disposals. DO&G received responses from four agencies: ADNR Office of History and Archaeology (OHA), Aleutians East Borough, US Fish and Wildlife Service (USFWS), and Alaska Department of Fish & Game, Division of Habitat (Habitat). See Appendix B for a summary of the comments received and the DO&G response to each (AS 38.05.035(e)(7)(A)).

On June 19, 2014, DO&G issued a Preliminary Best Interest Finding and released it for public comment.

b. Request for Public Comments

Once a preliminary best interest finding is issued, DO&G follows AS 38.05.945(a)(3)(A) to obtain public comments on the preliminary best interest finding. This statute includes specific provisions for public notice for written findings for oil and gas lease sales under AS 38.05.035(e)(5)(A).

Public comments assist in developing information for the final best interest finding. Information provided by agencies and the public assists the director in determining which facts and issues are material to the decision of whether the proposed lease sales are in the state's best interest, and in determining the reasonably foreseeable, significant effects of the proposed lease sale. Summaries of these comments and the director's responses are published in the final best interest finding (AS 38.05.035(e)(7)(B)).

DO&G received five public comments on the Preliminary Best Interest Finding. Summaries of the comments and DNR's responses can be found in Appendix B.

c. Final Finding

After receiving public comments on the preliminary best interest finding, DO&G reviews all comments, revises the best interest finding as needed, and incorporates additional relevant information and issues brought up during the public comment period. After considering the facts, laws, comments, and issues before him, the director makes a determination and develops a final written finding. The preliminary finding included a decision approving the explorations phase, however that has been removed from the final finding. The final best interest finding will be issued at least 90 days before the lease sale (AS 38.05.035(e)(5)(B).

d. Requests for Reconsideration and Appeals

A person who is eligible to file an administrative request for reconsideration may, within 20 days after issuance of the final written finding, file a request for reconsideration of the decision by the commissioner. An eligible person is someone who has meaningfully participated in the process set out for receipt of public comment by either submitting written comments during the comment period or by presenting oral testimony at a public hearing, if a public hearing was held, and is affected by the final written finding (AS 38.05.035(i)).

A person may appeal a final written finding to the superior court, but only if the person was eligible to request, and did request, reconsideration of that finding first at the agency level. The points on appeal are limited to those presented to the commissioner in the request for reconsideration (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the superior court, the agency is given full opportunity to review, analyze, and respond to the points on appeal before litigation. For purposes of appeal, the burden is on the party seeking review to establish the invalidity of the finding (AS 38.05.035(m)).

B. Annual Lease Sales

After a final best interest finding has been issued, DO&G may proceed with oil and gas lease sales in the area. A written finding is not required for a lease sale in an area subject to a best interest finding issued within the previous 10 years unless the commissioner determines that substantial new information has become available that justifies a supplement to the finding (AS 38.05.035(e)(6)(F)).

1. Calls for New Information

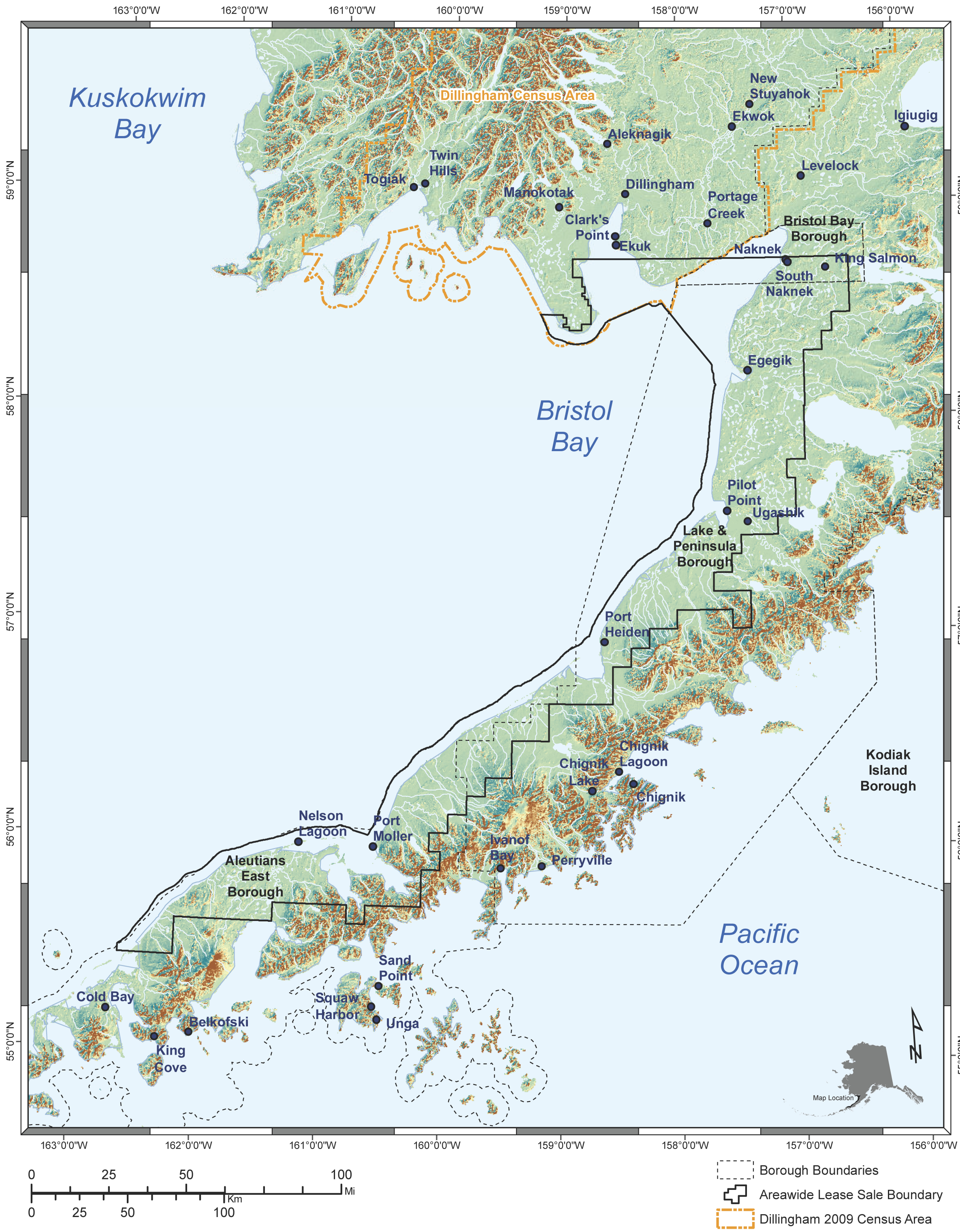
Before a lease sale, DO&G issues a Call for New Information requesting substantial new information that has become available since the most recent finding for that sale area was issued. This request is publicly noticed, and provides opportunity for public participation for a period of not less than 30 days. Based on information received, the director determines if it is necessary to supplement the finding. Based on that determination, the director either issues a supplement to the finding or a "Decision of No New Substantial Information" 90 days before the lease sale. The supplement has the status of a final written best interest finding for purposes of filing an administrative appeal or a request for reconsideration.

2. Bidding Method and Lease Terms

Under AS 38.05.180(f) and 11 AAC 83.100(a), the leasing of oil and gas resources must be by competitive bidding. For each lease sale under the proposed 10-year Alaska Peninsula Areawide Best Interest Finding, the commissioner will adopt the bidding method(s) and terms under AS 38.05.180 that the commissioner determines are in the state's best interest. The bidding method(s) and terms may not be the same for each lease sale over the 10-year term of this best interest finding. The bidding method(s) adopted for a particular lease sale will be published in the pre-sale notice describing the interests to be offered, the location and time of the sale, and the terms and conditions of the sale (AS 38.05.035(e)(6)(F)).

3. Lease Adjudication and Lease Award

The Alaska Peninsula sale area has been divided into lease sale tracts. For each announced lease sale DNR may release a tract map showing tracts available for bidding, lease status, and general mineral estate ownership. The extent of the state's ownership interest within tracts is generally not determined before a lease sale. Instead, following each lease sale, and before awarding leases, DNR will verify land available for leasing and acreage within tracts receiving bids. Determination of a lease award could take weeks to months following a lease sale depending on the number of tracts receiving bids and the complexity of lease history and ownership within the tract. It is possible that a lease cannot be awarded on a tract included in a lease sale. The state cannot legally award a lease if the mineral estate is not state owned or if all state owned lands within the tract are subject to an existing oil and gas lease. Should a potential bidder require land title, land status, or survey status information for a particular tract before submitting a bid, it will be the bidder's responsibility to obtain that information from DNR and federal public land records. Further, DNR reserves the right to defer or delete acreage or tracts from sale at any time up to lease award.



Map 2.1 Alaska Peninsula Lease Sale Area

Chapter Three: Description of the Alaska Peninsula Sale Area

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Chapter Three: Description of the Alaska Peninsula Sale Area

AS 38.05.035(g)(1)(B)(i) requires that the Director consider and discuss the property descriptions and locations of the sale area. The following overview includes information material to the determination of whether the lease sales will best serve the state's interest (AS 38.05.035(e)(1)(B)(iii)). It is not intended to be all inclusive.

A. Property Description

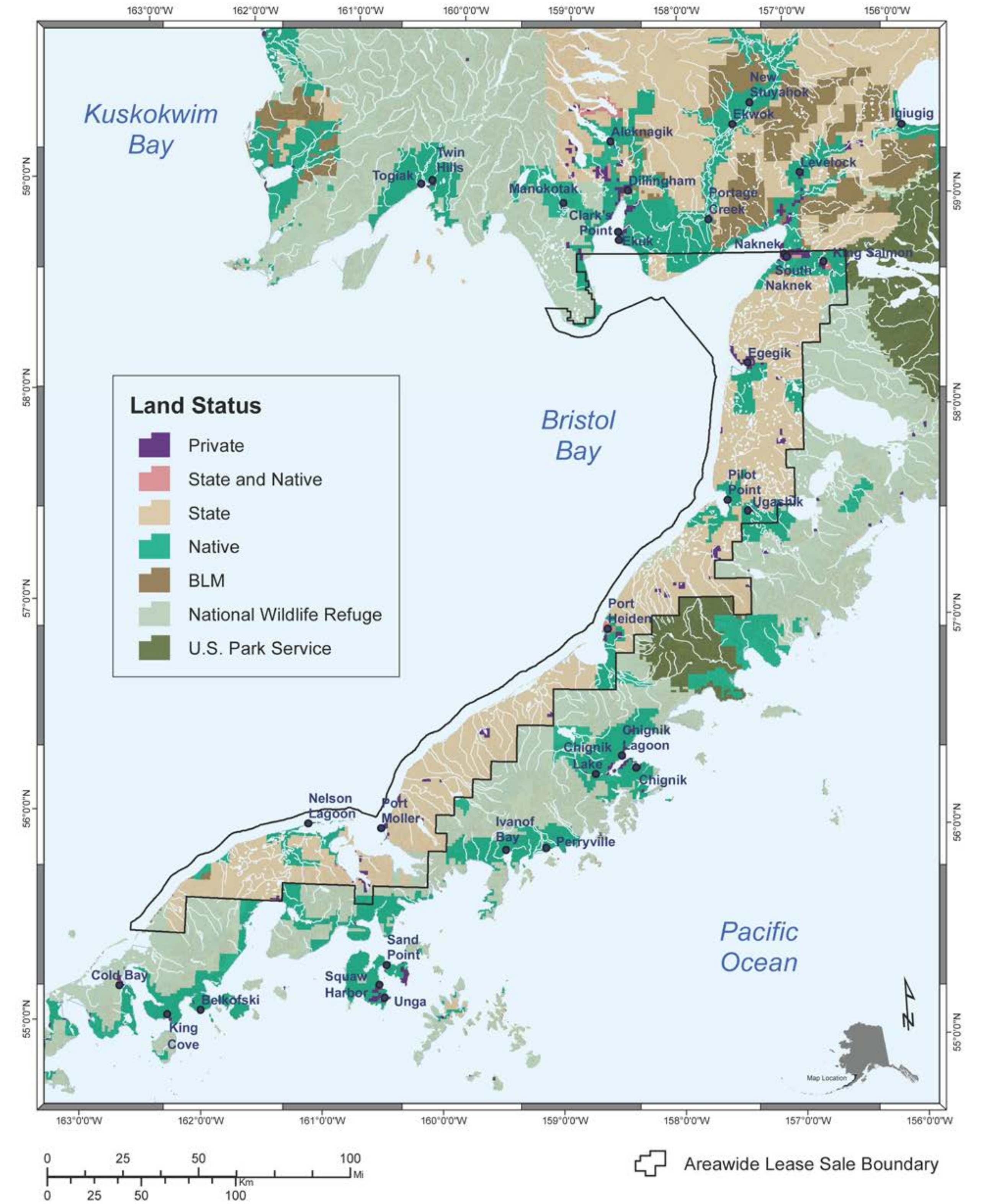
The Alaska Peninsula sale area includes approximately 4 million onshore acres and 1.75 million acres of offshore state waters. There are 1,047 tracts ranging in size from 640 to 5,760 acres. The sale area is located on the north side of the Alaska Peninsula. It stretches from the Nushagak Peninsula in the north, then south and west to the vicinity of Cold Bay. The state owns the majority of land in the sale area. The rest consists of a mixture of Native, federal, and private holdings (Map 3.1). The Aleutians East Borough, Bristol Bay Borough, and the Lake & Peninsula Borough are also major land owners. They acquired land under the state Municipal Entitlement Act which grants a borough 10% of the vacant, unappropriated, and unreserved state general grant land within its corporate limits.

The sale area lies within the Aleutians East Borough, Bristol Bay Borough, Lake & Peninsula Borough, and the Dillingham Census Area.

The sale area spans a wide and varied landscape that may be divided into ecoregions. Ecoregions are large areas of land and waters containing vegetation communities that share environmental conditions, species and ecological dynamics, and interactions critical for their long term persistence (ADF&G 2013i). The majority of the sale area is located in the Bristol Bay-Nushagak Lowlands ecoregion. The lowlands are characterized by rolling terrain, formed from morainal deposits. Dwarf scrub communities are widespread but large areas of wetlands also occur and lakes are scattered throughout. A small southern portion of the sale area is located in the Alaska Peninsula Mountains. This region is generally free of permafrost, and vegetation commonly consists of dwarf scrub communities (Gallant et al. 1995).

A wide variety of mammals inhabit the region including caribou, brown bear, moose, Pacific walrus, beluga whale, gray whale, Steller sea lion, harbor seal, and sea otter. Species listed as endangered (E) or threatened (T) under the federal Endangered Species Act are: the Steller sea lion (E), the spotted seal (T) (74 FR 52002), and the southwest Alaska Distinct Population Segment of the northern sea otter (T) (USFWS 2012). The above listed species are not included on the State Endangered Species List (ADF&G 2013m). Established rookery sites and federally recognized critical habitat sites exist within Bristol Bay for the Steller sea lion (NOAA 2012). No critical habitat is established for the spotted seal because their southern distinct population segment occurs outside the United States (75 FR 65239). Federal critical habitat is designated however, for the southwest Alaska Distinct Population Segment of northern sea otter in the Port Moller and Herendeen Bay area (74 FR 52002).

The Alaska Peninsula area provides staging, feeding, and nesting habitat for hundreds of species of shorebirds and waterfowl, numbering in the millions of birds. All five species of Pacific salmon occur in the area as well as other fishes. Fish and wildlife populations in the area are extensively harvested for subsistence and sport use, and significantly contribute to the local economy.



Map 3.1 Alaska Peninsula General Land Status

A number of state and federal wildlife refuges, critical habitat areas, recreation areas, and parks exist near the sale area. These areas encompass important fish and wildlife habitats, and have significant scenic and recreational value. These animals and habitats are considered and discussed in more detail in Chapters 4 and 5. Lessees are subject to regulatory requirements for these areas.

1. Land and Mineral Ownership

The Alaska Statehood Act granted to the State of Alaska the right to select from the federal public domain 102.5 million acres of land to serve as an economic base for the new state. The Act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying its interests in the land (AS 38.05.125). Therefore, when state land is conveyed to an individual citizen, local government, or other entity, state law requires that the deed reserve the mineral rights for the state. Furthermore, state law reserves to the state the right to reasonable access to the surface for purposes of exploring for, developing and producing the reserved mineral. Surface owners are entitled to damages under AS 38.05.130, but may not deny reasonable access. Mineral closing orders, which are commonly associated with surface land disposals, do not apply to oil and gas leasing.

The Alaska Native Claims Settlement Act (ANCSA), passed by Congress in 1971, also granted newly created regional Native corporations the right to select and obtain from the federal domain, the land and mineral estates within the regional Native corporation boundaries. It also allowed Native village corporations and individual Alaskan Natives to receive land estate interests. However, overlapping selections created conflicts and delays in conveying the land from the federal government, and some selected lands have yet to be conveyed.

The Bristol Bay Native Corporation and the Aleut Corporation own land and the mineral estate within the sale area (DNR 2004). The Aleutians East Borough, Bristol Bay Borough, and the Lake & Peninsula Borough own land as a result of the state's municipal entitlement program. For the most part, the state, as the owner of the retained mineral estate, may lease these lands for oil and gas development.

B. Boroughs and Communities

The sale area lies within the Aleutians East Borough, Bristol Bay Borough, Lake & Peninsula Borough, and the Dillingham Census Area. These boroughs and census area contain approximately 28 cities, towns, villages and communities ranging in population from less than 100 to over 2,000 residents (Tables 3.1-3.4).

1. Aleutians East Borough

The Aleutians East Borough (AEB), is a second class borough, and is located on the western portion of the Alaska Peninsula, including some Pacific islands. The borough is located on about 6,988 sq. mi of land and 8,023 sq. mi of water. It has been the home for Unanga Natives for thousands of years. The Russian hunters and fur traders came to the area in 1800s, later followed by Scandinavian and European whalers and fishermen in the 1900s. The area was also an important strategic site during World War II (ADCRA 2012a).Communities located within the borough include: Akutan, Belkofski, Cold Bay, False Pass, King Cove, Nelson Lagoon, Pauloff Harbor, Sand Point, and Unga (Table 3.1).

Table 3.1 Aleutians East Borough community profiles

Community	Incorporation Type	Land Area (sq. mi)	Population 2010	Population 2000	Population 1990
Aleutians E. Borough	2nd Class Borough	6,988	3,141	2,697	2,464
Akutan	2nd class city	14	1,027	713	589
Belkofski	Unincorporated	N/A	0	0	0
Cold Bay	2nd class city	54	108	88	148
False Pass	2nd class city	27	35	64	68
King Cove	1st class city	25	938	792	451
Nelson Lagoon	Unincorporated	N/A	52	83	83
Pauloff Harbor	Unincorporated	N/A	0	0	0
Sand Point	1st class	8	976	952	878
Unga	Unincorporated	N/A	0	0	0

Source: ADCRA 2012d.

a. Population

In 2010, an estimated 3,141 people lived within the AEB. Demographically, about 21% of the population was white, 30% was Alaska Native, 36% was Asian, and the remaining totaled 15%. Overall, the AEB population increased about 1% from 2000 – 2010 (ADCRA 2012a).

b. Economy

The AEB economy is cash-based. Commercial fishing and fish processing remains the dominate economy and occurs nearly year-round. In 2010, the per capita income was $22,279 (inflation adjusted dollars) and about 10.4% of all residents' incomes were below poverty level (ADCRA 2012a).

c. Transportation

The AEB can be accessed by air and water, including by floatplanes and cargo vessels. The state ferry operates only in the summer and fishing boats or skiffs are the primary mode of local transportation. Transportation services are necessary enough to provide year round employment (ADCRA 2012a).

d. Government and Education

No property or special taxes are collected in the AEB but there is a 2% raw fish tax, 1.5% severance taxes on metal ores and gravel, and 2% tax on commercial products of AEB waters (ADCRA 2012a).

The AEB had a total of six schools operating during the 2011-2012 school year with approximately 250 students enrolled. Expenditures per student were nearly $33,000 for the 2010-2011 school year. In 2010, the dropout rate for students in grades 7-12 was 4% (ADCRA 2012a).

2. Bristol Bay Borough

The Bristol Bay Borough (BBB) is a second class borough incorporated as the state's first borough in 1962 and has a population of 1,035 as of 2011. It is located in Southwest Alaska, at the upper eastern end of Bristol Bay. The area encompasses 504.9 sq. mi of land and 382.8 sq. mi of water. Communities located within the Borough include King Salmon, Naknek, and South Naknek (ADCRA 2012b) (Table 3.2).

The first Russian traders arrived in 1818 and in 1820 the first Russian settlement was established. Once the United States purchased Alaska in 1867, U.S. interests were directed primarily at the fur and fishing potential in this area. During World War II, King Salmon Air Force Base was developed (ADCRA 2012b).

Table 3.2 Bristol Bay community profiles

Community	Incorporation Type	Land Area (sq. mi)	Population 2010	2000	1990
Bristol Bay Borough	2nd Class Borough	505	997	1,258	1,410
King Salmon	Unincorporated CDP	N/A	374	442	696
Naknek	Unincorporated CDP	N/A	544	678	575
South Naknek	Unincorporated CDP	N/A	79	137	136

Source: ADCRA 2012d. CDP- census designated place

a. Population

In 2010, the BBB population was 997 people. Demographically 48% of the population was white, followed 34% Alaska Native, and the remaining population totaled 18%. From 2000 – 2010, the BBB population has increased by approximately 1% (ADCRA 2012b).

b. Economy

The BBB has a strategic geographic location between the Dillingham area and the Lake and Peninsula Borough. The mainstays of the BBB economy are commercial fishing, fish processing, government jobs, and transportation services. Naknek and South Naknek are dependent on fishing and processing while King Salmon offers many government and air taxi jobs. In 2010, the per capita income was $31,260 (inflation adjusted dollars) and about 5% of all residents' incomes were below poverty level (ADCRA 2012b).

c. Transportation

Inter-regional access within the area is limited to air or water transportation. King Salmon is the hub for the BBB. Scheduled and charter flights are available from Anchorage. The exception is one 15.5 mile road that connects Naknek to King Salmon (ADCRA 2012b).

d. Government and Education

Many King Salmon residents work for the government. The BBB collects no sales tax but a property tax of 13.0 mills, and special bed and fish taxes are collected at 10% and 4%, respectively (ADCRA 2012b).

The BBB had a total of two schools operating during the 2011-2012 school year with approximately 160 students enrolled. Expenditures per student were nearly $25,000 for the 2010-2011 school year. In 2010, the dropout rate for grades 7-12 was 0% (ADCRA 2012b).

3. Lake and Peninsula Borough

The Lake & Peninsula Borough (L&PB) is a home rule borough located on the Alaska Peninsula. It has an area of 23,782 sq. mi of land and 7,125 sq. mi of water. Bristol Bay is to the west and the Gulf of Alaska lies to the east. It reportedly has been inhabited for the past 9,000 years by Yup'ik Eskimos, Aleuts, Athabascan Indians, and Inupiaq cultures. Russian explorers, hunters and traders came to the area in the 1700s. Fishing and canning grew in the late 1800s (ADCRA 2012f).

Communities located within the borough include 2nd class cities and unincorporated CDPs (Table 3.3).

Table 3.3 Lake & Peninsula Borough community profiles

Community	Incorporation Type	Land Area (sq. mi)	Population 2010	Population 2000	Population 1990
Lake & Penin. Borough	2nd Class Borough	23,782	1,631	1,823	1,668
Chignik	2nd class city	N/A	91	79	188
Chignik Lagoon	Unincorporated CDP	N/A	78	103	53
Chignik Lake	Unincorporated CDP	N/A	73	145	133
Egegik	2nd class city	32	109	116	122
Igiugig	Unincorporated CDP	N/A	50	53	33
Iliamna	Unincorporated CDP	N/A	109	102	94
Ivanof Bay	Unincorporated CDP	N/A	7	22	35
Kokhanok	Unincorporated CDP	N/A	170	174	152
Levelock	Unincorporated CDP	N/A	69	122	105
Newhalen	2nd class city	N/A	190	160	160
Nondalton	2nd class city	N/A	164	221	178
Pedro Bay	Unincorporated CDP	N/A	42	50	42
Perryville	Unincorporated CDP	N/A	113	107	108
Pilot Point	2nd class city	N/A	68	100	53
Port Alsworth	Unincorporated CDP	N/A	159	104	55
Port Heiden	2nd class city	N/A	102	119	92
Ugashik	Unincorporated CDP	N/A	12	11	7

Source: ADCRA 2012d. CDP- census designated place

a. Population

The population of the L&PB was reported to be 1,631 in 2010. Demographically, the majority of the population was Alaska Native at 65% (primarily Aleuts, with a mixture of Eskimos and Athabascans) with the white population following at 23%. The remaining population totaled 12% (ADCRA 2012f).

b. Economy

Commercial fishing and processing make up most businesses of the area. Seven land-based processors and many floating processors operate within the borough. Tourism and recreation are also important industries, with over 60 hunting and fishing lodges located in the borough. Subsistence hunting and fishing are pursued year-round (ADCRA 2012f).

In 2010, the per capita income was $15,161 (inflation adjusted dollars) and about 21.4% of all residents' incomes were below poverty level (ADCRA 2012f).

c. Transportation

Iliamna and Newhalen are the only L&PB communities connected by road. Air taxi and charter services transport passengers and perishable goods from hubs to local communities. Some L&PB communities are served by ship, barge, or ferry. The Alaska Marine Highway System serves the community of Chignik about six times a year (ADCRA 2012f).

d. Government and Education

L&PB does not collect property or sales taxes. However, special 2% raw fish, 6% bed, $3 a day guide, and $1 a day lodge taxes are collected (ADCRA 2012f).

The L&PB had a total of 14 schools operating during the 2011-2012 school year with approximately 379 students enrolled. Expenditures per student were nearly $41,000 for the 2010-2011 school year. In 2010, the dropout rate for grades 7-12 was 11% (ADCRA 2012f).

4. Dillingham Census Area, City of Dillingham

The Dillingham Census Area is recognized as part of an unincorporated borough and encompasses the City of Dillingham which is the center of economic, government, transportation, and public services. The City of Dillingham is located at the confluence of the Wood and Nushagak rivers at the head of Nushugak Bay (City of Dillingham 2012b). The area of the city is about 35 sq. mi, and is located about 350 mi southwest of Anchorage (City of Dillingham 2012a).

The city is a commercial center for fishing, health services, tourism and visitor services, and freight and transportation throughout the region. Commercial and sport fisheries are important for the local economy (ADCRA 2012d; City of Dillingham 2012a).

Table 3.4 Dillingham Census Area community profiles

Community	Incorporation Type	Land Area (sq. mi)	Population 2010	2000	1990
Dillingham Census Area	Unincorporated	18,569	4,847	4,922	4,012
Dillingham	1st class city	33.6	2,329	2,466	2,017

Source: USCB 2012; DOLWD 2012; ADCRA 2012d.

a. Population

In 2010, the population of the Dillingham Census area was estimated to be 4,847. In 2011, the population was predominately Alaska Native at 71%, white at 19%, and the remaining population totaled 10% (USCB 2012). In 2012, the population of the City of Dillingham was about 2,264 (City of Dillingham 2012a).

b. Economy

The Dillingham Census Area’s economy is highly seasonal and driven by the harvest and processing of sockeye salmon. A number of floating processing facilities along with three onshore processing facilities operate in the Dillingham Census area. Commercial fishing, fish processing, cold storage, and support of the fishing industry mainly sustain the area’s economy (SWAMC 2012b).

c. Transportation

Access to the City of Dillingham is by sea or air, and a 25 mi road extends from Dillingham to Aleknagik to the northwest (City of Dillingham 2012b). A state-owned airport provides regular jet flights to and from Anchorage (ADCRA 2012c).

d. Government and Education

The City of Dillingham collects a 6% sales tax and the property tax is 13.0 mills. There are two special taxes, a 10% bed tax and a 10% alcohol tax (ADCRA 2012c).

Dillingham Census Area schools are part of the Rural Education Attendance Areas (SWAMC 2012c). Rural Education Attendance Areas serve students living in towns and villages in politically unorganized areas of rural Alaska (ADEED 2012). The city of Dillingham had 493 students attending 3 schools for the 2011-2012 school year. Expenditures in the 2010-2011 school year were just over $17,000 per student and the dropout rate for students in grades 7-12 was 9.2% (ADCRA 2012c). The University of Alaska also maintains a branch campus in the City of Dillingham (SWAMC 2012c).

C. Historic and Cultural Resources

The Bristol Bay area was probably settled between 3,000 to 4,000 B.C. by Athabascan Indians, Central Yup'ik Eskimos, and Sugpiag Eskimos, as evidenced by hunting and fishing camps found along the Naknek River and other locations in the Aleutians (ADCRA 2012b). Migration of inhabitants along the peninsula occurred from east to west in more than one migration event. Most Aleut villages were probably located on the northern coasts of the islands due to the availability of subsistence resources in the Bering Sea, while villages on the southern coasts may have been used as seasonal camps (Stein 1977).

The attraction of fur resources brought Russian hunters and traders, and settlements developed, including the establishment of Russian Orthodox missions starting in 1841 (ADCRA 2012b). Changes to the population between 1741 and 1820 are likely attributed to the coming of Russian fur hunters and traders. It is estimated that a loss of up to four-fifths of the island and peninsula population occurred due to disease, the movement of hunters to other hunting areas to the east, and social unrest. Exploitation of furbearing animals hastened this depletion. Increased hunting caused animals to move to the east to safer places, causing hunters to follow them. Russian influence declined in the region after Russian governance and possession was passed to the United States in 1867 (Stein 1977).

The attacks on Dutch Harbor, Kiska, and Attu in 1942 focused national attention on and resulted in the development of the Aleutians. Inhabitants were relocated to other locations in Alaska until the Japanese threat to the area was removed (Stein 1977). In response to the threats of World War II, the U.S Air Force built an airport at King Salmon, a community grew, and a road was constructed to connect the city with Naknek to the west. The city continues to be a transportation hub for Bristol Bay (ADCRA 2012e).

Increased commercial fishing brought fish processing and canneries to the region in the 1800s, with sustained support of the fishing and processing industries in Bristol Bay and along the Aleutian Islands. The population of the region increases by several thousand people each year due to the sockeye salmon fishing season and the related industry support services (ADCRA 2012b).

Several important cultural and historical sites have been identified on the Alaska Peninsula on the uplands and within tidal and subtidal areas (NRHP 2012a). Historic and cultural resources include deposits, structures, ruins, sites, buildings, shipwrecks, graves, artifacts, fossils or other objects of antiquity which provide information pertaining to the historical or prehistoric culture of people in the state, as well as to the natural history of the state. Several churches and buildings are listed in the Aleutians East Borough (NRHP 2012b), Bristol Bay Borough (NRHP 2012c), Dillingham Census Area (NRHP 2012d), as well as the Lake & Peninsula Borough (NRHP 2012e).

D. Climate

Surface conditions along lowlands and maritime ecoregions of the Alaska Peninsula vary dramatically. In summer the climate is generally mild. In contrast, winters can be severe, forcing many species to migrate to other regions. Annual temperatures can range from -9° to 76°F throughout the area). The annual precipitation ranges from 20 to 33 in, and annual snowfall is about 45 to 50 in (ADCRA 2012a, 2012b, 2012f).

Most of the Alaska Peninsula, its villages and geographic areas are within the western maritime climatic zone. All of the Aleutians East Borough, some of the Bristol Bay Borough, and the southern portion of the Lake & Peninsula Borough are in this zone. Maritime climate zones are characterized by cool, humid, and windy weather (ADCRA 2012a, 2012b, 2012f); SWAMC 2012a). Ocean influences may also bring both warming and cooling effects to the area. Foggy conditions and overcast skies are common (SWAMC 2012a). The maritime zone is characterized by mild temperatures and heavy precipitation, mostly as rain (LaRoche and Associates 2011).

Most of the Dillingham Census Area, Bristol Bay Borough, and a portion of the Lake & Peninsula Borough are located in the west coast climatic zone. Here the primary climatic influence is maritime, but continental influences from the interior also affect the Bristol Bay Coast. Moderate to strong winds are common and severe winter storms bring extreme temperature and wind chill conditions. Cold Siberian air can reach this region when the winter ice spans the Bering Sea between Russia and Alaska (SWAMC 2012a).

The lowlands transitional zone experiences winds that bring precipitation along the coast. Average summer temperatures in the Dillingham area range from 37° to 66°F (LaRoche and Associates 2011). Extreme temperatures have been recorded in the Bristol Bay Borough ranging from -46° to 88°F (ADCRA 2012c). The annual precipitation is about 20 to 26 in, mostly in the summer. Fog conditions are common on the coast and winter winds can reach 60 to 70 miles per hour (LaRoche and Associates 2011).

The maritime zone summer temperatures can range from 39° to 60°F (LaRoche and Associates 2011). Winter temperatures average 21° to 50°F. The maritime climate areas are generally free of permafrost but still support glaciers at higher elevations (SWAMC 2012a).

Temperature and precipitation records from 1949 to 1998 show annual and seasonal mean temperature increases throughout Alaska (Stafford 2000). The average temperature increase in Alaska from 1949 to 2009 was 3.0°F, although the temperature changes varied greatly across the state. Most of the change occurred in winter and spring months and the least amount in fall (ACRC 2012). Global surface temperatures have increased about 0.9°F since the late 19th century. The increase per decade was 0.09°F for the past century, and was about 0.29°F per decade during the past 30 years, roughly from 1976 to 2006 (NCDC 2012).

At northern latitudes potential effects of climate change may include rising temperatures, melting glaciers, reduction in seasonal sea ice cover resulting in increased storm effects and higher coastal erosion rates, increased permafrost melting, shifting vegetation zones, increased fires, insect outbreaks, changing animal migration paths, and changing subsistence patterns. Climate changes and associated geologic hazards may threaten and negatively impact Alaskans and other users of the Arctic (ADGGS 2012b).

In 2006, the Alaska Climate Impact Assessment Commission was formed to assess the effects of climate change on citizens, resources, economy, and assets of the State of Alaska (ACIAC 2008). In September 2007, Administrative Order 238 was signed, creating the Climate Sub-Cabinet. Members of the sub-cabinet represent ADEC, ADF&G, ADNR, Alaska Department of Transportation (DOT), Department of Commerce, Community and Economic Development (ADCCED), University of Alaska, and the Office of the Governor. The sub-cabinet was tasked with developing an Alaska Climate Change Strategy, providing assessments and recommendations for adaptation, mitigation, and for defining research needs to assist Alaskans with the impacts of climate change. The strategy serves as a guide for responding to climate change, identifying immediate priorities, long-term strategies, and including recommendations for saving energy and reducing greenhouse gas emissions. Dillingham, Clark's Point, and Port Heiden are three of the 31 Alaskan villages imminently threatened by coastline impacts (Alaska Climate Sub-Cabinet 2009).

In April 2008, the Governor's sub-cabinet released its report of recommended actions including emergency planning and training, erosion control, and village relocation planning (IAW 2008). In 2009-2010, the ACIAC released two draft and two final reports written by the Climate Change Advisory Groups. The Adaptation Advisory Group's report discussed how to address present and future impacts on infrastructure, human health, and ecosystems. Current impacts are those associated with village relocation in Western Alaska, though climate change affects all of the state. The Mitigation Advisory Group focused on preparing recommendations to be included in a strategy to mitigate greenhouse gas emissions in Alaska. One section of their report looks at the oil and gas industry. Though there is no oil and gas exploration or development occurring in the sale area at this time, the Mitigation Advisory Group's recommendations may be beneficial to possible future development (ACAIC 2012).

E. Geologic Hazards

Geologic hazards in or near the Alaska Peninsula sale area include earthquakes and seismic instability, volcanic activity, flooding, erosion, slope instability, localized permafrost, frozen-ground phenomena, and high winds. These geologic hazards could constrain exploration, production, and transportation activities associated with possible petroleum development. Additional precautions taken to identify and accommodate special site-specific conditions, along with proper siting, design, construction, and operation of facilities should address any hazards present in the area (ADGGS 2004).

1. Earthquakes

The Aleutian seismic zone to the south of the Alaska Peninsula is one of the most active seismic zones in the world. Earthquakes are common along its length, and seismically induced ground motion is a major hazard. Two earthquakes of magnitude 7.8 or greater have occurred near this area since 1899. These two events were a magnitude 7.9 event southeast of Sand Point on May 31, 1917, and a magnitude 8.3 event due east of Sand Point on November 10, 1938 (ADGGS 2004).

Although the hazard from seismic tsunamis (earthquake-generated ocean waves) is probably low-to-moderate, on April 1, 1946, a strong earthquake generated one of the most destructive tsunamis recorded in the Pacific Ocean. The tsunami wave was directed mainly to open ocean to the south, but some of its energy impacted the shores of Bristol Bay on the north side of the Alaska Peninsula. Recent modeling has suggested the 7.4 earthquake may have triggered one or more submarine landslides that contributed energy and southward directionality to the tsunami (ADGGS 2004).

Potential physical effects resulting from earthquakes include foundation settlement, foundation failure, structural failure, soil liquefaction, landslides, compaction, and seiches, which can include not only sloshing of water in lakes but also the contents of storage tanks. The severity of these earthquake-induced hazards depends largely on local site conditions, such as slope, soil properties, soil thickness, and saturation (ADGGS 2004).

2. Volcanic Hazards

Of the volcanoes that have erupted worldwide in the last 200 years, three quarters of them were in Alaska (AVO 2012). Volcanic ash clouds can drift thousands of miles from their source. Ashfall from volcanoes is a hazard to mechanical and electronic equipment such as computers, transformers, and turbine engines, potentially causing electrical shorts and fusing jet engines. Fine ash is a nuisance and can cause respiratory problems; heavy ash fall can disrupt activities by interfering with power generation and impairing visibility. Strong winds may cause dry ash to re-suspend, causing the effects of ash fallout to persist well beyond the eruption (ADGGS 2004).

The 1912 Novarupta-Katmai eruption formed the Valley of Ten Thousand Smokes on the Alaska Peninsula. This eruption was the largest 20^{th}-century eruption on earth and the largest historical eruption in Alaska (AVO 2012). The towering column of ash jetted skyward for 60 hours with little interruption. The ashfall filled the Valley of Ten Thousand Smokes and fed a high umbrella cloud more than 1,000 mi wide that shrouded most of Southern Alaska (NPS 2012). Ash from Novarupta spread worldwide and is often still reactivated by strong winds (AVO 2012).

Volcanogenic tsunamis may pose a threat to the sale area. Tsunami waves may be generated when debris produced by volcanic activity falls into the water. The potential exists for future, but infrequent, tsunamis to be generated in the Bristol Bay area (ADGGS 2004).

Some eastern portions of the sale area may be within range of volcanic hazards such as lava flows, block-and-ash flows, pyroclastic flows, hot gas surges, lahars (volcano-induced mudflows), volcanic gases, and volcanogenic floods, including glacial outburst floods (ADGGS 2004) (Map 3.2).

Map 3.2 Volcanoes near the Alaska Peninsula Sale Area

3. Flooding, Erosion, and Slope Instability

Flood hazards that may affect the sale area can result from ice jams, high rainfall, and storm surges. Severe storms coupled with high tides may cause coastal flooding, and high rainfall floods can occur on any stream. Elevated water levels combined with powerful and destructive storm surges make coastal floods one of the leading causes of property damage in Alaska (ADGGS 2004). Bristol Bay's exposed lowland coast is especially vulnerable to storm surges. In 1980, a severe storm surge caused extensive damage to fishing boats and canneries, pushing high water inland near Dillingham to 11 ft. above normal high tide elevations. Much of the north Peninsula Bristol Bay shoreline is exposed to moderate to high wave action (LaRoche & Associates 2011). Almost all coastal erosion is caused by the turbulence of waves breaking in shallow waters by the shore. Wind is also a contributing factor since winds blowing across the sea surface generate waves (Smith and Hendee 2011). Three communities particularly vulnerable to coastal erosion are: Port Heiden, Clark's Point, and Dillingham (COE 2009).

Primary hazards to facilities from river flooding include bank erosion, increased sediment deposition, high bedload transport, and changes in river channels (ADGGS 2004). Slopes may become unstable for a variety of reasons including heavy rains, flooding, and deglaciation. This may result in rapid down slope movement of large quantities of material into or under the water (ADGGS 2012a).

Glacial outburst flooding may be triggered by sub-glacial volcanic activity. Flooding may also be triggered by melting of a drainage channel or waters lifting ice. Regardless, they are a sudden, often annual, release of meltwater from a glacier, or glacier-dammed lake (ADGGS 2012a).

4. Sediment Transport

Storms are frequent in the Bering Sea. Wind-induced waves may move sea floor sediment and can quickly redistribute large volumes of sediment. This redistribution of sediment presents a potential hazard to man-made structures in coastal areas and on the sea floor (ADGGS 2004).

5. Sea Ice

Sea ice poses a geologic hazard when it destabilizes a shoreline via erosion (ADGGS 2012a). The southern Bering Sea has ice cover during 10-50% of the year. With more than 403 miles of coastline in the Alaska Peninsula sale area, sea ice is a concern to coastal development (ADGGS 2004). Sea ice does not generally form in coastal waters along the south side of the Alaska Peninsula but may occasionally form in calm protected waters at the heads of bays. When present, moving sea ice can damage structures in its path and scour shorelines and intertidal coastal areas (LaRoche and Associates 2011).

6. Snow Avalanches

Avalanche potential is moderate to high in mountainous regions and limited in the low-lying coastal areas. Regions of moderate avalanche potential have snow avalanches that may occur once every one-to-five years, or during winters with unseasonably heavy snowfall. Snow avalanches occur seasonally in regions of high avalanche potential. Avalanches may occur at any time of the year above 9,843 ft. The coastal areas have no known avalanche activity (ADGGS 2004).

7. Permafrost

Thaw-unstable permafrost is a hazard and is very sensitive to human and natural disturbances. Researchers suggest rising temperatures in northern latitudes may be causing permafrost to warm (ADGGS 2012a).

Some potential hazards due to thawing permafrost may include surface subsidence, heaving and ground cracking, and freezing of buried sewer, water, and oil lines. Severe permafrost hazards result from the thawing of massive ground ice and include pore ice, segregated ice, ice-wedge ice, pingo ice, and buried ice. Since no large bodies of ground ice have been located in the sale area, it is unlikely any severe permafrost hazards will develop. Any potential hazards listed above would likely be localized and limited (ADGGS 2004).

8. Stream Icings

Stream icings are seasonal flood phenomena that develop where water flows over the ice surface during freezing temperatures and forms ice layers that may be several meters (feet) thick and extend for many kilometers (miles). Icings can present difficult engineering problems for bridge, road, and other structure construction and typically affect braided streams. Construction may actually exacerbate the conditions leading to icing development. Two braided rivers in the sale area, both named King Salmon, may experience icing. One drains into Egegik Bay while the other drains into Ugashik Bay (ADGGS 2004).

9. High winds

The Lake & Peninsula Borough is subject to windstorms. Resulting storm surges may contribute to widespread damage. The region is also vulnerable to hurricane force storms. In the fall of 2004 and 2005, strong winds and extreme storm surge caused significant damage to communities along the Bristol Bay coastline (LaRoche & Associates 2011).

10. Mitigation Measures

Several geologic hazards exist in the Alaska Peninsula area that could pose potential risks to oil and gas installations and are discussed above.

Detailed site specific studies may be necessary to identify any specific earthquake hazards for any specific site within the sale area. The risks from earthquake damage can be mitigated by siting onshore facilities away from potentially active faults and unstable areas, and by designing them to meet or exceed national standards and International Building Code seismic specifications for Alaska.

Snow avalanche activity in the mountainous regions may call for some risk mitigation. This can be accomplished by evaluation and avoidance of susceptible slopes or appropriate engineering of any structures that may be placed in these areas.

Before developing any kind of infrastructure it is important to determine if permafrost is present. Potential hazards may be mitigated by incorporating careful evaluation, proper engineering, or avoidance of susceptible areas. Stream icings may also be a problem, but are highly localized hazards and may be mitigated by careful evaluation and avoidance of susceptible areas.

Although geologic hazards could damage oil and gas infrastructure, measures in this best interest finding, regulations, in addition to design and construction standards, are expected to mitigate those hazards. Mitigation measures in this finding address siting of facilities and design and construction of pipelines. A complete listing of mitigation measures is found in Chapter Nine.

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Chapter Four: Habitats, Fish, and Wildlife

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Chapter Four: Habitats, Fish, and Wildlife

This chapter considers and discusses the habitats and fish and wildlife populations of the sale area, as required by AS 38.05.035(g)(iii). This chapter is not intended to be an exhaustive examination of all habitats and fish and wildlife species of the area, but rather, the director has established and limited the scope of the administrative review and finding to considering and discussing those that have important subsistence, recreational, or commercial value and that are material to the determination of whether the lease sales will best serve the interests of the state (AS 38.05.035(e)(1)(A)(B)).

A. Habitats

The Alaska Peninsula sale area includes a wide variety of terrestrial, freshwater, and marine habitats, and a broad diversity of fish and wildlife species that support many subsistence, economic, and recreational activities in the area.

The U.S. Geological Survey divides Southwest Alaska into seven ecoregions. The sale area exists in two of the ecoregions. The majority of the sale area is in the Bristol Bay-Nushagak Lowlands, and some portions are in the Alaska Peninsula Mountains (Map 4.1). The sale area includes habitats such as: estuaries and lagoons; wetlands and tideflats; rocky islands and seacliffs; exposed high-energy coasts; rivers, streams, and lakes; boreal forests/taiga; alpine and low arctic tundra; and glaciers and barren alpine tundra. Each ecoregion has distinctive topography, vegetation patterns, climatic zones, and fauna (SWAMC 2012).

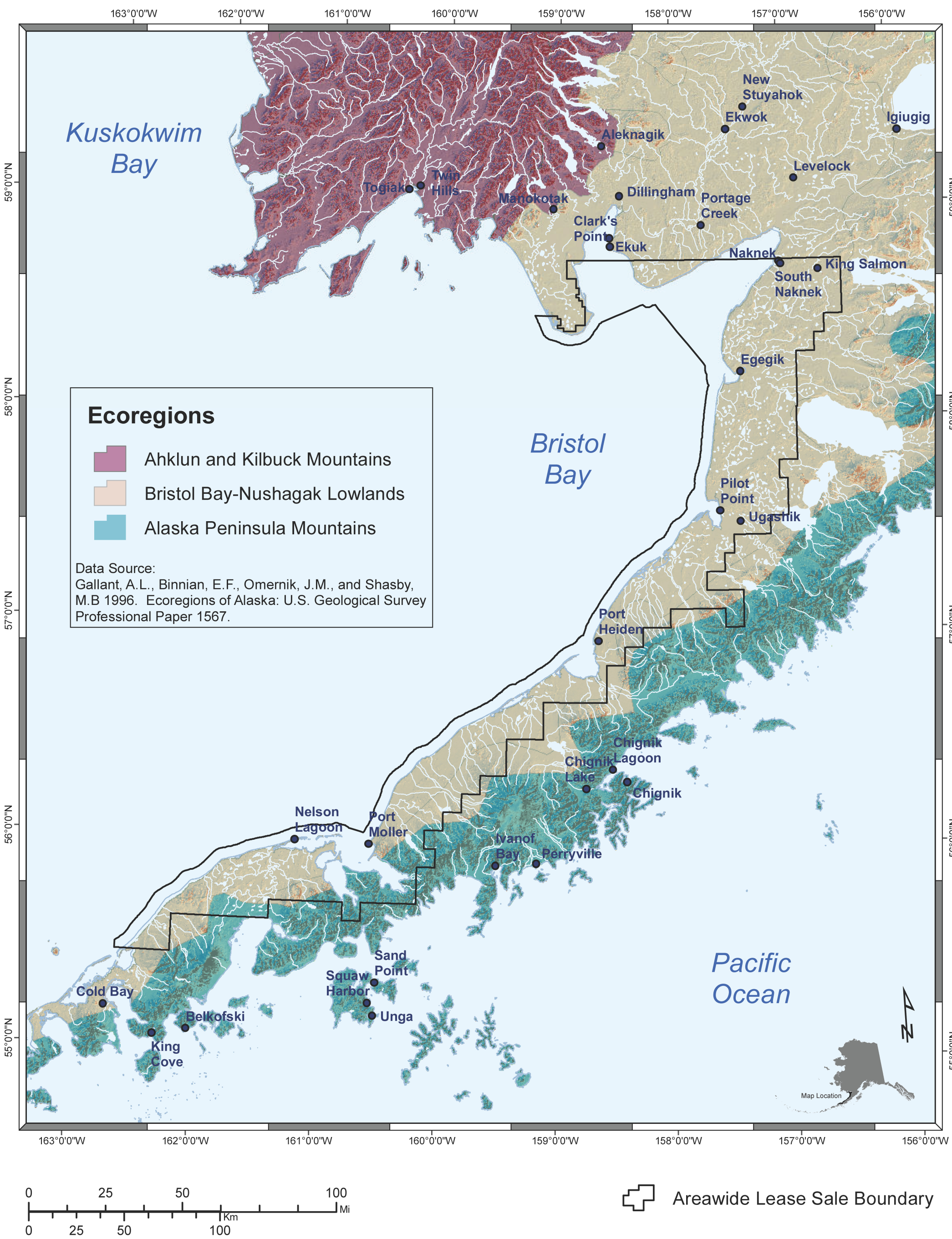
The Bristol Bay Nushagak Lowlands on the north side of the peninsula are characterized by flat to gently-rolling terrain with lakes, ponds, rivers and wetlands. Rivers and streams meander among small lakes and ponds into estuaries at the mouths of major rivers (LaRoche and Associates 2011). Lowlands range in elevation from sea level to about 500 ft. The shoreline is composed of sand and gravel beaches and tidal mudflats. Sand dunes are found on bluffs of the rivers and coastlines (ADF&G 2006). This area is a staging and migration area for waterfowl, and the marine and freshwater habitats experience one of the largest sockeye salmon runs in the world. The lowlands are underlain by glacial till and outwash deposits as a result of glaciations from the Aleutian and Ahklun mountains (SWAMC 2012). The dwarf shrub vegetation consists of willow, birch, alder, and tussock sedges in wet organic soils. Groundcover is a combination of mosses and lichens (ADF&G 2006).

The lakes and wetlands in this ecoregion are key components of the water habitat system associated with the large runs of sockeye salmon in Bristol Bay. Especially productive lakes include Naknek, Becharof, Black, Chignik, and the Upper and Lower Ugashik lakes. The larger lakes (Naknek, Becharof, Upper and Lower Ugashik) are drained by the Naknek, Egegik, and Ugashik rivers, respectively (LaRoche and Associates 2011).

Under AS 16.05.871(a), ADF&G is required to specify and inventory known anadromous bodies of water. These are published in the Anadromous Waters Catalog and Atlas and updated annually (ADF&G 2012f). If water bodies are not ‘specified’ in the catalog, they are protected under AS 16.05.841.

Many systems such as flood channels, intermittent streams, beaver ponds, and small tributaries to known anadromous fish-bearing water bodies are not surveyed so are not included in the catalog or atlas. This may be due to remote location, small size or their ephemeral nature (Johnson and Blanche 2012). Major river systems located in the sale area are the Naknek, Egegik, Ugashik, Ilnik, Bear and Nelson rivers. Additional salmon-bearing waterbodies are Black Hills Creek, Franks Lagoon, Milky River and Muddy River (ADF&G 2013g).

The Alaska Peninsula Mountains are characterized by mountain and volcanic slopes covered with dwarf shrub on upper slopes and low scrub in lower areas (Gallant et al. 1995). The streams and rivers on the south side of the peninsula are commonly short, steep and fast, and drain into the steep terrain of the Pacific coastline (LaRoche and Associates 2011). The coastline and fjords along the Gulf of Alaska on the south side of the peninsula serve as habitats for wildlife, fish and bird populations (ADF&G 2006).



Map 4.1 Ecoregions In or Near the Alaska Peninsula Sale Area

The Alaska Peninsula mountains include the Aleutian Range which divides Bristol Bay from the North Pacific Ocean. The Aleutian Range forms the watershed drainage divide between Bristol Bay to the north, and the Gulf of Alaska to the south (LaRoche and Associates 2011). It reaches heights up to 8,580 feet above sea level (ADF&G 2006). The glacier carved valleys and high peak glaciers provide large variations in surface relief. The peaks slope down to lowlands on the north side, with estuaries, lakes and large river basins. Wetlands are common in these low-lying areas (CEC 1997). These aquatic systems support wet moist tundra communities with water flowing into broad estuarine habitats of Bristol Bay and the Bering Sea (ADF&G 2006).

1. Marine and Coastal Habitats

For the purpose of the Alaska Peninsula Areawide Lease Sale, the offshore marine environment includes those waters extending seaward from the mean lower-low water to the three-mile limit of state jurisdiction. These waters are essential habitat to a wide variety of fish, shellfish, seabirds, waterfowl, and marine mammals. In addition, the offshore marine environment is an important interface between marine and upland habitats (LaRoche and Associates 2011). The marine environment is influenced by the major river systems of the area including the Nushagak, Kvichak and Naknek rivers within inner Bristol Bay, and the Egegik, Ugashik and Meshik rivers within the northern portion of the Alaska Peninsula (Johnson and Blanche 2012). The freshwater discharges from rivers and the upwelling marine currents provide nutrients for offshore coastal areas. The composition of the substrate factors significantly in the productivity of the nearshore environment in terms of plant production, use as a nursery area by fish and shellfish, and feeding areas for waterfowl and shorebirds (LaRoche and Associates 2011).

The shoreline of the Alaska Peninsula supports a diversity of habitats, including the intertidal zone, mudflats and beaches, and marine eelgrass beds. In the intertidal zone, wave energy, substrate, tidal action, temperature and salinity influence the biota abundance. The three main types of rocky intertidal habitats include:

- exposed rocky shores with steeply dipping, vertical bedrock, high to moderate wave energy;
- exposed wave cut platforms with wave-cut or low-lying bedrock, high to moderate wave energy; and
- sheltered rocky shores with vertical rock walls, bedrock outcrops, wide rock platforms, boulder strewn ledges, usually found along sheltered bays or along inside of bays and coves.

Seasonal changes affect the distribution and composition of the biota. Spring and summer climates encourage productivity, with detritus (decomposed organic matter) becoming food sources that in turn support filter feeders, which then also become food sources for other birds and fish in the intertidal community (ADF&G 2006).

Eelgrass beds are found in nearshore shallow water, and support a diverse biota of invertebrates and fish. The grasses generate food and nutrients for a variety of migrating birds and sea otters, and vary seasonally. The algae and invertebrates on the grass are important food sources. The perennial grasses stabilize the substrate against tidal wave action and seasonal storms. Small fish use eelgrass as refuge from predators, and herring spawn on eelgrass beds (LaRoche and Associates 2011; ADF&G 2006). Besides supporting fish and waterfowl the eelgrass beds of the bays and lagoons, along with the assortment of wildlife, all support the Bristol Bay and the Alaska Peninsula economies (ADF&G 2012b).

Intertidal areas alternately exposed by rising and falling tides are often referred to as tideflats. Tideflats, also called mudflats, and beaches are habitats formed by unconsolidated deposits. Mudflat substrates can vary from mud to sand and gravel. Kvichak Bay is an example of a broad, exposed mudflat. Mudflats support a low to moderate level of plant and animal life, while sheltered mudflats are usually more productive and support a wide array of plant and animal communities (LaRoche and Associates 2011). Biological communities include numerous species of filter feeders and invertebrates. Mudflats are important for migrating birds as stopover locations. Clams, a type of filter feeder, are an important food source for waterfowl.

Cobble beaches foster species that can survive pounding waves and grinding substrate. Beach communities can be composed of substrates ranging from fine sediments to gravels, coarse sands and shell fragments (ADF&G 2006). Harbor seals haul-out on beaches and mudflats. Fish species that are important for commercial and recreational fisheries use these areas for spawning and nursery habitats as well.

2. Estuaries

Estuarine habitats are common in the sale area. An estuary is a partly enclosed coastal body of water where river water mixes with seawater. Estuarine environments are defined by their salinity boundaries instead of geographic boundaries (Britannica 2012). In the sale area, estuaries occur as bays at the mouths of rivers, marine waters behind barrier islands, and upstream in rivers and waterways to the limit of salt water intrusions. During the summer, most of inner Bristol Bay could be considered an estuary due to the amount of freshwater flowing into the bay from major rivers. The largest estuaries in the sale area include river mouths and associated bays of the Nushagak, Kvichak, Naknek, King Salmon, Egegik, Cinder, and Meshik rivers (LaRoche and Associates 2011; SWASHP 2011).

The mixture of fresh and salt water in the estuarine environment provides a unique yet important habitat for feeding and rearing fish, shellfish, waterfowl, marine mammals and benthic invertebrates. Estuaries are important habitat for juvenile salmon as they initially enter the marine environment, serving as nurseries for fish and invertebrates and later as staging points for large salmon runs (SWASHP 2011). Larger estuaries attract feeding seals and beluga whales when salmon are abundant

3. Barrier Islands and Lagoons

Barrier islands and lagoons form low-lying peninsulas or spits of accumulating sand or gravel across the mouths of bays, inlets, or other coastal embayments. This may be due to the transport of materials by ocean currents or wave action, or deposition from the outflow of streams and rivers. These unique and important habitats shelter the water in the protected lagoons while maintaining continuous or periodic exchanges of water with the sea. Barrier island lagoons contain a mixture of fresh and salt water, which often results in much more productive habitats than adjacent marine waters (LaRoche and Associates 2011).

Barrier islands protect a considerable lagoon system along the north shore of Bristol Bay. These lagoons provide a unique set of conditions that attract millions of migrating birds (DMLW 2005). In addition, barrier islands and lagoons accommodate vital molting and staging areas for waterfowl and shorebirds, and feeding areas for birds, seals and fish. Besides protecting coastal areas from scouring and wave erosion, barrier islands serve as nest habitats for birds, seal haul-outs and pupping areas, and as beach spawning habitat for some marine fish species such as capelin and sand lance. Barrier island and lagoon systems in the area include the Seal Islands, southwest entrance to Port Heiden, Cinder River Lagoon, Goose Point and various unnamed islands off the mouth of Egegik Bay (LaRoche and Associates 2011).

4. Wetlands

Wetlands are transitional zones between aquatic and terrestrial habitats characterized by poor soil drainage. There are primarily four types of wetlands identified in Alaska: bogs, grass wetlands, sedge wetlands, and salt marshes. Wetlands can be hydrologically connected to rivers, streams and lakes

(ADF&G 2006). Hydrological connections are "water-mediated transfers of matter, energy, and/or organisms within or between elements of the hydrologic cycle" (Pringle 2003). Wetlands may also be isolated or ephemeral in nature.

Significant wetlands exist along the coastline and next to river deltas. Wetlands are used by migratory birds along the flyways, are highly productive habitats, and important in preserving biological diversity (ADF&G 2006). The USFWS has developed a wetlands inventory for its Region 7, which includes the sale area. At this time, the only area completed in the Alaska Peninsula inventory is King Salmon and some of the surrounding area (USFWS 2009; USFWS 2012g).

a. Bogs

Most of Alaska's wetlands are bogs. Bogs form when several vegetative layers have accumulated over time. Most bogs receive their water from rainfall and are acidic. This leaves a system low in the nutrients needed for plant growth. Flora and fauna that do live in bogs have adapted to cope with low nutrient levels. Tree species include dwarf black spruce, dwarf tamarack, and birch. Common shrubs are sweet gale, willow, leatherleaf, resin birch and thinleaf alder. Other shrubs include crowberry, blueberry, and mountain cranberry. Mosses may comprise 50 to 100% of the ground cover. Common wildlife species found in bog environments are flycatchers, blackbirds, solitary sandpipers, lesser yellowlegs, dragonflies, damselflies and wood frogs (ADF&G 2006).

b. Grass Wetlands

Grass wetlands are composed of water-tolerant grass species that grow in clumps and tussocks. Wetter locations are generally hummocky. The soil substrate is generally organic or rich in minerals. Grass wetlands provide important wildlife habitat, perform as ground water recharge areas, and store storm and floodwaters which helps maintain minimum base flows critical for aquatic resources downstream. Common species found in grass wetlands are the northern harrier, short-eared owl, dragonflies, damselflies, Columbia spotted frog, wood frog, and the western toad (ADF&G 2006).

c. Sedge Wetlands

Sedge wetlands are typically inundated by water. Tall sedges, cottongrasses, rushes, bulrushes, and aquatic mosses may be present. Sedge wetlands may be found in very wet areas of floodplains, slow-flowing margins of ponds, lakes, streams, sloughs, and depressions of upland areas. Species in these wetland habitats are the red-necked grebe, horned grebe, dragonflies, damselflies, and some species of blackfish and sticklebacks (ADF&G 2006).

d. Salt Marshes

Salt marshes are typically located at the mouths of rivers, behind barrier islands, coves, and spits of land. Tide flats may harbor salt marshes because low energy wave action and fine sediment deposits create elevated land where marsh vegetation establishes itself. Salt marshes comprise a large portion of the Lake and Peninsula Borough's Bristol Bay shoreline. The salt tolerant vegetation grows between the mean high water and lower intertidal zone. Plant species include hairgrass, alkali grass, beach sandwort, sea arrowgrass, sea plantain, saltbrush, sand spurry and scurvey grass. Salt marshes provide spawning and nursery habitat for marine invertebrates and fishes such as stickleback, Dungeness crab, and Pacific herring. Copepods and fish species such as broad whitefish, Bering cisco, Pacific sand lance, and capelin are also found there. Birds associated with salt marshes include merlin falcon, short-eared owl, Tule white-fronted goose, lesser yellowlegs, solitary sandpiper, migrating geese, ducks, and shorebirds (ADF&G 2006).

In summary, wetlands are vital habitats serving many needs (LaRoche and Associates 2011). They:

- replenish and regulate stream flow;

- contribute to maintenance of water quality in lakes and streams;
- provide important source of organic nutrients to estuaries and coastal waters;
- nesting, rearing , molting, and staging areas for migratory birds;
- rearing areas for resident fish and freshwater rearing stages of anadromous fish;
- early spring feeding areas for bears;
- feeding areas for caribou; and
- sustain small mammal and furbearer populations.

Many species use more than one type of habitat over the course of their lifetime because resource limitations in one area may be offered in another. Wetlands are one of the most productive and important habitats in preserving the state's biological diversity (ADF&G 2006).

5. Rivers, Streams, and Lakes

Freshwater habitats range from alpine glacier environments to marine waters at sea level. Erosion of river banks create sediments that deposit elsewhere along the water system. These deposits become sand and gravel bars where colonies of herbaceous plants, grasses, sedges, willows and deciduous trees develop (ADF&G 2006; ADF&G 2012c).

Rivers are important to the boreal forest ecosystem. Rivers and their tributaries provide protective plant cover, and support terrestrial wildlife along the riparian areas and serve as travel corridors (ADF&G 2012c). These edge environments between aquatic and terrestrial habitats host a diversity of wildlife. They filter sediment, reduce the effects of the wind, regulate water temperature, and stabilize stream banks. Beavers, river otters, muskrat, moose, bear and other mammals also use these waterbodies and their riparian zones. Waterfowl and resident birds use the lakes and ponds for feeding, staging, and resting areas (LaRoche and Associates 2011). Birds and wildlife forage, breed, and nest here. Some common species living in riparian corridors are songbirds, the rusty blackbird, blackpoll warbler, Tule white-fronted goose, swallows (barn, bank, and cliff), snowshoe hare, and moose (ADF&G 2006, 2012c). The Alaska Peninsula rivers, streams, lakes, and ponds support world-class runs of salmon and resident rainbow trout, Arctic char, Arctic grayling and other fish (LaRoche and Associates 2011).

Riparian vegetation along small streams and rivers benefit fish by providing shade, temperature control, organic debris, low velocity refuges during high runoff, and bank stabilization. Riparian habitat also provides food for fish directly through insects falling into the water and indirectly through detrital food web. (Levings and Jamieson 2001). In Alaska, the most common detritus comes from dead plant material, which makes up to 90% of the organic matter supporting headwater stream communities. Rivers also provide migratory routes, spawning and rearing habitats, overwintering habitat, and refugia (unique areas allowing species to survive when elsewhere is impossible) (ADF&G 2006).

Water comes from numerous sources in Alaska, from glaciers, to ground water, to rain and snowfall. The glaciers from high mountain areas provide flow into tributaries and rivers. Glacially influenced rivers experience high volume and variable rates of flow that may cause large fluctuations in volume discharges. These rivers can carry heavy sediment loads of clay and silt. Variable, yearly fluctuations are common, with peak glacial river flows observed in May through August (ADF&G 2006).

Clearwater rivers and streams have high clarity and low turbidity unlike glacial water systems. Clearwater flow comes mainly from ground water, rain, and snowfall. Compared to glacier fed rivers, these waterways have narrower channels, low sediment loads, stable, well-defined banks and beds, and increased habitat complexity. These waterways often freeze to the bottom (ADF&G 2006). Becharof Lake, the second largest lake in Alaska, is located in the sale area. It is river and stream fed, 35 mi long, 15 mi wide, and up to 600 ft. deep. Becharof Lake serves as a nursery for the world's second largest run of sockeye salmon, which attract and feed one of the largest concentrations of brown bear in Alaska. Other wildlife using this habitat includes caribou, wolverine, fox, river otter, and beaver (USFWS 2012c).

6. Uplands

Upland forest ecosystems support high levels of biodiversity. This forest region contains a large diverse patchwork of distinctive ecosystems and flora. Complex interrelationships exist among climate, solar radiation, surface water, slope, soil, permafrost, disturbance effects, wildlife, and plant cover creating patterns of vegetation over the landscape (ADFG&G 2006).

The higher elevations are steep, rugged volcanic peaks with slopes vegetated by dwarf scrub, such as Arctic willow and mountain-avens. These uplands consist of vegetated and unvegetated areas, forested lands, and riparian areas along streams and rivers (Gallant et al. 1995). Drier upland soils support spruce, birch, dwarf dogwood, highbush cranberry, and lingonberry (ADF&G 2006).

Some upland spruce-hardwood forests are found in the Bristol Bay Borough, Dillingham Census Area, and the Lake & Peninsula Borough. These are generally dense areas containing white spruce, birch, aspen, and poplar. Black spruce can be found in stands on north facing slopes and poorly drained flats (SWAMC 2012).

The Alaska Peninsula's high altitude tundra (alpine tundra) is a semiarid habitat, found above the tree line, supporting low shrubs, lichens, mosses, and grasses. These plant communities are low lying mat and cushion forming species intermittently spaced with shrubby species (ADF&G 2006). Tundra can also contain many wetlands, especially when frozen soils trap surface moisture close to the surface, forming a complex mosaic of moist and dry sites (ADF&G 2012d).

Some of the wildlife species found here are the golden eagle, rough-legged hawk, gyrfalcon, ptarmigan, squirrel, marmot, and curlew.

7. Designated Habitat Areas

This region includes state and federal land refuges, critical habitat areas, parks and preserves, and other designated areas (DMLW 2011) (Map 4.2). Specific legislation provides additional protection of habitat that is important to fish and wildlife populations and recreational opportunities (ADF&G 2013j). Special Areas are legislatively designated state game refuges, critical habitat areas, and wildlife sanctuaries. Special Areas can include uplands, tidelands, and submerged lands, and state waters. Most recreational activities do not require a permit, but any land or water use activity, or activities that may impact fish, wildlife, habitats, or existing public uses may require one.

a. <u>State-managed Areas</u>

Five state critical habitat areas, one fisheries reserve, and one state game refuge fall within or are adjacent to the boundaries of the sale area.

i. State Critical Habitat Areas

Waterfowl and shorebirds rely heavily on both state-designated and other conservation units for their specialized habitat needs (ADF&G 2006). The importance of staging and feeding areas led the following estuaries to be designated as State of Alaska Critical Habitat Areas: Egegik Bay, Ugashik

Bay (Pilot Point), Cinder River, Port Heiden and Port Moller (LaRoche and Associates 2011; ADF&G 2012a). Birds are not the only species using these critical areas. Harbor seals, sea otters, brown bears and caribou may be seen here along with smaller mammals. Likewise rivers flowing into these habitats are productive salmon streams.

ii. Fisheries Reserve

A portion of the sale area, from approximately Ugashik Bay northward, is located within the Bristol Bay Fisheries Reserve. This reserve was established by the State Legislature under AS 38.05.140(f). The Reserve is dedicated to the protection of fish and wildlife as well as recreational resources (DMLW 2005). The Reserve is identified as the submerged and shore land lying north of 57 degrees, 30 minutes North latitude, and east of 159 degrees, 49 minutes West longitude within the Bristol Bay drainage. Within the Bristol Bay Fisheries Reserve, surface entry to develop an oil or gas lease is not permitted on state owned or controlled land unless the legislature specifically finds that surface entry will not constitute danger to the fishery (Alaska Att'y Gen. Op. 2012; AS 38.05.140(f)) (Map 4.3).

iii. State Game Refuge

Izembek State Game Refuge includes state lands and waters within the Izembek National Wildlife Refuge. It also includes tide and submerged land within Izembeck Lagoon and extends beyond the barrier reefs into the Bering Sea. It was established by the Alaska Legislature in 1972 to protect natural habitat and game populations, especially the millions of waterfowl and shorebirds that visit each year on their way to and from nesting grounds to the north. In 1986 the Convention on Wetlands of International Importance designated both refuges as the United States' first Wetland of International Importance. It is co-managed by ADF&G and ADNR (ADF&G 2006; 2013n).

b. Federally-managed Areas

The sale area abuts or is near several federal conservation system units (DMLW 2005):

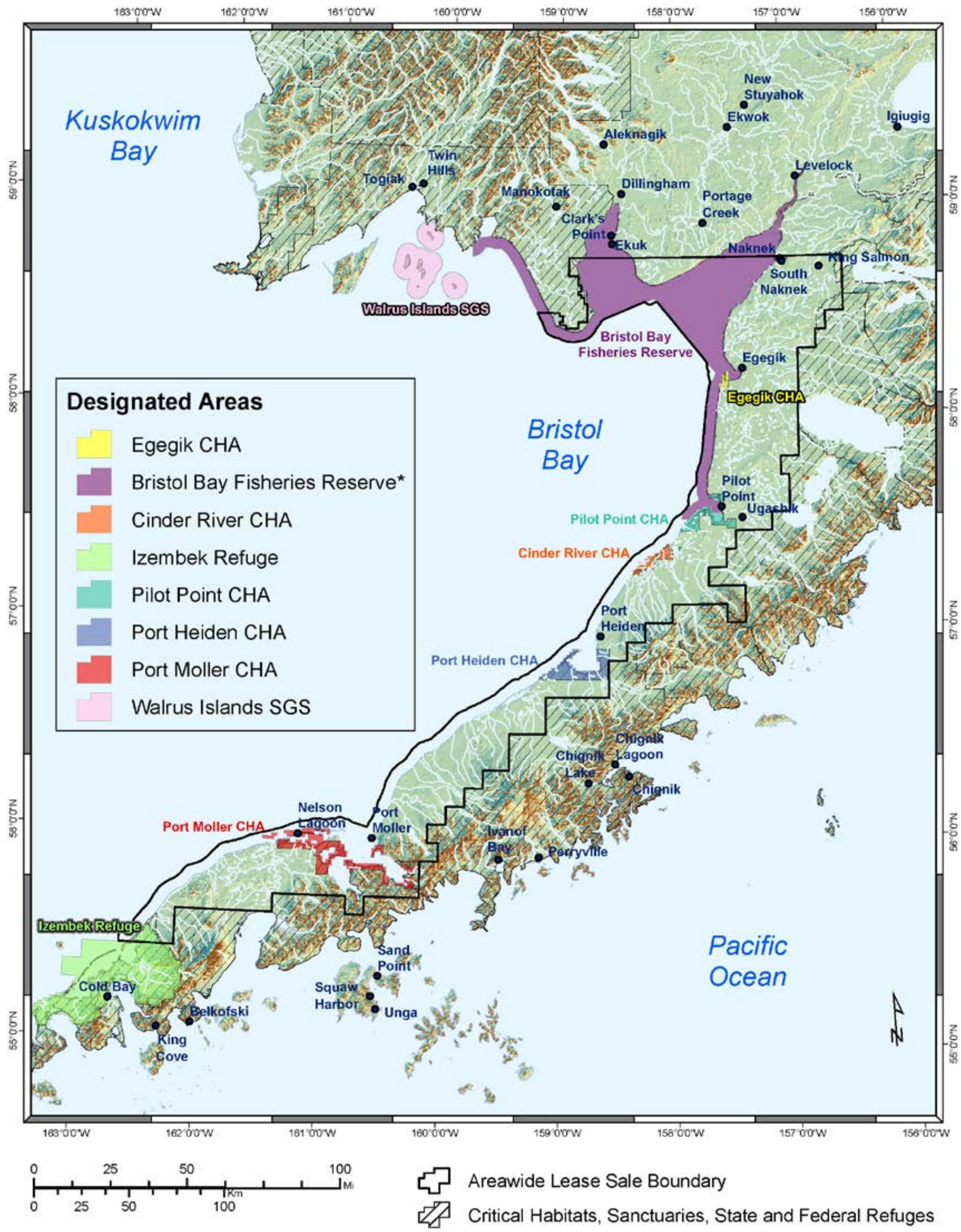
- Alaska Peninsula National Wildlife Refuge;
- Izembek National Wildlife Refuge;
- Becharof National Wildlife Refuge;
- Aniakchak National Monument and Preserve; and,
- Katmai National Park and Preserve.

The Izembek National Wildlife Refuge was designated a Wetland of International Importance in recognition of the millions of migrating waterfowl and shorebirds that use it. It also protects the watershed of the Izembek Lagoon (ADF&G 2006).

The Alaska Peninsula, Izembek, and Becharof National Wildlife Refuges are managed by the U.S. Fish and Wildlife Service (USFWS). These lands are set aside to conserve, manage, and where appropriate, restore America's fish, wildlife, plants, and their habitats for the benefit of present and future generations (USFWS 2013c).

The National Park Service oversees the management of Katmai National Park and Preserve and Aniakchak National Monument and Preserve. National preserves are established mainly to protect certain resources. Hunting and fishing or the extraction of minerals and fuels may be permitted if they do not jeopardize the natural values (NPS 2003).

Katmai National Park and Preserve was created in 1918 to preserve the Valley of Ten Thousand Smokes for further study. Today it is also known for brown bears (NOS 2013a). Over the years, boundaries were extended to protect the bears. Aniakchak National Monument and Preserve was originally established to recognize the unique geological significance of the Aniakchak caldera (NPS 2013b).



Map 4.2 Legislatively Designated Areas In or Near the Alaska Peninsula Sale Area

*Includes all waterbodies within the Bristol Bay drainage subject to the conditions of AS 38.05.140(f).

B. Fish and Wildlife Populations

1. Fish and Shellfish

a. Pacific Salmon

The numerous freshwater habitats of the sale area provide expansive, nearly continuous fisheries habitat, especially for anadromous fish species such as Pacific salmon. These habitats range from the low lying floodplains and meandering waterways on the north side of the sale area, to short steep-gradient rivers on the south side of Alaska Peninsula. All five species of Pacific salmon are found in the sale area: Chinook, sockeye, coho, pink, and chum. Streams on the southern side support mainly chum and pink salmon habitat, but coho and sockeye salmon are present if suitable overwintering and rearing habitat is available (LaRoche and Associates 2011).

All Pacific salmon species spawn only once and then die. In Bristol Bay, salmon migrate in runs returning to spawn from May to mid-October, with species-specific timing for each run (ADF&G 2012i). The 2012 Bristol Bay sockeye salmon run was about 29 million fish with about 21 million harvested. The total sockeye salmon harvest was 6% below the preseason forecast. Chinook salmon harvests were below average in every district while coho salmon was 26% above the recent 20-year average. Pink salmon runs appear strong and the 2012 preliminary chum salmon harvests were up and down depending upon the district (Eggers et al. 2013).

Depending on the species, the young salmon emerge from the gravel in the spring and generally rear in freshwater for a few months to a few years, and then migrate to the ocean. Juvenile salmon undergo significant physiological changes in preparation for migrating to the ocean. Young salmon spend varying time in nearshore waters and then most move further offshore.

During their ocean residence, salmon grow quickly as they feed on abundant marine food supplies. After feeding for one to several years in the ocean, mature adults migrate back to their natal fresh water stream or lake to spawn (ADF&G 2012e; DCCED 2013). Some salmon species make long migrations on the high seas that span thousands of miles and up to seven years. As they near freshwater, salmon use olfactory cues to find their home stream with great precision. Eggs are laid in the gravel where they remain through the winter. Growth and development of eggs and alevins in the gravel depends on water temperature, and requires good flow of clean water through the subsurface gravel (ADF&G 2012i). Salmon die after spawning, but their decomposed bodies provide essential nutrients that contribute to the productivity of the entire stream ecosystem (Walker and Davis 2004).

In 2000, the Alaska Board of Fisheries adopted the Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222) which strengthened long-time principles of salmon management by ADF&G and provided a systematic approach for evaluating the health of salmon populations. Criteria were included to identify three levels of concern for salmon populations. As of 2013, no salmon population in the Bristol Bay or North Alaska Peninsula areas was listed in a level of concern (Eggers et al. 2013).

A recommendation of no change was made for salmon escapement goals for the North Alaska Peninsula area (Sagalkin and Erickson 2013). In Bristol Bay, 18 salmon escapement goals were evaluated. The review committee recommended eight goals change in range, four changes in type, from sustainable escapement goal (SEG) to biological escapement goal (BEG), and three were eliminated. The committee also recommended no change to five goals and two new goals were established (Fair et al. 2012).

i. Chinook (king) Salmon

Chinook salmon are the largest of the Pacific salmon species at maturity, frequently exceeding 50 lbs. (ADF&G 2012i). Females lay 3,000 – 14,000 eggs (ADF&G Chinook Salmon Research Team 2013).

After hatching and emerging from the gravel, juvenile Chinook feed on plankton and insects while in freshwater (ADF&G 2012i). Most Chinook salmon remain in freshwater for one or two years before their seaward migration and they spend three to five years in the ocean (ADF&G Chinook Salmon Research Team 2013). In the ocean, Chinook feed on herring, pilchard, sandlance, squid and crustaceans as well as other available fish and shellfish (ADF&G 2012i).

ii. Sockeye (red) Salmon

Sockeye salmon females lay 2,000 – 5,000 eggs (ADF&G 2012i). Sockeye are unique in that after emerging from the gravel, they usually spend one to two years in lakes as juveniles (Armstrong 1996). Important food sources in lakes include plankton and insects. They are one of the smaller species of Pacific salmon, reaching 18 – 31 in long and weighing 4 – 15 lbs. In the ocean, sockeye feed on plankton, insects, small crustaceans, and sometimes squid and small fish (ADF&G 2012i).

iii. Coho (silver) Salmon

Coho salmon females deposit from 2,400-4,500 eggs in stream gravel. Most coho remain in freshwater until the following spring. During fall and winter, juvenile coho seek out deep pools and side channels in which to overwinter. While in freshwater, coho feed on a wide range of aquatic insects and plankton. They may also feed on eggs deposited by adult spawning salmon. While in the ocean, they feed mainly on fish and squid (ADF&G 2012i).

iv. Pink Salmon

Pink salmon are the smallest of the five species of Pacific salmon and weigh between three and five lbs. Pink salmon females lay between 1,200 – 1,900 eggs. They generally spawn in the lower reaches of streams within a few miles of the ocean, and may even spawn in intertidal areas. Most pink salmon do not travel more than 40 miles up a river to spawn. However, in Alaska they do sometimes travel greater distances in larger river systems such as the Nushagak. Because pink salmon migrate to the ocean shortly after emerging from the gravel and spend only one year in the ocean, they have a distinct two-year life cycle from egg to spawning; therefore, populations are characterized as either odd- or even-year. During their migration to the ocean, pink salmon generally do not eat as they leave freshwater. For the few that spawn further inland, they may feed on aquatic insects. Once in the ocean, pink salmon feed on plankton, small fish, squid, and tiny marine crustaceans (ADF&G 2012i).

v. Chum (dog) Salmon

Chum salmon females lay between 2,000 – 4,000 eggs. After hatching in the spring, young chum immediately migrate to the ocean. They form large schools and remain in estuaries and near-shore waters feeding on plankton until fall, when they migrate to the open ocean. While in the ocean, chum feed on copepods, tunicates, mollusks, and a variety of fishes. After three to six years at sea, chum return to their home streams to spawn (ADF&G 2012i).

b. Other Freshwater Species

Rivers, streams, and lakes of the sale area support populations of other freshwater fish. These include rainbow trout, Dolly Varden, lake trout, Arctic grayling, northern pike, burbot, and humpback whitefish (LaRoche and Associates 2011). These species overwinter mainly by occupying lakes, deep slow waters, or large rivers. Some, like the Arctic grayling and Dolly Varden that normally live in rivers or streams, may also migrate to deeper waters. Rainbow trout have been known to migrate to lakes with sockeye salmon runs, but some live year round in streams. Most northern pike overwinter in deep slow waters of large rivers (ADF&G 2012i). Humpback whitefish prefer deep pools but have been found in rivers and brackish water of Bristol Bay (ADF&G 2011).

i. Rainbow and Steelhead Trout

Rainbow and steelhead trout are actually the same species, and they are in the same genus as Pacific salmon. Steelhead trout migrate to the ocean; rainbow trout remain in freshwater for their entire life, either in streams or lakes. Both rainbow and steelhead trout may spawn multiple times in their life. Females lay between 200 and 8,000 eggs in stream gravel. Rainbow trout may spawn when they reach two to three years of age. Generally steelhead are older before they spawn. Steelhead usually spend about three years in freshwater before migrating to the ocean. There they may spend about two years before returning to their home streams to spawn. The clearwater lakes and streams draining into Bristol Bay provide an important habitat for rainbow trout. Rainbow trout freshwater populations appear stable throughout their native range, including the sale area (ADF&G 2012i).

ii. Dolly Varden

Dolly Varden are closely related to Arctic char and distinguishing between the two requires a close examination of several body structures. The northern form of Dolly Varden may be found in or near the lease sale area. Both freshwater-resident and sea-run Dolly Varden populations occur in this area. Among freshwater residents, there are lake, stream, and dwarf forms (ADF&G 2012i).

After their first migration to the ocean, Dolly Varden may spend the remainder of their lives overwintering in lakes and migrating between the ocean and freshwater. Dolly Varden that are hatched and reared in a lake system migrate to the ocean to feed and return annually to a lake or river to overwinter. Dolly Varden that hatch in non-lake systems seek out a lake for overwintering. They search for a lake randomly, migrating from system to system until they find a system with a lake. After overwintering in the lake, Dolly Varden may also migrate annually to sea in the spring, and may search for food in other stream systems. When Dolly Varden reach sexual maturity, usually between ages 5-9, they migrate directly from their overwintering areas to their home stream to spawn (ADF&G 2012i).

Dolly Varden are capable of spawning multiple times during their lives, usually in the fall. The female, depending on her size, lays between 600 – 6,000 eggs in streambed gravel. Dolly Varden are more of a scavenger than a predator feeding on a variety of prey. In freshwater they may eat winged insects and larvae. They also may eat drifting salmon eggs, small crustaceans, and small fish. In the ocean they may feed on amphipods and small fish (ADF&G 2012i).

c. <u>Other Marine Species</u>

Marine fish found in or near the sale area include Pacific cod, walleye pollock, Pacific halibut, Pacific herring, capelin, and eulachon (hooligan). The largest concentrations of Pacific herring in Alaska are found in Bristol Bay. This area also provides important rearing areas for a variety of marine species, particularly halibut. Pacific herring and capelin spawn along the Alaska Peninsula coastline (ADF&G 2012i; LaRoche and Associates 2011).

Shellfish in the region include cockles, soft-shell, butter, surf and razor clams, king, tanner, Dungeness, and hair crabs, and shrimp. Extensive clam beds can be found in shallow coastal waters adjacent to the north side of the Alaska Peninsula (northeast of Bristol Bay) while smaller concentrations of clam beds occur in bays on the south side of the peninsula (LaRoche and Associates 2011). The Alaska Peninsula also supports scallops (ADF&G 2006).

2. Birds

a. <u>Waterfowl</u>

Habitats of the sale area support millions of waterfowl, some of which inhabit the area seasonally and some year round. Species include tundra swans, snow geese, emperor geese, white-fronted geese, lesser Canada geese, black brant, eiders, and 27 species of ducks (ADF&G 2006; LaRoche and Associates 2011).

The largest concentrations of ducks, geese, swans, and cranes occur during the spring and fall migrations. Port Heiden, Ugashik, and Egegkik, provide plentiful food (especially eelgrass) and protected areas that allow waterfowl to rest and feed undisturbed. The Bristol Bay wetlands support about 18% of diving ducks breeding in Alaska. More than 100,000 dabbling ducks nest in ponds throughout these wetlands. An estimated 600,000 ducks are hatched and an additional million ducks migrate through the Bristol Bay wetlands each year (LaRoche and Associates 2011).

b. Seabirds and Shorebirds

One of the largest and most diverse gatherings of marine birds in the world can be found on the isolated islands and productive seas near the Alaska Peninsula. Various species of marine birds use different portions of the marine ecosystem (ADF&G 2006).

Although the Alaska Peninsula's steep cliffs and rugged offshore islands along the Pacific side provide excellent nesting habitat for seabirds, colonies are relatively sparse and small along the Peninsula and in Kvichak and Nushagak bays. However, during the summer, an additional 8-13 million nonbreeding seabirds arrive to feed before leaving to breed in New Zealand, Australia, and South America. Some of the seabirds that do remain include common murres, black-legged kittiwakes, tufted and horned puffins, glacous-winged gulls, pelagic, red-faced, and double crested cormorants, and Aleutian terns (LaRoche and Associates 2011).

Alaska Peninsula estuaries are important staging and stopover sites for shorebirds migrating in the fall. In fact, each spring, Izembek and Moffet lagoons have experienced concentrations of more than 500,000 shorebirds, including marbled godwits and rock sandpipers. Each fall the Alaska Peninsula also has the majority of the eastern Pacific population of black brant (ADF&G 2006). Due to harsh climatic conditions, few species of shorebirds overwinter along the coast. Those that do, include rock sandpipers, som dunlins, sanderlings, and surfbirds (ADF&G 2012h).

Bristol Bay, particularly along the lagoon systems and estuaries on the northern side of the Alaska Peninsula, accommodates vast flocks of molting, feeding, and staging shorebirds every fall. The intertidal flats of Nushagak, Kvichak, Cinder rivers, Egegik and Ugashik bays, Port Heiden and the Seal islands are the most heavily used estuaries (LaRoche and Associates 2011). Of all the birds found in the state Critical Habitat Areas, shorebirds use them in the largest numbers (ADF&G 2012a).

About 30 species migrate or nest in the region, but only eight species can be found in significant numbers. These are greater yellowlegs, northern phalarope, common snipe, short-billed dowitcher, western, least, and rock sandpipers, and dunlin (LaRoche and Associates 2011).

c. Raptors

Raptors may be found throughout the sale area. Raptors are considered an indicator species of ecological changes and human-induced influences or impact because they are high trophic-level (top of the food chain) predatory birds (ADF&G 2006). Some raptors that may be found in the sale area are bald eagles, peregrine falcons, various hawks and owls (eBird 2012).

Bald eagles are commonly found throughout the Alaska Peninsula (USFWS 2010). Most bald eagles winter in southern Alaska, but some do leave the state (ADF&G 2012h). In fact, more than 1,000 bald eagles nest along its rivers, lakes, and coastline, primarily on the south side of the peninsula (LaRoche and Associates 2011).

On August 9, 2007, bald eagles were removed from the federal threatened and endangered species lists under the Endangered Species Act. However, they do remain protected under the Bald and Gold Eagle Protection Act and the Migratory Bird Act. This act prohibits anyone from taking or disturbing bald eagles (ADF&G 2012h). According to the Protection Act, "disturb" means:

> "…to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (USFWS 2007).

d. Landbirds

The following landbirds are representative of some of the summer or yearlong residents found in or near the sale area: song and savannah sparrows, blackpoll warbler, rusty blackbird, rosy finch, spruce grouse, ptarmigan, common ravens, magpies, woodpeckers, and chickadees (ADF&G 2006, 2012g; LaRoche and Associates 2011; USGS 2012). Due to inaccessibility in some areas, information is lacking about landbirds specific to the sale area.

3. Mammals

a. Terrestrial Mammals

The Alaska Peninsula is inhabited by several species of large terrestrial mammals, including caribou, moose, brown bear, and wolf (USFWS 2012b). Other, smaller mammals living in or near the sale area are the bat, shrew, beaver, river otter, mink, short-tailed and least weasel, red and Arctic fox, wolverine, lynx, and marten (LaRoche and Associates 2011). Mice, voles, hoary marmots, red squirrels, lemmings, tundra hares, and the smaller mammals already listed tend to be grouped together as furbearers (ADF&G 2006; ADF&G 2012k).

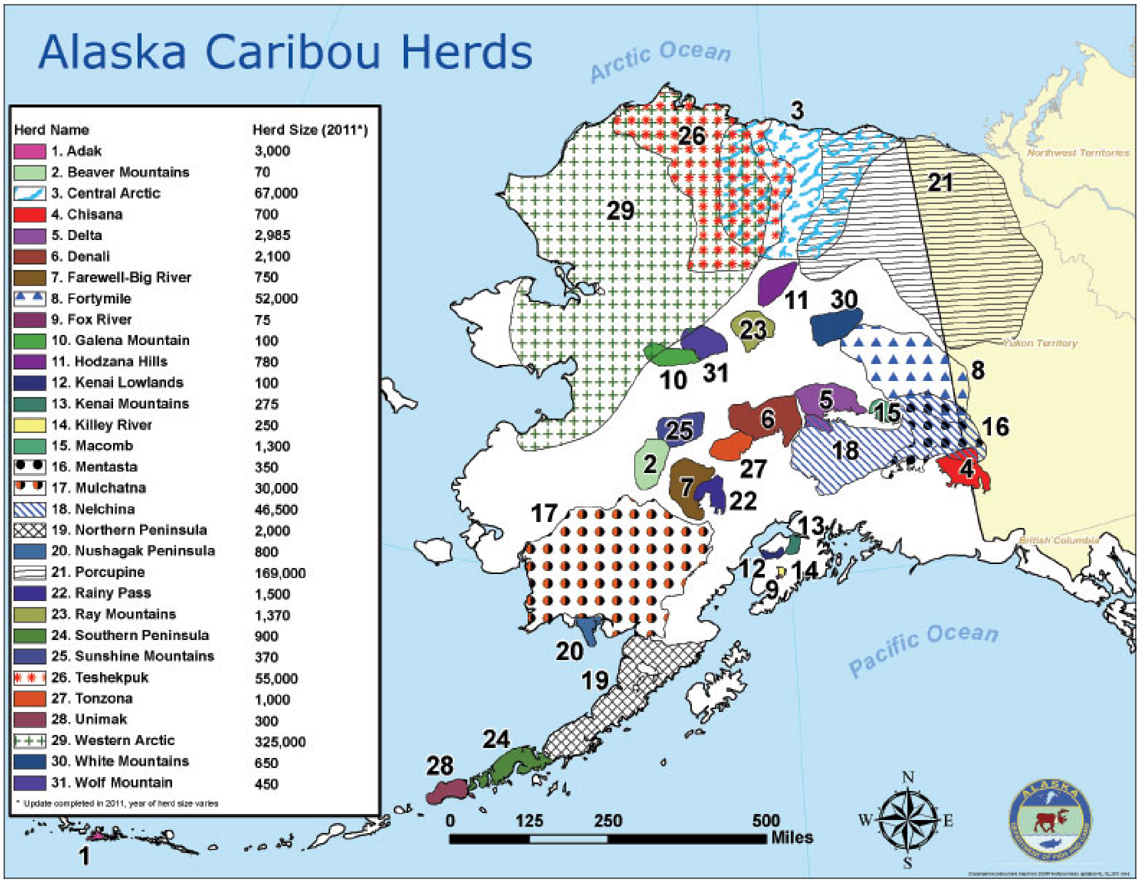
i. Caribou

Three caribou herds reside in the sale area. The Northern Alaska Peninsula herd (NAPH) has the largest range of the area. Next is the Southern Alaska Peninsula herd (SAPH), then the Mulchatna herd (MCH). As a herd animal, caribou must keep moving to find adequate food sources. Larger herds may migrate up to 400 miles between summer and winter ranges while smaller herds may not migrate at all (Map 4.3). During the summer, caribou eat willow leaves, sedges, flowering tundra plants and mushrooms. During the winter, they switch to a diet of lichens (reindeer moss), dried sedges, and small shrubs (ADF&G 2012k)

Calving occurs in early June for the herds of the Alaska Peninsula. Most females do not breed until they are 28 months old but some females in very good condition may breed as early as 16 months of age. Most adult cows are pregnant every year and give birth to one calf. After calving, caribou gather into large post calving aggregations to avoid predators and insects such as mosquitoes and warble flies. After insect numbers decline, usually around August, caribou scatter and focus on feeding heavily to regain body weight (ADF&G 2012k).

In Alaska, caribou prefer treeless tundra and mountains during all seasons but may winter in boreal forests. Calving areas are usually located in mountains or open, coastal tundra. Caribou tend to calve and migrate in the same general areas for years, but may suddenly abandon those routes in favor of movements to new areas with more food. Changing weather conditions such as the onset of cold weather or snowstorms probably also trigger caribou movements. Once they undertake migration, they can travel up to 50 miles a day (ADF&G 2012k).

The NAPH ranges roughly from north of King Salmon south to Port Moller. Historically, the NAPH population has fluctuated widely but herd numbers continue to decline and survival and recruitment remain low. In 1986, a significant number of NAPH animals began to winter between the Naknek River and Lake Iliamna and it was hoped the excellent forage conditions there would sustain the herd. However, about the same time, up to 50,000 MCH caribou also began using this area. Herds intermingled and due to the increasing competition for winter forage, the NAPH did not increase as much as originally hoped. Hunting restrictions and closures were implemented to minimize any negative human influence, but they were not expected to reverse the population trend. Currently, there is no intention of reopening hunts until the herd recovers. As of 2009, herd population appears to be between 2,000 – 2,500 animals (Riley 2011a).



Source: ADF&G 2012k

Map 3.3 Alaska Caribou Herds

The range of the SAPH extends from Port Moller to False Pass. After a peak of more than 10,000 caribou in 1983, the SAPH began declining sharply and continued until the herd stabilized in the mid-1990s. The population grew to 4,100 by 2002, but the population again began declining. Counts completed during 2007 and 2008 estimated the minimum population to be 600 – 700 caribou during each year. Recent studies suggest wolves significantly reduced calf survival and led to population decline. At the same time, other herds on the Alaska Peninsula experienced low calf recruitment. Calf recruitment increased in 2008, 2009, and 2010 following selective wolf removal on the calving grounds. Timing may be coincidental or it may indicate a common regional factor may be affecting caribou populations in this part of the state. As of 2010, the causes for this population decline were unclear (Riley 2011b).

During the 1980s and late 1990s, the MCH appeared to intermingle with the NAPH. During the winter of 2008 – 2009, a large part of the herd wintered south of the Kuskokwim River while the remainder wintered in the lower Nushagak and in the Kvichak drainage. Generally, the MCH does not move as a distinctive herd but in recent years the herd basically splits. Part of the herd moves to the eastern side of its range and the rest to the western side in the summer. Then they assemble for the fall rut and then move back to winter in these areas. Come late winter/spring, the caribou travel back to the middle and northern part of their range for calving, repeating this process come summer. Over the past 25 years, there have been dramatic changes in the MCH's range, sometimes seasonally occupying ranges used by smaller resident caribou herds. As of summer 2008, the MCH population had declined to 30,000, a decrease from 200,000 in 1996 (Woolington 2011a).

ii. Moose

Moose can be found predominately along riparian areas. Although little is known about specific movement patterns, it is known moose are influenced mainly by the rutting season in late September and snow conditions in winter (Woolington 2010b). Most moose migrate seasonally to calving, rutting, and wintering areas. They may travel only a few miles or up to 60 miles during these transitions. Sexual maturity is closely linked to range conditions. Most females breed at about 28 months though breeding has been known to occur as early as 16 months of age. Rutting season usually occurs in late September and early October (ADF&G 2012k).

Moose are herbivores and during the fall and winter they consume large quantities of willow, birch, and aspen leaves and twigs. In the spring they browse and graze. During the summer they eat sedges, pond weeds, grasses and willow, birch and aspen leaves. In the wild they rarely live beyond 16 years (ADF&G 2012k).

Moose were scarce in the Alaska Peninsula and Northern Bristol Bay area before the 1950s and 1960s, when the population increased dramatically and spread southwest. An ADF&G 1983 census taken in the central part of Unit 9E estimated 1,148 moose. This number was extrapolated to the rest of Unit 9E resulting in a rough estimate of 2,500 moose. As of 2010, it appeared moose populations in most of Unit 9 have been relatively stable while moose densities remained very low in Units 9A, 9B, and 9D (Butler 2010b). ADF&G began collecting data on moose in Units 17A and 17C in 1971. Over the last 30 years, moose populations have increased substantially in number and in range, especially in unit 17A. Population in this area is estimated to be 4,000 – 4,700 and increasing (ADF&G 2012k).

iii. Brown Bears

Brown bears (classified as the same species as grizzlies) are abundant on the Alaska Peninsula and the sale area. The Alaska Peninsula contains an abundance of good denning habitat commonly found in alder, willow, or grass areas (LaRoche and Associates 2011). Access to an abundance of spawning salmon, coupled with a milder climate and wide variety of vegetation, leads to larger bears living in higher densities than in northern and interior parts of the state.

Brown bears are very adaptable and eat a large variety of foods. Common foods include salmon, berries, sedges, cow parsnip, ground squirrels, carrion, and roots. Brown bears may also hunt caribou and moose, especially newborns (ADF&G 2012k). In the early spring, after emerging from winter dens, coastal grass flats play an important role as the first food source available to bears. The newly emerging sedges here provide a reliable high quality food source year after year when the bears need it most and are generally in the poorest condition. Also, because relatively few large coastal flats exist in the area, they are considered a highly important habitat. Other important spring food sources include carcasses of marine mammals that have washed ashore (LaRoche and Associates 2011).

Most brown bears reach sexual maturity at 5 years of age, but females do not usually produce a litter until later. Brown bears mate from May to July. In the fall, pregnant females usually enter dens first, and leave them, with their newborn cubs, last in the spring. Cubs are born in the den during January and February and twins are common. Adult males do the opposite, entering dens later in the fall and emerging sooner in the spring (ADF&G 2012k). Most denning sites are found on hillsides or mountain slopes, usually below 1,800 ft. elevation. In areas with mild winters, some male bears may stay active all winter. The oldest recorded brown bears in Alaska were a 39 year old female and 38 year old male (ADF&G 2012k).

Based on data gathered from 1999 - 2005, density estimates suggest a population size of 6,000-6,800 bears occupying lands open to hunting in Game Management Units 9A, 9B, 9C, and 9D (Riley and Butler 2011). No data are available on bear populations specific to Unit 17. The bear population is probably stable to increasing in this unit (Woolington 2011b).

iv. Furbearers

Numerous furbearers can be found throughout the Alaska Peninsula and the sale area. The rocky shores and beaches are inhabited by river otter, mink, short-tailed and least weasel, and red and arctic fox. They feed on carrion, clams, and crabs. The Bristol Bay Lowlands are an important habitat for wolves, lynx, and martens. Most streams and large lakes here are home to beaver. They are particularly abundant in the Nushagak and Muchatna drainages. Smaller mammals include Arctic ground squirrels, tundra hares, hoary marmots, and tundra voles. In fact, tundra voles exist in all Alaskan habitats except on bare rocks and glaciers. They are a food staple for weasel, marten, foxes, coyotes, all owls, most hawks, inland breeding gulls, jaegers, and on occasion, great blue herons, domestic cats, northern pike, and other voles. Other furbearers found in the lease sale area are wolverine, shrews, mice, lemmings, and pikas (ADF&G 2006, 2012i; LaRoche and Associates 2011).

Wolves are found throughout the sale area. Their primary food source is moose and caribou though squirrels, snowshoe hares, beaver, and occasionally birds and fish supplement their diets. Wolves are social animals and usually live in smaller packs averaging six or seven animals. Sometimes packs of 20 to 30 animals occur and two or three litters of pups. Wolves have never been threatened or endangered in Alaska. However, wolf populations may be negatively affected by events such as severe winters, a decline in their prey, or even harvesting by humans. Major sources of wolf mortality are other wolves (defense of territory), hunting, and trapping. Disease, malnutrition and accidents also affect wolf numbers (ADF&G 2012k).

b. Marine Mammals

i. Beluga and Other Whales

During the summer several whale species feed in the waters of Bristol Bay. Beluga whales follow returning salmon and smelt to the northeast bays of Bristol Bay (ADF&G 2006). Beluga whales are present in Bristol Bay throughout the year and are seen mainly in Kvichak and Nushagak bays (Lowry et al. 2008). In the spring they migrate to warmer waters such as estuaries, bays and rivers where they may molt, give birth and care for their calves (Allen and Angliss 2012). They are sometimes found at the mouths of major streams and rivers, even occasionally upstream in large rivers beyond tidal influence areas in their pursuit of salmon (LaRoche and Associates 2011).

Besides salmon, beluga whales also feed on smelt during late spring and summer. From mid-June through mid-August, salmon is their main diet. After mid-August, this changes to flatfish, sculpin, lamprey, and shrimp. Little is known about their diet during the fall and winter months (Lowry et al. 2008). It is estimated that the Bristol Bay beluga population increased about 5% annually and 65% over the twelve-year period 1993-2005. There is no clear or single explanation for this increase so it is not possible to make any definitive conclusions as to why this is happening (Lowry et al. 2008).

Minke whales feed in bays and shallow coastal waters in summer while killer whales feed on several marine mammal species in the coastal waters and bays. Gray whales are known to travel in nearshore waters during their spring migration north. Fin, humpback, and mink whales are found in the nearshore and offshore waters of the Alaska Peninsula during the summer (ADF&G 2006). Of the whales found near the sale area, three are on the federal endangered species list. These are the humpback, fin, and bowhead (USFWS 2012f). Beluga, minke, killer, and gray whale populations are considered healthy and stable (ADF&G 2012k; USFWS 2012f).

ii. Walruses, Seals, Sea Lions, and Sea Otter

The waters of northeast Bristol Bay support a wide variety of benthic marine life and extensive clam beds. Because of this, Bristol Bay supports several large marine mammal predator species such as Pacific walrus. All marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA gives Pacific walrus management authority to USFWS. Part of this management includes preparing Pacific walrus stock assessments which are updated every three years (USFWS 2011).

Adult male walruses use haulouts around the bay (ADF&G 2006). Pacific walrus congregate in Bristol Bay and rest on haulouts between feeding bouts. Haulouts located near the sale area are Cape Constantine, Round Island, Cape Newenham, and Cape Seniavin located on the Alaska Peninsula (USFWS 2012e). Walrus have been hauling out here regularly since the 1970s. Large year to year fluctuations in haulout numbers suggest walrus may not return to the same haulout each year. Factors including the status of food stocks near haulouts, population size, disturbance levels, and winter/spring distributions may influence walrus abundance and are poorly understood.

Harbor seals haul out on beaches along both coastlines of the Alaska Peninsula (ADF&G 2006). They are seen congregating on shoals and sandbars and feeding on schools of herring and capelin. Some have been seen pursuing salmon upstream beyond tidal area. Haulout areas are critical to maintaining harbor seal populations because there are a limited number of suitable sites and these experience high intensity use (LaRoche and Associates 2011). Haulouts are used to rest, give birth, and nurse their pups which are born between May and mid-July. An actual census is difficult to obtain because harbor seals can only be accurately counted when they are hauled out, and they haulout at different times of the day at thousands of locations in Alaska. Harbor seals were listed as an Alaska Species of Special Concern, which is no longer maintained by ADF&G; however, harbor seals are on the nominee species list in Alaska’s Wildlife Action Plan (ADF&G 2012k; 2014).

Spotted seals may be found in the vicinity of the sale area, although their preferred habitat is the edge of pack ice in loose floe areas. They may be found in Bristol Bay during the winter along the southern edge of the broken pack ice. Spotted seal pups are born on sea ice rather than land. Spotted seals in Alaska are not listed as threatened or endangered under the Endangered Species Act. Spotted seals are prey to many marine and land mammals (ADF&G 2012k).

Haulouts and rookeries for Steller sea lions can be found primarily along the gulf coast where they land to rest and suckle their young. Sea lions do not migrate, but do move their central haulout to follow their many types of prey (ADF&G 2006, 2012i). Since 2000, there has been a substantial effort to identify causes and possible remedies to the western stock population decline. These are the subject of considerable debate but causes may be from both “top-down” (predation, disturbance, intentional killing, and entanglements) to “bottom-up” (reduced prey quality and abundance and long-term shifts in environment) processes (ADF&G 2012k).

Commercial harvesting of sea otters had reduced their population to a few hundred animals in the early 1900s (USFWS 2012d). Since then, sea otters have recolonized the southern half of the Alaska Peninsula, but the population decreased dramatically in recent years. This decline may be due to increased predation by killer whales (ADF&G 2006). Because of this decline, the Southwestern stock of Northern sea otter is listed as threatened under the Endangered Species Act (USFWS 2012f). As of 2008, the abundance of sea otters in Alaska is estimated to be about 70,000 (ADF&G 2012k).

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Chapter Five: Current and Projected Uses

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Chapter Five: Current and Projected Uses

This chapter considers and discusses the current and projected uses in the sale area, including uses and value of fish and wildlife as required by AS 38.05.035(g)(iv). The land and waters included in and near the Alaska Peninsula sale area provide habitat for a variety of fish and wildlife as described in Chapter Four. The sale area also provides a variety of uses such as subsistence, sport, and commercial harvest activities. These and other current and projected uses are considered and discussed below. The following information is not intended to be all inclusive, but to provide an overview of the current and projected uses.

A. Uses and Value of Wildlife, Fish, and Plants

Alaska Game Management Units are managed by the Alaska Department of Fish and Game (ADF&G). ADF&G compiles and analyzes harvest and biological information, enabling the establishment of ecologically sound population-based fishing, hunting, and trapping regulations. This information may also be used to promote conservation strategies and recovery actions (ADF&G 2013j). The sale area is located in the following game management units: 9B, C, D, E and 17A and C.

1. Subsistence

State and federal subsistence fishing and hunting occur in Bristol Bay and on the Alaska Peninsula. Alaska law defines subsistence as "noncommercial, customary and traditional uses" of fish or game for a variety of purposes. Alaska law AS 16.05.258 requires that subsistence uses be consistent with sustained yield.

The ADF&G, Division of Commercial Fisheries manages subsistence fishing in state managed fisheries. The USFWS, Office of Subsistence Management manages subsistence hunting, trapping and fishing on Alaska's Federal public lands and non-navigable waters. Since 1999, federal subsistence management has expanded to include fisheries on all federal public lands and waters (ADF&G 2013n).

Many residents rely not only upon fish, but also wildlife and plants for subsistence. Wildlife harvested may consist of moose, caribou, bear, rabbit, porcupine, waterfowl, and seal. Plant resources such as berries and roots and firewood/log harvests are also important. Subsistence harvest uses include furs and hide for clothing, wood and other fuels for heating and cooking, wood and other natural materials for construction, making household goods, trade goods and cash, ceremonial, and arts and crafts (SWAMC 2012).

Subsistence use remains the most consistent and reliable economic component of local communities of the sale area. For many residents, subsistence is the preferred lifestyle and source of food, and wages are used to supplement their subsistence activities. Subsistence fishing, hunting, and gathering provide hundreds of pounds of highly nutritious foods for residents. Some studies estimate that subsistence harvests of wild food provide between 40 and 90% of the protein consumed by the region's residents (Holen and Lemons 2012; LaRoche and Associates 2011).

Subsistence activities are seasonal. Subsistence knowledge is preserved and communicated through the gathering and processing of the area's wild resources, including fishing and hunting activities (Holen and Lemons 2012). Likewise, an important link to cultural heritage and lifestyle is maintained through subsistence harvests and activities. These activities may provide a stabilizing influence in times of rapid social change, and contribute to social cohesion through the exchange and distribution of goods between relatives and other villages (LaRoche and Associates 2011; SWAMC 2012).

Adequate substitutes for locally-harvested food are lacking, would be cost-prohibitive, and would likely have negative cultural, social, and nutritional effects (Holen and Lemons 2012).

Subsistence surveys of 18 local communities were conducted between 2005 and 2010 and six surveys were conducted in the mid-1980s. Results show salmon made up 56% of the subsistence harvest, land mammals (mostly moose and caribou) 23%, fishes other than salmon 9%, and other resources (marine mammals, birds, eggs, marine invertebrates, and wild plants) 12%. Results for smaller communities were similar: 51% salmon, 25% land mammals, 11% other fishes, and 13% other resources. Subsistence provides a substantial part of residents' diet. This is especially true for inland communities where there are fewer employment opportunities (LaRoche and Associates 2011).

a. Fish and Shellfish

Salmon, halibut, finfish, crab, and shrimp are harvested for subsistence use (ADF&G 2013f). From 2009-2011, subsistence harvest of salmon from the Bristol Bay management area ranged from 113,238 to 126,743 salmon. Sockeye salmon comprise most of the salmon catch around 80% while Pink usually bring in less than 1% (Table 5.1). Pacific herring subsistence fisheries predate recorded history and halibut have been harvested for centuries by indigenous coastal peoples (ADF&G 2012i). Rainbow trout, whitefish, herring, Dolly Varden, Arctic graying and northern pike are also harvested for subsistence in the Bristol Bay area (Holen and Lemons 2012). Clams are also harvested in the Port Heiden, King Cove and False Pass areas (DMLW 2005).

Table 5.1. Estimated historical subsistence salmon harvests, Bristol Bay management area.

Year	Sockeye	Chinook	Chum	Coho	Pink	Total
Number of fish						
2009	98,951	14,020	5,052	7,982	442	126,447
2010	90,444	10,852	4,692	4,623	2,627	113,238
2011	101,017	14,106	3,794	7,493	333	126,743
Percent of harvest						
2009	78%	11%	4%	6%	<1%	
2010	80%	10%	4%	4%	2%	
2011	80%	11%	3%	6%	<1%	

Source: Holen and Lemons 2012.

b. Terrestrial Mammals

It is difficult to quantify caribou harvests for the MCH for subsistence due to unreported harvests and hunting from herds other than the MCH (Woolington 2011a). State and federal subsistence hunts of the NAPH have been closed since 2005 and not been reopened as of 2010. However, two ceremonial permits were issued to harvest one caribou each in 2007 and 2008 and both were successful (Riley 2011a). State and federal hunts, including subsistence, have been closed for the SAPH since 2008 and as of 2010 not reopened (Riley 2011b).

Moose are harvested for their meat and as a game animal. In 2007, 90% of the moose harvested, including for subsistence, were taken by Alaskan residents (Woodford 2009). In the Alaska Peninsula and Northern Bristol Bay area, it was not until March of 1999 that the Board of Game (BOG) found moose in Units 9B, 9C, and 9E met the criteria to be considered "important for providing high levels of human consumptive use" and hunting was allowed in these areas (Butler 2010b).

c. Marine Mammals

Marine mammals have long been an important resource for Alaska Natives. Coastal communities use whales, walruses, seals, sea lions, and sea otters. Only Alaska Natives are allowed to harvest marine mammals for subsistence.

Beluga whales are a traditional food source for the Yup'ik people living in Bristol Bay (ADF&G 2006). The oil is used for cooking and fuel and beluga bones are sometimes used in crafts.

Walruses are important to the Alaska Native cultures of Bristol Bay for their nutritional and cultural values. Every year several thousand walruses are harvested in Alaska. Management issues are addressed jointly by the USFWS and the Eskimo Walrus Commission (EWC).

Nearly every part of the walrus may be used. Hides can be processed into rope or used to cover boats. Ivory tusks are carved into artwork, jewelry, and other crafts. Stomach lining is used in making traditional drums for Eskimo dances. The meat, blubber, skin, and organs are also used as food (ADF&G 2012k).

Harbor seals are important to Alaska Native culture and diet. Clothing and handicrafts are made from the hide and meat, and organs and oil from blubber are used for consumption. Otters are taken by Alaska Natives for their fur to make handicrafts and clothing (ADF&G 2012k).

Alaska Natives harvest spotted seals for subsistence but the number taken each year is unknown (ADF&G 2012k). Ice seal hunters, tribes, and researchers have become concerned about ice seals, their habitat, and abundance. Concerns include reduction in sea ice associated with climate change; changes in show and ice cover of arctic waters; offshore oil and gas development; increased ship traffic; environmental contamination; natural predation; prey availability; and noise protection. In 2012, the Ice Seal Management Plan was adopted to outline principles of how the ice seals will be co-managed by subsistence hunters and National Marine Fisheries Service (NOAA 2012).

Although western Stellar sea lions are listed as endangered (USFWS 2012), subsistence harvest is allowed and continues because it has not been shown to contribute to the decline in population (ADF&G 2012k).

2. Commercial Fishing

Alaska's commercial fishing industry is the most productive and valuable in the nation with a wholesale value of over $3 billion. In 2011, the seafood industry in Bristol Bay generated an estimated $148 million in labor income and relies mainly on the sockeye salmon runs, which are the world's largest. It is estimated that 49% of all working age adults living in the Bristol Bay region directly participate in the commercial seafood industry for a part of each year (McDowell Group 2013). As of 2011, commercial fishing and seafood processing were the most important components of the Lake and Peninsula Borough's economy (LaRoche and Associates 2011).

Alaska's science-based management system is widely regarded as one of the best in the world (ADF&G 2013e). In fact, Alaska is the only state in the nation whose constitution includes a mandate that requires sustainability of its fish and wildlife resources (DCCED 2013), an indication of the importance of Alaska's vast fishery resources to the history and culture of the area, and the economy.

The Division of Commercial Fisheries manages the State of Alaska's commercial fisheries within the state's jurisdiction. The division also manages some commercial fisheries that occur in the Exclusive Economic Zone (subject to federal jurisdiction) under authority delegated to it by the North Pacific Fisheries Management Council. Because of the cross jurisdictional boundaries and the migratory nature of fishery resources, the Pacific Salmon Commission, joint Canadian/US Yukon River Panel, North Pacific Fisheries Management Council and other interstate and international agencies are also involved in management of Alaska's fisheries (CF 2013; NOAA 2013a).

Alaska's commercial fisheries are divided into four regions. The sale area is a part of the Central and Western Regions. The Bristol Bay Management Area includes five management districts: Naknek-Kvichak, Egegik, Ugashik, Nushagak, and Togiak. Within those management districts are nine major river systems: Naknek, Kvichak, Alagnak, Egegik, Ugashik, Wood, Nushagak, Igushik, and Togiak (ADF&G 2012d). The north side of the Alaska Peninsula Management Area belongs to the Westward Region (ADF&G 2013c).

Alaska's commercially important species of seafood include the five species of Pacific salmon, five species of crab, various groundfish, herring, shrimp, and other shellfish. Salmon is the most valuable commercial fishery managed by the State of Alaska. From 2010-2013, total harvest of salmon from Bristol Bay and north Alaska Peninsula ranged from about 150 million to about 213 million pounds (Table 5.2). Bristol Bay is the largest sockeye salmon fishery in the world and the most valuable single salmon fishery in Alaska. The Alaska Peninsula is a major pink salmon producing area (ADF&G 2013d). Over half of Alaska's commercial fishermen work on salmon fishing boats (McDowell Group 2013).

Table 5.2 Commercial salmon catch and average salmon price in dollars per pound by species in Bristol Bay and North Alaska Peninsula, 2010-2013.

Year	Sockeye		Chinook		Chum		Coho		Pink		Total
	BB	AP	BB	AP	BB	AP	BB	AP	BB	AP	
Harvest in pounds (thousands)											
2010	169,834	20,117	454	147	6,093	7,496	728	1,612	4,400	2,576	213,457
2011	134,722	16,800	462	127	4,501	8,542	83	1,069	2	18,864	185,172
2012	119,209	16,316	267	139	4,281	6,544	631	779	2,822	2,020	153,008
2013	92,000	17,094	350	83	5,600	7,724	810	2,064	2	24,170	149,897
Price per pound											
2010	$1.06	$1.23	$1.02	$0.75	$0.28	$0.41	$0.64	$0.50	$0.36	$0.38	
2011	$1.18	$1.25	$0.88	$1.01	$0.37	$0.53	$0.63	$0.60	$0.28	$0.40	
2012	$1.07	$0.84	$1.17	$0.99	$0.34	$0.43	$0.51	$0.45	$0.39	$0.35	
2013	$1.5	$1.26	$0.77	$0.56	$0.30	$0.47	$0.80	$0.48	$0.30	$0.35	

Source: ADF&G 2013b.

Several marine fish and shellfish species are harvested commercially in or near the sale area. These include Pacific cod, walleye pollock, Pacific herring, halibut, eulachon, Dungeness, king, and tanner crab, and razor clams (ADF&G 2012i; ADF&G 2012j). Walleye pollock made up 62% of the total groundfish caught in 2011, coming in with 1,282,780 metric tons (AFSC 2013b). Pacific cod accounted for 304,950 metric tons or 15% of all Alaska groundfish caught in 2011 (AFSC 2012a). Along the northern coast of the Alaska Peninsula, commercial fishing also includes yellowfin sole, herring, and herring roe (DMLW 2005).

Shellfish is the second most valuable fishery managed by the state. The predominant commercial harvest is red king crab and the largest harvests come from Bristol Bay. In 2009, Dungeness crab, Tanner crab, and octopus were commercially harvested (Carroll 2005; Stichert 2010). Swikshak Beach on the Alaska Peninsula is the only beach besides those in the Cordova and Cook Inlet area that is certified for the razor clam human consumption market. They have been harvested there since 1929 (ADF&G 2012j).

3. Sport Fishing

Sport fishing is an important part of the culture and economy of the Alaska Peninsula and Bristol Bay areas. It provides recreation, food, and jobs to both residents and visitors. The revenue from the sale of sport fishing licenses, tags, and permits directly supports ADF&G's research and management of sport fisheries (ADF&G 2013h).

The sale area lies in the Bristol Bay Sport Fish Management Area. The Bristol Bay Sport Fish Management Area contains some of the most productive fishing waters in the world. This management area is not linked to the state's highway system. Local roads provide sport fishermen limited access near major communities. Despite its remote location, over 30,000 visitors a year come through Naknek and King Salmon, most for sport fishing (ADF&G 2013n).

Sport fishing in Bristol Bay is second only to commercial fishing as the most important private economic sector in the region. In a 2005 survey, anglers consistently emphasized the importance of Bristol Bay's uncrowded, remote, wild setting in their decisions to fish there. In 2012, nearly 1,800 anglers spent over 9,000 angler days fishing in saltwater and over 6,000 anglers spent nearly 27,000 angler days fishing in freshwater (Table 5.3). It is estimated that in 2008 nonresidents were paid about $5 million and about $25 million to Alaska residents to fish salmon in the Bristol Bay region (Table 5.4). This generated about 1000 jobs for residents and nonresidents alike (Table 5.4). Total spent on Bristol Bay fishing trips in 2008 by residents and nonresidents is estimated to be $75 million (Table 5.5) (Duffield et al. 2007; Duffield 2009).

Table 5.3 Alaska Peninsula/Aleutian Islands sport fish anglers and days fished, 2012.

Areas Fished	Anglers	Days Fished
Saltwater		
Boat – Alaska Peninsula	584	2,084
Boat – Unlalaska Island	732	5,250
Boat – Other	345	549
Shorelines – Other	241	1,154
Saltwater Total	1, 1774	9,037
Freshwater		
Naknek Lake	464	741
Naknek River above Rapids Camp	1,162	3,415
Naknek River below Rapids Camp	1,519	6,133
Naknek River and Tributaries	435	2,415
American Creek	514	1,147
Brooks River	1,466	3,607
Egegik River and Becharof system	659	1,571
Sapsuk River (Nelson River)	390	1,339
Ugashik system	371	1,756
Other Alaska Peninsula/Aleutian streams	1,257	4,335
Other streams and lakes	149	478
Freshwater Total	6,068	26,937
Grand Total	7,412	35,974

Source: ADF&G 2013o.

Table 5.4 Total full-time equivalent employment (2008) and Alaska payroll associated with use of Bristol Bay wild salmon ecosystems (Thousand dollars (2008)).

	Alaska Residents			**Nonresidents**	**Total**
Sector	Local	Non-Local	Total AK		
Jobs					
Sport fishing	258	483	741	146	887
Sport hunting	40	76	116	2	118
Payroll					
Sport fishing	$7,963	$17,074	$25,037	$5,096	$30,133
Sport hunting	$1,111	$2,677	$3,778	$66	$3,854

Source: Duffield et al. 2007; Duffield 2009.

Table 5.5 Total estimated recreational direct spending in Alaska attributable to Bristol Bay wild salmon ecosystems, 2008.

	Alaska Residents			**Nonresidents**	**Total**
	Local	Non-Local	Total AK		
Trips					
Sport fishing	8,748	3,153	11,908	16,561	28,462
Sport hunting		1,538	1,538	2,310	3,848
Spending					
Sport fishing	$3,273,000	$5,005,000	$8,278,000	$66,400,000	$74,678,000
Sport hunting		$1,282,000	$1,282,000	$9,815,691	$11,097,691

Source: Duffield et al. 2007; Duffield 2009.

4. Sport Hunting

Sport hunting is also an important part of the culture and economy of the Alaska Peninsula and Bristol Bay areas. Revenue from sales of licenses, tags, and permits funds ADF&G's research and management of wildlife (ADF&G 2013h).

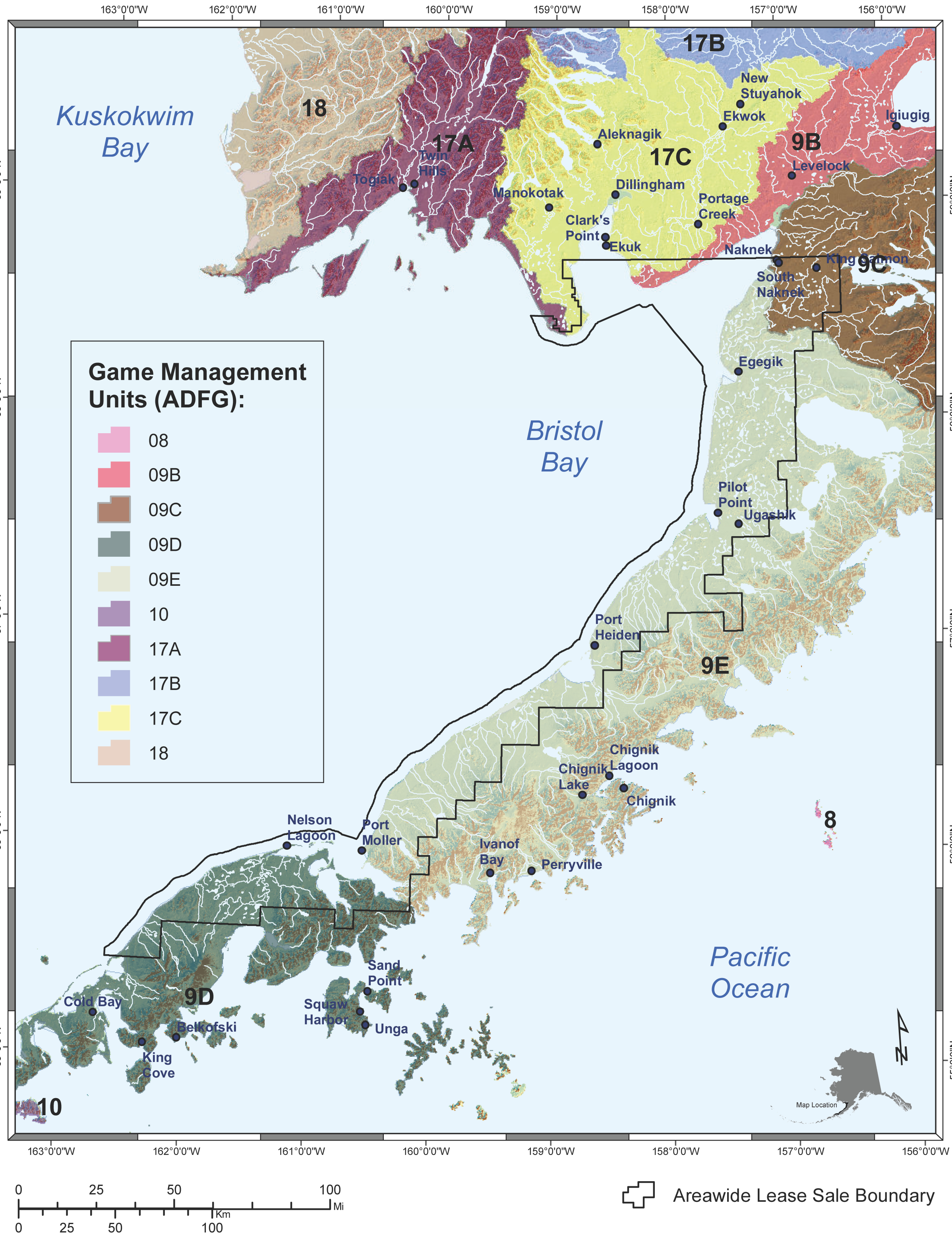
Sport hunting offers high quality hunting for highly valued species such as caribou, moose, and brown bear (Map 5.1). Big game hunters living outside the area spend about $12.4 million a year in direct hunting related expenditures. This estimate may include some caribou hunting of the MCH outside the Bristol Bay region game management units (Duffield et al. 2007).

Some big game species found in and near the sale area are brown bears, caribou, moose, wolf, and wolverine. Some of the highest brown bear population densities are on the Alaska Peninsula. The MCH is also one of the largest in the state. Though hunted, wolverine are infrequently taken (ADF&G 2013k).

The Alaska Peninsula is a premier destination for brown bear viewing and hunting (Riley and Butler 2011). Hunting is traditionally and economically an important aspect of life in Alaska. Most hunting regulations in coastal areas are geared toward maintaining high bear densities and giving hunters opportunities to pursue large bears. In the 2008 – 2009 hunting season, about 70% of the bears taken in the Bristol Bay area Unit 17 were taken by nonresidents (Woolington 2011b). During that same season, about 81% of the bears taken in Unit 9 were harvested by nonresidents (Riley and Butler 2011).

In the Bristol Bay and Alaska Peninsula region common furbearers being trapped include beaver, coyote, red and arctic fox, lynx, mink, muskrat, river otter, ermine, and wolverine (Butler 2010a; Woolington 2010).

In the Bristol Bay area, beaver was historically the most important furbearer being trapped. However, in the last decade or so, trapping in general has declined in importance to the economy and seasonal activities of local residents, thus beaver trapping activity has declined as well (Woolington 2010).



Map 5.1 Game Management Units In or Near the Alaska Peninsula Sale Area

5. Recreation and Tourism

Southwest Alaska is one of the least visited regions in the state. However, the Division of Economic Development is actively working with the Southwest Alaska Municipal Conference to increase recreation and tourism in the area (DCCED 2009). The scenery, parks and refuges, fish and game, birds, Alaska Native cultures, Russian colonial heritage, and historical sites provide opportunities and potential for sustained tourism development (SWAMC 2013). Tourists come to this region primarily for world class sport fishing and hunting, bear viewing, and adventure based activities (Rural Alaska Tourism Infrastructure Needs Assessment 2004). Tourism and recreation are the second most important industries and rapidly increasing in economic importance (Lake and Peninsula Borough 2013). Even some of the most remote communities benefit from wildlife tourism, especially birding. Birdwatchers visit many communities throughout the summer to view the many species of birds found nowhere else in North America (ADF&G 2006).

The following table lists some of the activities available to tourists in the Alaska Peninsula, Bristol Bay, and Aleutian Islands (Table 5.6).

Table 5.6 Recreation and tourism activities available in the Bristol Bay/Alaska Peninsula area

Activity	Alaska Peninsula	Bristol Bay	Aleutian Islands
Fishing	*	*	*
Hiking	*	*	
Hunting	*	*	
Traditional Culture	*	*	*
Parks and Refuges	*	*	
Bird Watching			*
Wildlife Viewing	*	*	
Boating / Rafting	*	*	
Marine Wildlife		*	
Air Tours		*	
Historical Culture and sites		*	*

Source: SWAMC 2013

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Chapter Six: Oil and Gas Exploration, Development and Production, and Transportation

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Chapter Six: Oil and Gas Exploration, Development and Production, and Transportation

A. Geology

1. Tectonic and Structural Framework

The Alaska Peninsula is part of an active region of the earth's crust. In plate tectonic terms, the Pacific Plate is being subducted under the North American plate along the Aleutian trench at an oblique angle. The magmatic arc that runs the length of the Alaska Peninsula trends toward the northeast and has been active since the Mesozoic era. It is located between the Mesozoic-Cenozoic Cook Inlet forearc basin to the south and the Cenozoic North Aleutian/Bristol Bay backarc basin to the North. This magmatic arc contributes to a complex thermal and tectonic history. Rocks of the Alaska Peninsula range in age from the Permian to Holocene and rock structures trend predominantly northeast, below and parallel to the arc and the peninsula's long axis. Exposed rocks include both volcanic (formed from cooling lava on the surface) and plutonic rocks (formed from cooling magma below the surface), and shallow marine and continental sedimentary deposits containing mainly volcanic and plutonic debris (Vallier 1994).

Beneath much of the Alaska Peninsula is a complex layering of different sequences of rocks formed when fragments of crust break off one tectonic plate and become part of a different plate, often during subduction. This is referred to as tectonostratigraphic terrane. The Alaska Peninsula or Peninsular terrane consists of Permian to Upper Cretaceous rocks placed there through plate tectonic processes. Paleocene and younger deposits cover much of the Peninsular terrane region. These deposits become thicker towards the northwest and into the North Aleutian backarc basin.

The Peninsular terrane is a combination of two different subterranes separated by faults and roughly the same age. These are the Iliamna and Chignik subterranes (Wilson et al. 1985). Northeast of Becharof Lake, both subterranes are well exposed and clearly separated by the Bruin Bay fault. On the northwest side of the fault, the Iliamna subterrane is thrusting upwards. The exposed subterrane contains mainly plutonic, volcanic, and metamorphic rocks, including the Alaska-Aleutian Range batholith. On the southeast side, the Chignik subterrane is sinking down and contains Triassic to Cretaceous sedimentary units, including rich oil-prone source rocks, some of which are at oil-window (ready to easily expel oil) and others which are at a lower level of thermal maturity.

South of Becharof Lake, it is believed the Bruin Bay fault is covered by Tertiary extensional faults from the Ugashik Lakes fault system, supporting subsidence (sinking) of the northeast sector of the North Aleutian basin and Ugashik sub-basin (Decker 2008). Continuing southward, the commingled Bruin Bay and Ugashik Lakes fault systems are obscured by younger volcanic cover. It is unclear how much of the source-prone Chignik subterrane may lie underneath Tertiary deposits along the edge of the North Aleutian basin in the sale area.

The North Aleutian basin is oldest and deepest in the area west and north of Port Moller, where the east-west basin axis contains up to approximately 5,500 m (18,000 ft.) of Paleocene and younger sedimentary strata, or layers. Review of seismic and rock outcrop information indicates that a mix of compressed, extensional (pulling apart), and strike-slip (blocks of rock that slide past each other horizontally) structures form the southern boundary of the basin adjacent to the Black Hills uplift and the Staniukovich anticlinorium in the southwestern-most part of the sale area (Finzel et al. 2005; Decker et al. 2005; Decker 2008).

2. Previous Work and Sources of Additional Stratigraphic Information

Significant new information regarding the petroleum resource potential of the Alaska Peninsula has become available since the previous best interest finding for the Alaska Peninsula issued in 2005. This information is now available as the result of several years of integrated field and subsurface research in the Alaska Peninsula region led by DNR geologists from the Division of Geological and Geophysical Surveys (ADGGS) and the Division of Oil and Gas (DO&G). Additional technical information about the regional petroleum systems is available in DNR-published reports (e.g., Finzel et al. 2005; Decker et al. 2005; Reifenstuhl and Decker 2008 and the reports contained therein). A major biostratigraphic study of 11 onshore and offshore wells in the region was underwritten by DO&G, and is available for free download from the Division's website (Micropaleo Consultants 2005). Appendix A of this best interest finding contains descriptions of the formations referenced in the stratigraphic column for the area modified by Hite (2004) (Figure 6.1); units are described in stratigraphic order from oldest to youngest.

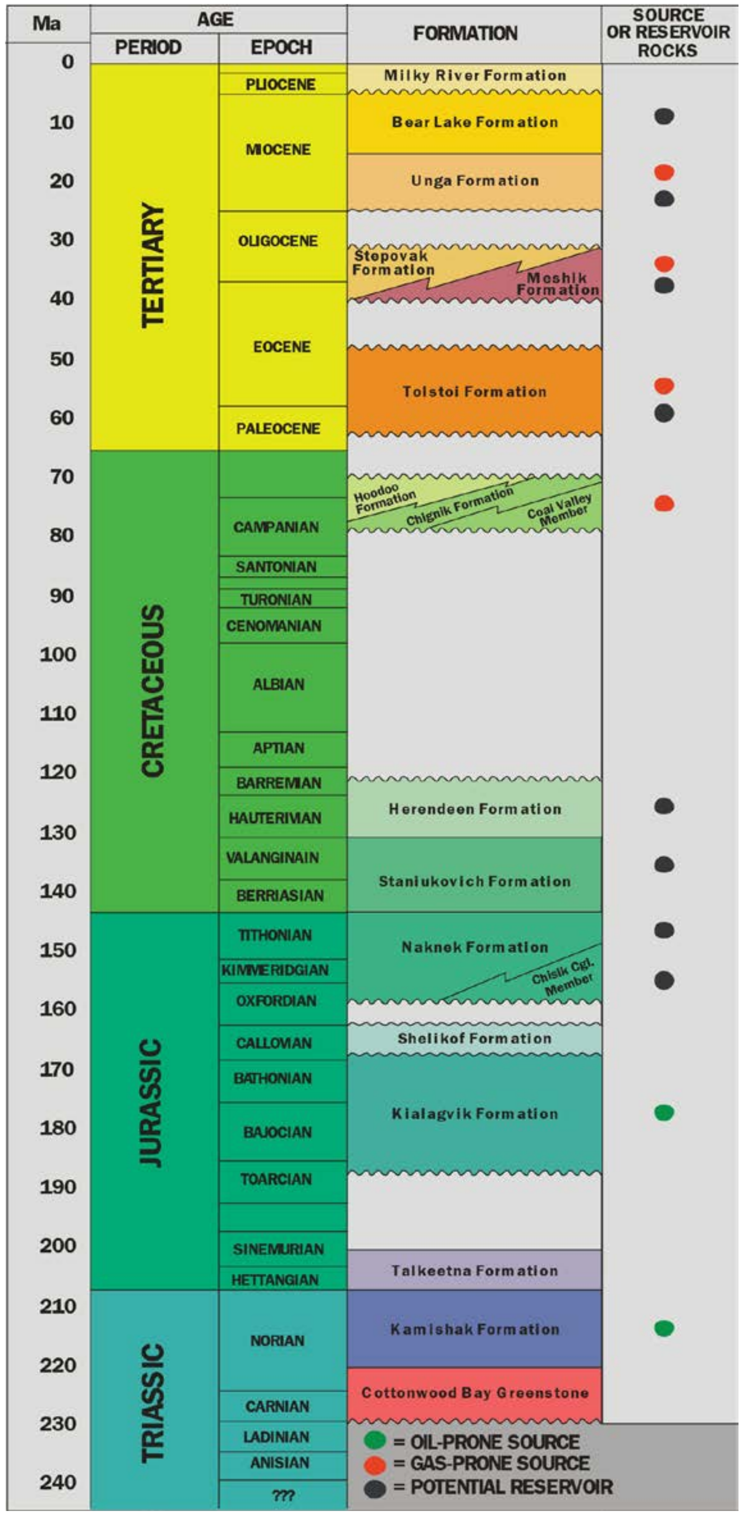


Figure 6.1 Stratigraphic Column Modified by Hite (2004)

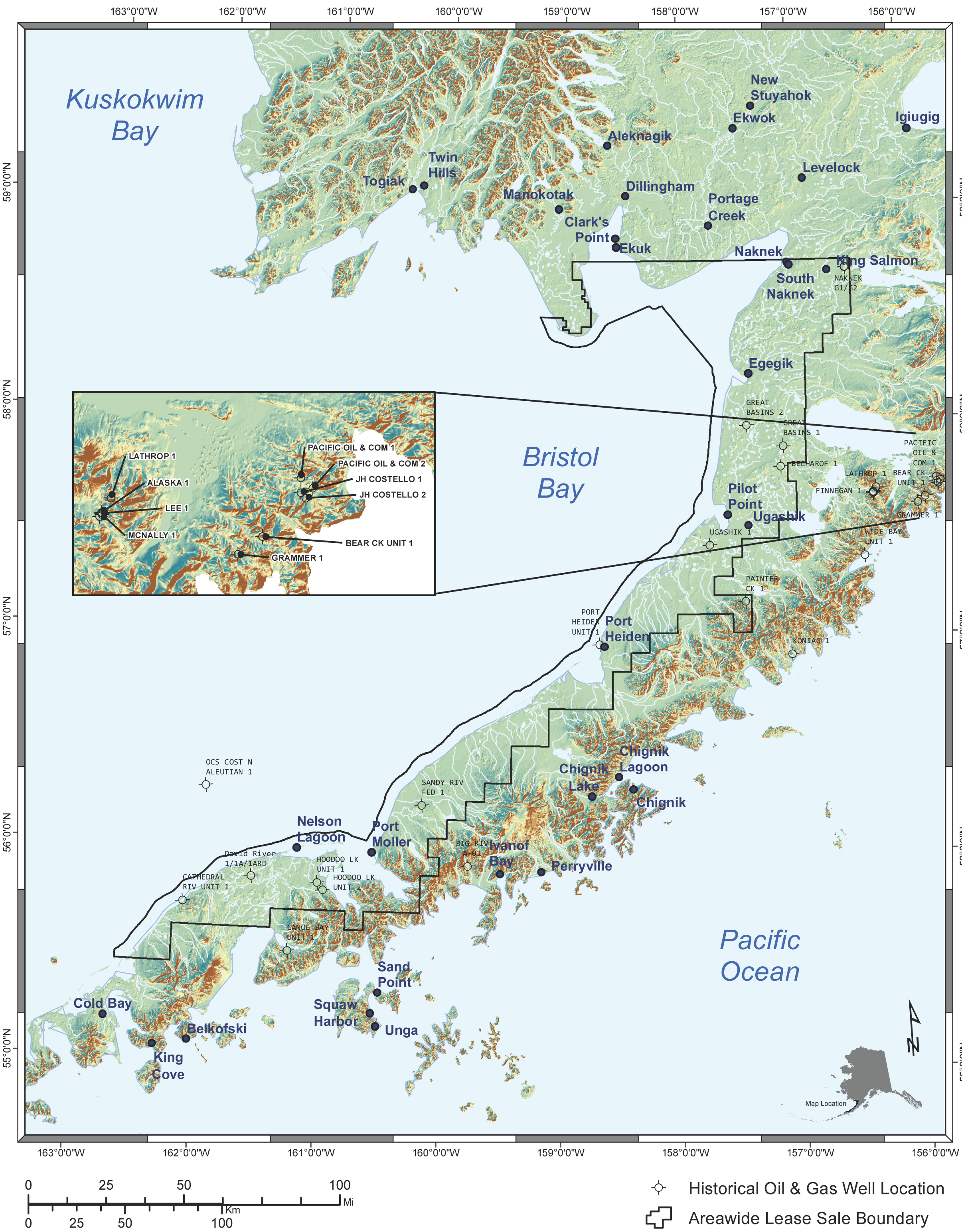
B. Exploration History

Oil and gas seeps were first discovered in the region on the Iniskin Peninsula on the west side of Cook Inlet by Russians around 1855. On the Alaska Peninsula, oil and gas seeps are mostly concentrated near the Wide Bay area on the southeastern side of the peninsula south of Becharof Lake (see Blodgett and Clautice 2005 for detailed locations and descriptions). Surface petroleum seeps in this area have been clearly linked to Mesozoic oil and gas source rocks (Magoon and Anders 1992; Decker 2008).

The Alaska Peninsula was first explored in the early 1900s and the first wells were drilled on the southeast side near active oil and gas seeps. Exploration shifted to the northwest side of the Alaska Peninsula in the late 1950s through early 1980s. Since 1902, 35 exploration wells have been drilled, 11 of which are within the boundary of the sale area. Only four wells were drilled between 1977 and 1985. The two most recent wells drilled in the region were the North Aleutian COST 1, completed in offshore Federal waters in 1983, and the Amoco Becharof 1, drilled on state acreage in 1985.

Concern, over potential damage to the prolific wild salmon fishery in Bristol Bay, halted hydrocarbon exploration throughout the area from 1985 until 2005 when the State first offered onshore and nearshore acreage for lease in the Alaska Peninsula areawide sale. In that first sale, the state received bids on 37 tracts. Shell Offshore Inc. bid on 33 tracts and Hewitt Mineral Corp. bid on four tracts. All 37 tracts leased were contiguous in the Nelson Lagoon, Herendeen Bay, and Port Moller Areas. In 2007, Hewitt Mineral Corp. acquired one tract, southwest of Herendeen Bay, adjacent to their previously leased acreage. Shell Offshore Inc. relinquished their leases on October 20, 2008 and Hewitt Minerals Corp. relinquished their leases on October 25, 2010. No other companies have bid on state acreage in the annual Alaska Peninsula areawide lease sales since 2007. To date, no development, production, or transportation has taken place.

Although nearly all the wells in the area have had at least modest shows of oil and/or gas, to date there have been no commercial oil or gas discoveries or sustained production from state lands on the peninsula (Map 6.1). While oil and gas prone source rocks are clearly present and functioning in areas containing flowing oil and gas seeps, their subsurface distribution and maturity are unknown in other areas. This creates uncertainty regarding reservoir quality, thermal maturity, and the location and integrity of both structural and stratigraphic traps. Recent industry focus appears to be on natural gas as a more likely product than oil, and industry recognizes that much of the gas potential is offshore beneath the federal waters of Bristol Bay (Decker 2006).



Map 6.1 Historical Well Locations In and Near the Alaska Peninsula Sale Area

Based on very little data, the U.S. Geological Survey (USGS) estimated mean undiscovered, technically recoverable onshore Alaska Peninsula resources very conservatively, at 9 MMSTB (million stock tank barrels) of oil and 188 BCF (billion cubic feet) of gas (USGS 1996). That assessment assigned a 32% chance (0.32 marginal probability) that the area is capable of producing at least one technically recoverable accumulation. The term ‘technically recoverable’ does not consider economic factors related to the cost of drilling or producing hydrocarbons. Having participated in field and subsurface petroleum systems research in the region, DO&G staff are of the opinion that future resource assessments, if informed by a robust, regionally extensive grid of modern seismic data, would likely result in much higher estimates of undiscovered oil and gas.

C. Oil and Gas Potential

Appendix A contains detailed information regarding source rock, reservoir, and trap potential. Below are the overview and conclusions regarding oil and gas potential in the Alaska Peninsula sale area.

1. Overview of the Petroleum Systems Approach

The basic elements of a functional petroleum system are effective sources, reservoirs, and traps. The presence of these three elements by themselves does not ensure that a viable hydrocarbon system will be present. The elements must also interact with each other properly to create oil or gas accumulations.

Source rocks contain kerogen, organic material that is predominantly composed of carbon and hydrogen, the main ingredients in oil and gas. In order to form oil or gas, a source rock must be buried deep enough and long enough in an area of the basin that geochemists refer to as the ”kitchen”, where the proper range of temperature and pressure converts kerogen into hydrocarbons. Generation of the oil or gas in the source rock creates excess pressure which expels hydrocarbons out of the source rock. At that point, because it is lighter than and does not mix with the water saturating the surrounding rock, it tends to migrate upward, either directly or along a more indirect route, following the most permeable pathways it encounters.

A reservoir rock is a porous and permeable rock (typically sandstone or a carbonate rock type such as limestone or dolomite) that can effectively store oil or gas. Less permeable rocks are sometimes suitable reservoirs for gas or lighter oil, since those fluids flow more easily than normal or heavy crude oil. An important consideration for assessing potential reservoir rocks in the Alaska Peninsula are the composition and diagenesis (chemical alteration) of the volcanic rock fragments that comprise a significant percentage of framework grains in many of the sandstones in the area. Formations buried less deeply are more likely to have better preserved primary porosity.

The reservoir rock must be contained in a sealing configuration called a trap, which allows hydrocarbons to migrate into the reservoir, but prevents it from escaping, thereby creating an oil or gas accumulation. Effective containment inside the trapping configuration requires an effective seal, generally a clay or mudstone layer that forms an impermeable barrier at the top of the trap that prevents hydrocarbons from escaping.

Conventional trapping configurations are generally either structural or stratigraphic. Structural traps are formed by deformation of originally flat-lying, planar strata to create either anticlines (up-warped layers) or fault-bounded compartments, forming large concave-down shapes that allow buoyant oil or gas to migrate upward and accumulate. Stratigraphic traps result when porous and permeable reservoir rock is bounded both above and to the side(s) by impermeable seal rocks, simply due to the way the different sediment types were deposited. There are also traps that are a combination of structural and stratigraphic configurations. Effective traps must be created prior to hydrocarbon generation, expulsion, and migration from the kitchen and remain intact, uncompromised by later folding, faulting, or excessive burial in order to host a productive oil or gas field (Decker 2006).

Further subsurface work is required to determine whether all three of the critical petroleum system elements (source rocks, reservoirs, and traps) are present, effective, and have interacted with favorable timing to form viable hydrocarbon traps in the Alaska Peninsula sale area. The area remains dramatically underexplored for oil and gas, and the question can only be answered through additional exploration drilling of prospects mapped using modern, high-quality 2-D and/or 3-D seismic surveys. The remote location of the Alaska Peninsula presents logistical and economic challenges for exploration and development operations.

2. Conclusions

Recent work by DNR geologists demonstrates that the Alaska Peninsula sale area likely contains all the essential elements of petroleum systems (effective hydrocarbon sources, reservoirs, and traps) and offers reasonable hydrocarbon potential. There is uncertainty about the timely combination of petroleum system elements to create major economic hydrocarbon accumulations, but concerted exploration would likely discover recoverable hydrocarbons in Tertiary reservoirs, and potentially in some Mesozoic units. Some of the challenges are due to the tectonic setting, provenance, depositional and burial history, and diagenesis of the area. Limitations in data availability (the lack of regional onshore seismic surveys and sparse well control) pose significant challenges to defining drillable prospects.

Though past exploration has not yielded commercial production, there are indications that the necessary components of active petroleum systems may be present in both Mesozoic and Cenozoic sequences. Source presence and effectiveness are demonstrated by the presence of significant oil and heat producing gas seeps in Mesozoic units, and by subsurface thermogenic (generated by heat) and biogenic (generated by bacteria) gas shows in Tertiary units in wells. Mesozoic sandstones are degraded by zeolites, but may function as tight-gas reservoirs, particularly in the presence of favorable fracture systems, and the carbonates of the Triassic Kamishak Formation may locally develop reservoir quality. Reservoir presence and effectiveness is much more promising in Tertiary formations, in particular the Miocene Bear Lake Formation, as confirmed by classification and porosity permeability analyses of outcrop and well samples. The area's complex stratigraphic and structural history suggests that structural and unconformity-related stratigraphic trapping configurations are likely present. Seal capacity studies demonstrate that both Mesozoic and Cenozoic formations could contain significant hydrocarbon columns (Reifenstuhl 2008).

D. Stages of Oil and Gas Resource Development

The entire process of locating oil and gas and bringing it to market can be separated into stages: exploration, development and production, and transportation. These stages may occur simultaneously on any part of the lease or unit. Whether exploration and eventual development will occur in the sale area depends on several factors, such as the subsurface geology of the area, a company's worldwide exploration strategy, the projected price of oil and gas and their market demand, and other economic, environmental and logistical factors. Geology dictates the extent of exploration. Several dry holes (drilling that results in no substantial hydrocarbons encountered) can discourage further exploration in an area. Whether a lessee proceeds with exploration of an area may depend on the area's priority when weighed against the lessee's other worldwide commitments. If extensive exploration does occur in an area, and an accumulation is discovered, development and production will only proceed if the lessee finds the risks acceptable, given the potential costs. This depends on the price of oil and gas, the lessee's development costs, and the cost of getting the oil and gas to market. As stated above, the remote location of the Alaska Peninsula presents logistical and economic challenges for exploration and development operations.

1. Disposal

Oil and gas lease sales are a first step in developing the state's oil and gas resources. Annually, DO&G prepares and presents a 5-year program of oil and gas lease sales to the legislature. DO&G also conducts annual competitive areawide lease sales, offering for lease all available state acreage within five areas. A lease sale area is divided into tracts, and interested parties that qualify may bid on one or more tracts.

Although beyond the scope of this best interest finding, exploration licensing supplements the state's areawide oil and gas leasing program by targeting areas outside of known oil and gas provinces. The intent of licensing is to encourage exploration in areas far from existing infrastructure, with relatively low or unknown hydrocarbon potential, where there is a higher investment risk to the operator. Because bonus payments are required to win a lease, lease sales held in some of these higher-risk areas tend to attract little participation. Exploration licensing gives an interested party the exclusive right to conduct oil and gas exploration without this initial expense. Through exploration licensing, the state receives valuable subsurface geologic information on these regions and, should development occur, additional revenue through royalties and taxes (AS 38.05.131-134).

2. Exploration

Oil and gas resource exploration begins with gathering information about the petroleum potential of an area by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. The surface analysis includes the study of surface topography or the natural surface features, and near-surface structures revealed by examining and mapping nearby exposed rock layers. Geophysical surveys, primarily seismic, help reveal the characteristics of the subsurface geology. Geophysical exploration and exploration drilling are likely activities that could result in potential effects to the sale area.

Seismic exploration and related activities do not require a disposal decision, lease, or approval of the exploration phase, but do require the appropriate authorizations. For example, seismic exploration would require a land use permit issued by DNR. Exploration can also happen at any time. Activities associated with exploration can occur simultaneously, before, after, or even during disposal and development and production. Exploratory drilling, on the other hand, would occur after disposal and require a plan of operations and DO&G approval before a lessee began any on-the-ground work. In the meantime, other operations such as production activities may have already been approved and may be occurring on another part of the lease or unit.

a. Geophysical Exploration

Seismic surveys are the most common type of geophysical exploration. Energy is emitted at the survey location into the subsurface and reflected seismic waves are recorded at the surface geophones and/or hydrophones (vibration-sensitive devices). Different rock layers beneath the surface have different velocities and densities. This results in a unique seismic profile that can be analyzed by geophysicists to interpret subsurface structures and petroleum potential. Advancements in seismic sensors and recording systems technology have resulted in higher definition and greater productivity. In addition, it is anticipated this will create greater efficiency in exploration with fewer effects on the environment (New Developments in Upstream Oil and Gas Technologies 2011).

Additional geophysical techniques can be used to gather information specifically about very near surface geology, usually to identify drilling hazards. They include high-resolution shallow seismic, side-scan sonar, fathometer recordings and shallow coring programs. High-resolution shallow seismic surveys are specifically designed to image the bottom of a water body and very shallow geology. They employ a lower energy seismic source and a shorter cable than surveys targeting deeper oil and gas potential.

b. Drilling Exploration

Exploratory drilling often occurs after seismic surveys are conducted, and review of the seismic and geologic data indicates possible oil and gas prospects. Drilling is the only way to learn whether a prospect contains commercial quantities of oil or gas, and helps determine whether to proceed with development. Drilling operations collect well logs, core samples, cuttings, and a variety of other data. A well log is compiled by lowering measuring instruments in a well bore and taking measurements at various depths. Well logs can also be recorded while drilling. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled.

One way to take readings is through Measurements While Drilling (MWD) technology. Tools at the end of the drilling apparatus may include gyroscopes, magnetometers, and accelerometers. These provide real-time drilling information such as wellbore position, drillbit information, directional data, and borehole inclination and azimuth during drilling. These data are transmitted to the surface through pulses through the mud column and electromagnetic telemetry. Data are decoded at the surface and transmitted to an offsite location. This allows drilling engineers to make important decisions while drilling (Rigzone 2013).

3. Development and Production

During development, operators evaluate exploratory drilling results and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. The fluids undergo operations to purify, measure, test and transport. Pumping, storage, handling, and processing are typical production processes (Van Dyke 1997). The final project parameters will depend on the surface location, size, depth, and geology of a specific commercial discovery.

After exploration wells have been drilled, a process called extended reach drilling (ERD) may be used during production. ERD can be used for both onshore and offshore reservoirs. ERD is already being used in Prudhoe Bay, Alaska to access offshore reservoirs using drilling rigs from land (New Developments in Upstream Oil and Gas Technologies 2011). ERD not only reduces wellsite footprints and minimizes environmental effects, but also improves reservoir drainage at the least cost (Schlumberger 2013).

Production facilities contain oil and gas production equipment located within their boundaries (EPA 2011). On the well site, these may include processing facilities to remove some of the water produced with the petroleum, water and sewage treatment equipment, power generators, drilling rigs, and support buildings and housing for workers. Support facilities may include a production facility to receive and treat or transport the oil and gas to markets, refineries, or shipment to other processing facilities located in the lower 48 states and elsewhere. Other support facilities may include a supply base and transportation system for cement, mud, water, food, and other necessary items.

4. Subsurface Oil and Gas Storage

Under AS 38.05.180(u), the Commissioner of DNR may authorize the subsurface storage of oil or gas to avoid waste or to promote conservation of natural resources. In Alaska, depleted reservoirs with established well control data are preferred storage zones. By memorandum dated September 2, 2004, the Commissioner approved a supplement to Department Order 003 and delegated the authority to authorize subsurface storage of oil or gas to the Division of Oil and Gas Director.

Subsurface storage of gas increases reliability of gas delivery to all sources of demand. The need for gas storage also depends upon access to transportation, pipeline infrastructure, existing production infrastructure, gas production sources, and delivery points. A subsurface storage authorization allows the storage of gas and associated substances in the portions of the gas storage formation, subject to the terms and applicable statutes and regulations, including mitigation measures and advisories incorporated by reference into the authorization. It does not matter whether the oil or gas is produced from state land, so long as storage occurs in land leased or subject to lease under AS 38.05.180.

5. Transportation

Transportation is also a phase of oil and gas resource development. See the next section for further discussion.

E. Likely Methods of Oil and Gas Transportation

AS 38.05.035(g)(1)(B)(viii) requires the director to consider and discuss the method or methods most likely to be used to transport oil or gas from the sale area, and the advantages, disadvantages and relative risks of each. Any oil or gas ultimately produced from leases will have to be transported to market. It is important to note the decision to lease oil and gas resources in the state does not authorize the transportation of any oil or gas. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transporting will be made through the local, state, and federal permitting process.

No oil or gas will be transported from the sale area until the lessee has obtained the necessary permits and authorizations from federal, state, and local governments. The state has broad authority to withhold, restrict, and condition its approval of transportation facilities. In addition, the federal and local governments may have jurisdiction over various aspects of any transportation alternative.

Modern oil and gas transportation systems may consist of pipelines, marine terminals with offshore loading platforms, trucks, and tank vessels. The location and nature of oil or gas deposits determine the type and extent of facilities needed to develop and transport the resource. Due to the limited road system in the sale area, the most likely method of transportation will include pipelines, marine terminals and tanker vessels. Currently, truck transportation is not an option although its possibility is discussed below. A general overview of the likely transportation methods is discussed below.

1. Pipelines

One method of transporting oil is by pipeline. Pipelines may be onshore or offshore. Onshore pipelines may be buried or unburied. Buried pipelines, over which the ground is normally reseeded, are advantageous because they do not pose an obstacle to wildlife or result in scenic degradation. However, buried pipelines are more expensive to install and to maintain than unburied pipelines. This is especially true in regards to inspection, repair and maintenance (SPCO 2011). Spills may result from pipeline leaks in either buried or unburied pipelines, and leak detection systems play a primary role in reducing discharges of oil from either system. Elevated pipelines offer more ways to monitor the pipeline such as ground inspection, visual air inspections, ground-based infrared (IR) and airborne forward-looking infrared (FLIR) surveys. In-Line Inspection (ILI) can be used for both aboveground and belowground crossings, but is the only practical method for belowground installations (SPCO 2011).

Offshore pipelines usually do not hinder water circulation and minimally affect fish and wildlife habitat. Weighted pipelines are used in areas where tidal currents are exceptionally strong. Marine arctic pipelines are usually trenched and buried (C-CORE 2008). This technique is advantageous because it may offer a way to avoid creating a navigational hazard or being damaged by ship anchors, by sea ice, or by trapping fishing nets. In deeper water, weighted pipelines may be disadvantageous because they may become silted-in or self-buried. A disadvantage of sub-sea pipelines is that they are expensive to build and maintain. They can be difficult to monitor for leaks, defects, and corrosion problems, however significant advances have been made in recent years.

Sophisticated monitoring methods now available can overcome many disadvantages of subsea pipelines. Some of these include:

- volumetric flow measurement;
- pressure monitoring;
- pressure measurement with computational analysis;
- external oil detection;
- remote sensing;
- geophysical sensing techniques;
- pressure or proof testing;
- pipe integrity checking (i.e., smart pigging);
- visual inspection; and
- through-ice borehole sampling.

Many of these methods are considered to be proven technology while others are still under development (C-CORE 2008).

2. Marine Terminals

If oil or gas must be transported across marine waters by tanker, a marine terminal is necessary. Crude oil terminal facilities generally store quantities of oil equivalent to several large tanker loads. Therefore, a disadvantage of transporting oil or gas by tanker is the possibility for a very large spill at these facilities. A strong earthquake or other natural disaster could damage the facilities and initiate a large spill. The risk of explosion or sabotage at the facilities also exists. Accidental ballast discharge or loading or unloading accidents could also cause a spill. However, environmental risks have been minimized through improved design, construction, operating techniques and spill prevention measures.

The fixed location of loading facilities at marine terminals improves spill response and contingency planning. With constant staffing, leaks are easier to detect than with some pipelines. For example, the Valdez Marine Terminal is staffed 24 hours a day and its oil response crews are trained to conduct land and water response operations. Even though a spill from a tanker is the responsibility of the tanker owner, Alyeska Pipeline Service Company provides initial response. Spill prevention measures include (APSC 2011):

- training;
- extensive inspection programs;
- monitoring of transfer operations;
- facility security programs;
- use of proper valves and overfill alarms;
- secondary and tertiary containment systems around the tanks; and
- drug and alcohol testing of personnel.

3. Tank Vessels

Deep water ports are required for tanker operations; it is therefore anticipated that any future tanker operations associated with the Alaska Peninsula would be located on the south side of the peninsula (MOU 2003a; USFWS 1985, 1988). The biggest disadvantage for tankers is the potential for a large oil spill, although in recent years spills from pipelines outnumber those from tankers (Etkin 2009). More recently, data indicate tanker spillage continues to decline despite an overall increase in oil trading (ITOPF 2012; Anderson et al. 2012).

Tankers are also used to transport natural gas. Liquefied natural gas (LNG) is methane that has been cooled to an extremely cold temperature (-260° F/ -162.2° C), where it becomes liquid. At standard atmospheric conditions, methane is a vapor. LNG is stored and transported exclusively at cryogenic temperatures, so it is maintained in a liquid state, facilitating storage and transportation. LNG should not be confused with NGL (Natural Gas liquid) or LPG (liquefied petroleum gas), which are transported at near ambient temperature.

4. Trucks

Transporting oil and gas by pipeline is safer than trucks on roadways when measured by incidents, injuries, and fatalities (Furchtgott-Roth 2013). Between 2011 and 2012 trucks moving oil to refineries within the United States and Canada has increased by 38% (IER 2013). The road system in the sale area is very limited. The Southwest Alaska Transportation Plan (SWATP) addresses the various transportation needs for communities in and around the sale area. In particular is the Cook Inlet to Bristol Bay corridor. A narrow existing road between Williamsport and Pile Bay has not been adequately maintained and several bridges need upgrading. Before this corridor can be completed, several individual smaller projects must be completed first. According to the SWATP, only three northern segments of the six proposed segments in this corridor are likely to be constructed in the next 10 years. They have most engineering and environmental documentation completed while the other segments are conceptual (DOT&PF 2004).

In part, due to changing levels of state and federal funding for transportation improvements, the SWATP is being updated. It includes a public involvement process, and is expected to be developed over a two-year period. Phase I of the planning project focuses on gathering information and identifying key issues and needs to be addressed in the transportation plan. Phase II's focus will be on evaluating various transportation system improvements to resolve issues or meet needs identified in Phase I. Overall, the plan will evaluate the best way to invest public infrastructure spending in Southwest Alaska (DOT&PF 2011). Further review of the DOT&PF website, SWATP, and SWATP update indicates the Cook Inlet to Bristol Bay corridor is being reevaluated and depending upon funding and need, may not be completed for many years (DOT&PF 2014).

The federal government is the major source for transportation funding in Alaska. DOTPF is responsible for prioritizing, arranging, and administering the majority of capital projects. The State of Alaska pays for maintenance and operations for State roadways, but does not dedicate revenue to transportation purposes. The Alaska legislature maintains a large degree of control over State transportation programs and priorities. DOTPF projects and programs must compete each year with other social and infrastructure needs for money from the General Fund (DOT&PF 2004).

5. Summary

The mode of transportation from a discovery will be an important factor in determining whether or not a discovery can be economically produced. The more expensive a given transportation option, the larger a discovery will have to be for economic viability. Oil and gas produced from the sale area would likely be transported by a system of gathering lines, processing facilities, marine terminal, and tankers. Because there has been no oil or gas production on the Alaska Peninsula to date, a transportation system of wells, gathering lines, processing facilities, terminals, other infrastructure, and tankers would have to be constructed. If resources are discovered and developed, more detailed transportation options, such as exact routes, locations, and size of facilities, would need to be evaluated.

F. Oil Spill Risk, Prevention, and Response

1. Introduction

AS 38.05.035(g)(1)(B)(vii) requires the director to consider and discuss lease stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the leases, and a discussion of the protections offered by these measures. The mitigation measures related to release of oil and hazardous substances were developed after the director considered the risk of oil spills, methods for preventing spills, and techniques for responding to spills. The director also weighed whether it was in the state's best interest to hold lease sales on the Alaska Peninsula. Mitigation measures can be found in Chapter Nine.

For most of the last 40 years or so, oil spill rates in U.S. waters have decreased as a result of prevention oriented regulations and voluntary industry initiatives. As of 2007, U.S. pipelines spilled considerably more than tankers and barges. Also, as of 2007 over nine times as much oil was released from natural seeps as was spilled from all sources, and spills attributable to public consumers input more oil into U.S. waterways annually than the Exxon Valdez oil spill did (Etkin 2001, 2009).

The largest offshore spills also decreased in size from 1964 through early 2010, a period of over 45 years. In 2010, improvements in the spill record were broken by the Macondo spill in the Gulf of Mexico. When calculating the spill volume for all offshore spills, the Macondo spill size overwhelmed the rest of the record. Its volume was more than 8.5 times the cumulative that had been spilled in the previous 46 years (Anderson et al. 2012).

From 1996-2010, Outer Continental Shelf (OCS) oil production moved into deepwater. For example, in 1996 deepwater oil production in the Gulf of Mexico was just under 20% of the total oil produced in that region. In 2010, that deepwater percentage increased to 81% (Anderson et al. 2012). Meanwhile onshore, about 85% of oil that does spill from inland pipelines goes to containment areas around breakout tanks or to solid ground rather than surface waters. Also, spillage from coastal facilities often includes oil that spills into secondary containment. These containment systems provide essential lines of defense in preventing oil from spreading and reaching waterways and temporary containment of the spilled oil until a response can begin (Etkin 2009).

Gas and other hazardous substances may be released in a well blowout. A well blowout can take place when high pressure gas is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that gas or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers, which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and work-over rigs and are routinely inspected by AOGCC (AS 46.04.030). Blowout preventers greatly reduce the risk of a gas release. If a release occurs, however, the released gas will dissipate unless it is ignited by a spark. Ignition could result in a violent explosion.

Each well has a blowout prevention program developed before the well is drilled. Operators review bottom-hole pressure data from existing wells in the area and seismic data to learn what pressures might be expected in the well to be drilled. Engineers use this information to design a drilling mud program with sufficient hydrostatic head to overbalance the formation pressures from surface to the total depth of the well. They also design the casing strings to prevent various formation conditions from affecting well control performance.

2. Risk

Any time crude oil or petroleum products are handled there is a risk that a spill might occur. Oil spills associated with the exploration, development, production, storage and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels and other vehicles used in exploration and development activities.

Although there is a risk spills will result from exploration, production, storage, and transportation of oil and gas, these risks can be mitigated through prevention and response plans such as the Unified Plan and Subarea Contingency Plans (DEC 2001, 2009, 2010).

3. Prevention

Information gleaned from past spills has led to increased emphasis on prevention rather than response alone. Contingency planning, exercise and practice programs, improved safety standards, and other measures have helped reduce U.S. spillage (Etkin 2001).

For example, the Alaska Department of Environmental Conservation (DEC) and the U.S. Coast Guard are working on a multi-stage risk assessment of maritime transportation in the Bering Sea and Aleutian Archipelago. From this collaboration, came the Aleutian Islands Risk Assessment. It is a two phase approach that includes a Preliminary Risk Assessment (Phase A) followed by a Focused Risk Assessment (Phase B) (AIRA 2013). The Phase A Summary Report has been completed (AIRA 2011).

Risk Reduction Options (RRO) were analyzed and discussed in Phase A. Two key principles were applied to the RRO analysis: (1) prevention measures take priority over response measures, and (2) all measures should support the basis for the Advisory Panel's recommendations. These recommendations were presented to the U.S. Coast Guard, State of Alaska, and local governments. Which measures will be adopted rests with these agencies (AIRA 2011).

4. Response

Response plans in relation to the sale area are included in the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan), the Aleutians Subarea Contingency Plan (AL SACP), and the Bristol Bay Subarea Contingency Plan (BB SACP) (DEC 2001, 2009, 2010).

A Unified Command structure of the Incident Command System (ICS) is the basis for government response and organization in the State of Alaska. The Unified Command brings together the Federal On-Scene Coordinator (FOSC), the State On-Scene Coordinator (SOSC), and the Responsible Party's Incident Commander into one governing unit. If an immediate threat still exists to the health and safety of the local populace the Local On-Scene Coordinator (LOSC) will also be brought in (DEC 2001, 2009).

Response objectives include (DEC 2001, 2009, 2010):

- ensure safety of responders and the public;
- stop the source of the spill;
- deploy equipment to contain and recover the spilled product;
- protect sensitive areas (environmental, cultural, and human use);
- track the extent of the spill and identify impacted areas;
- cleanup contaminated areas and properly dispose of wastes;
- notify and update the public; and
- provide avenues for community involvement where appropriate.

Federal response action priorities/strategies general guidelines include (DEC 2001, 2009, 2010):

- safety of life;
- safety of vessel, facility and cargo;
- control sources of discharge;
- limit spread of pollution; and
- mitigate effects of pollution.

DEC, Division of Spill Prevention and Response is responsible for ensuring facilities prevent spills and take proper response actions when spills occur. One of their programs is the Prevention and Emergency Response Program (PERP). Its mission statement is as follows (DEC 2011):

> Protect public safety, public health and the environment by preventing and mitigating the effects of oil and hazardous substance releases and ensuring their cleanup through government planning and rapid response.

Because of statutory requirements, the State of Alaska implemented the following Response Objectives (DEC 2001, 2009, 2011):

- **safety**—ensure the safety of all persons involved in a response or exposed to the immediate effects of the incident;
- **public health**—ensure the protection of public health from the direct or indirect effects of contaminated drinking water, air or food;
- **environment**—ensure the protection of the environment, including natural and cultural resources, from the direct or indirect effects of contamination;
- **cleanup**—ensure adequate containment, control, cleanup and disposal by the responsible party, or take over the response when cleanup is judged inadequate;\
- **restoration**—ensure the assessment of damages from contamination and the restoration of property, natural resources and the environment; and
- **cost recovery**—ensure the recovery of costs and penalties for reimbursement to the Oil and Hazardous Substance Release Prevention and Response Fund for use in Future emergency response actions.

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Chapter Seven: Governmental Powers to Regulate Oil and Gas

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Chapter Seven: Governmental Powers to Regulate Oil and Gas

AS 38.05.035(g)(1)(B)(v) requires the director to consider and discuss the governmental powers to regulate the exploration, development, production, and transportation of oil and gas or gas only. An oil and gas lease grants the lessee exclusive rights to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. However, an oil and gas lease does not authorize activities on the lease. First, the lease and regulations require a plan of operations or unit plan of operations to be approved before any activities or operations may be undertaken on or in the leased area (11 AAC 83.158). Further, oil and gas activities are subject to numerous laws, regulations, policies, and ordinances. Regulatory agencies may have different roles in the oversight and regulation of oil and gas activities; although some agencies may have overlapping authorities.

This chapter does not provide a comprehensive description of the multitude of laws and regulations that may be applicable to oil and gas activities. Rather, it illustrates the broad spectrum of authority various government agencies have to prohibit, regulate, and condition activities related to oil and gas. Actual requirements and processes, terms, and conditions may vary. Lessees are responsible for knowing and complying with applicable laws, regulations, policies, and ordinances.

In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires, under paragraph 26, that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases are subject to all future laws and regulations in effect after the effective date of the leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

State of Alaska

A. Department of Natural Resources (DNR)

DNR has several agencies that approve, oversee, or coordinate activities related to oil and gas.

1. Plan of Operations Approval (DO&G)

Operations undertaken on or in the leased area are regulated by 11 AAC 83.158, 11 AAC 83.346, and the lease. They require the lessee to prepare plans of operations that must be approved by DO&G before the lessee begins work. DNR requires a plan of operations that meet the lease requirements and applicable regulations. Each plan of operations is site-specific and is tailored to the proposed activity. DO&G may make field inspections to monitor and assess compliance.

When it considers a plan of operations, DO&G may require stipulations in addition to the mitigation measures developed through the written finding (11 AAC 83.158(e), 11 AAC 83.346(e)). These additional stipulations may address site-specific concerns directly associated with the proposed operations. The lease stipulations and the terms and conditions of the lease are attached to the plan of operations approval and are binding on the lessee. The lease also requires that the lessee keep the lease area open for inspection by authorized state officials. DNR, DEC, ADF&G, and AOGCC may monitor field activities for compliance with each agency's terms. In addition, each permittee must post a bond before beginning operations (11 AAC 83.160).

2. Geophysical Exploration Permit (DO&G)

The geophysical exploration permit is a land use permit issued by DO&G under 11 AAC 96.010. Seismic surveys related to oil and gas development are the most common activity authorized by this permit. Submission of seismic exploration and stratigraphic test data to the state is a permit condition (11 AAC 96.210). Under AS 38.05.035(a)(8)(C), the permittee may request that geological and geophysical data be kept confidential. Under 11 AAC 96.030(a), "the application must contain the following information in sufficient detail to allow evaluation of the planned activities' effects on the land:

(1) … a map at a sufficient scale showing the general location of all activities and routes of travel of all equipment for which a permit is required;

(2) a description of the proposed activity, any associated structures, and the type of equipment that will be used."

DO&G may require security depending on the applicant's history of compliance and potential risk to the state (11 AAC 96.060).

A geophysical exploration permit is usually issued for a single survey season, but may be extended. If extended, the director may modify existing terms or add new ones. A permit remains in effect for the term issued, but may be revoked. A permit may be revoked for cause for (1) a violation of a permit provision or (2) a violation of 11 AAC 96. A permit is revocable at will if DO&G determines that revocation is in the state's interest. DO&G will give 30 days' notice before revoking a permit at will (11 AAC 96.040(a)).

3. Pipeline Rights-of-way

The State Pipeline Coordinator's Office (SPCO) administers the Alaska Right-of-Way Leasing Act and issues leases on state land for pipeline rights-of-way (AS 38.35.210). Most oil and gas transportation facilities within the lease area or beyond its boundaries must be authorized by SPCO. As prescribed by AS 38.35.010, SPCO issues leases on state land for pipeline rights-of-way (SPCO 2012a).

4. Alaska Petroleum Systems Integrity Office (PSIO)

The PSIO is the lead state agency for oversight of facilities, equipment, and infrastructure for the sustained production and transportation of oil and natural gas resources in the state. The PSIO was established in 2007 by executive order of the governor to:

(1) ensure that oil and gas infrastructure is designed and maintained in a safe and environmentally sound manner in compliance with state law;

(2) minimize economic impacts of unplanned interruptions in oil and gas production to the ongoing functions of state government;

(3) avoid premature abandonment of oil and gas infrastructure and waste of state resources; and

(4) ensure efficient and effective oversight of oil and gas industry practices by utilizing existing state government structures and processes to the maximum extent possible.

Through designated agency liaisons, PSIO leads interagency efforts to evaluate industry system integrity performance. Designated agencies, to the extent authorized by state regulations, require oil and gas producers and operators to provide comprehensive descriptions of current practices of quality control, quality assurance, monitoring, and inspection used to ensure the integrity and reliability of oil and natural gas facilities, equipment, infrastructure and activities.

The goal of PSIO is to provide a comprehensive and cost-effective approach to statewide oil and gas oversight activities, and to address any gaps in oversight. PSIO is tasked with ensuring that overarching quality management programs are in place and followed, both within industry and involved state agencies. The PSIO makes recommendations to the commissioner of DNR regarding gaps, findings and issues that address the reliability and system integrity of oil and gas infrastructure (PSIO 2012).

Additionally, the Petroleum Systems Integrity Office Coordinator (PSIOC) makes recommendations to the DNR commissioner regarding enforcement actions by DNR and cases to be referred to other state, local, or federal agencies for appropriate civil or criminal penalties available under the law (PSIO 2007).

5. Bristol Bay Area Plan

Area plans are developed by DNR's Resource Assessment and Development Section within the Division of Mining, Land, and Water. AS 38.04.065 requires that state land be classified through a planning process prior to the issuance of an authorization such as a sale or lease (excluding oil and gas lease sales), and that this process provide for meaningful public participation. Area plans directly affect surface activities on state land and may include certain requirements relating to the subsurface, but they are primarily focused on the management of surface uses and resources.

The lease area is located within the Bristol Bay Area Plan (BBAP), which guides DNR in managing state uplands and shorelands within the planning boundary. The plan allocates land uses and resources within the planning area and also identifies surface land disposal locations, land use classifications, and establishes management guidelines for these uses, which include minerals, settlement, material sites, sensitive habitat, and wetland areas. The uses and resources of the BBAP include those uses that are generally allowed on state land, which include but are not limited to subsistence, sport hunting and fishing, recreation and tourism, and those land uses and resources noted above. The plan also reviews mining, coal, and oil and gas potential and describes the statutory authorities that affect mining, coal development, and oil and gas extraction (DMLW 2005; 2013).

6. Temporary Water Use Authorization (DMLW)

Exploration activities may require a temporary water use authorization. DMLW administers temporary water use authorizations as required under 11 AAC 93.035 before (1) the temporary use of a significant amount of water, (2) if the use continues for less than five consecutive years, and (3) the water applied for is not otherwise appropriated (DMLW 2012). The volume of water to be used and permitted depends upon whether it is for consumptive or non-consumptive uses, and the duration of use. The authorization may be extended one time for good cause for a period of time not to exceed five years.

The authorization may be suspended or terminated if necessary to protect the water rights of other persons or the public interest. Information on lake bathymetry, fish presence, and fish species may be required when winter water withdrawal is proposed to calculate the appropriate withdrawal limits.

7. Permit and Certificate to Appropriate Water (DMLW)

Industrial or commercial water use requires a Permit to Appropriate Water under 11 AAC 93.120. The permit is issued for a period of time consistent with the public interest and adequate to finish construction and establish full use of water. The maximum time period for this permit is five years, unless the applicant proves or the commissioner independently determines that a longer period is required. The commissioner may issue a permit subject to terms, conditions, restrictions, and limitations necessary to protect the rights of others, and the public interest. Under 11 AAC 93.120(e), permits are subject to conditions to protect fish and wildlife habitat, recreation, navigation, sanitation or water quality, prior appropriators, or any other purpose the department determines is in the public interest.

A Certificate of Appropriation will be issued under 11 AAC 93.130 if the permit holder:

(1) submits a statement of beneficial use stating that the means necessary for the taking of water have been developed and the permit holder is beneficially using the quantity of water to be certified, along with the required fee; and

(2) has substantially complied with all permit conditions.

8. Land Use Permits (DMLW)

DMLW issues land use permits and may require them for all oil and gas activities unless activities are otherwise approved under a plan of operations. Land use permits can be issued for periods up to five years, depending on the activity.

In accordance with 11 AAC 96.025, "a generally allowed use listed in 11 AAC 96.020 is subject to the following conditions:

(1) activities employing wheeled or tracked vehicles must be conducted in a manner that minimizes surface damage;

(2) vehicles must use existing roads and trails whenever possible;

(3) activities must be conducted in a manner that minimizes

(A) disturbance of vegetation, soil stability, or drainage systems;

(B) changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes; and

(C) disturbance of fish and wildlife resources;

(4) cuts, fills, and other activities causing a disturbance listed in (3)(A) - (C) of this section must be repaired immediately, and corrective action must be undertaken as may be required by the department;

(5) trails and campsites must be kept clean; garbage and foreign debris must be removed; combustibles may be burned on site unless the department has closed the area to fires during the fire season;

(6) survey monuments, witness corners, reference monuments, mining location posts, homestead entry corner posts, and bearing trees must be protected against destruction, obliteration, and damage; any damaged or obliterated markers must be reestablished as required by the department under AS 34.65.020 and AS 34.65.040;

(7) every reasonable effort must be made to prevent, control, and suppress any fire in the operating area; uncontrolled fires must be immediately reported;

(8) holes, pits, and excavations must be repaired as soon as possible; holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, or mining leasehold locations may be left open but must be maintained in a manner that protects public safety; and

(9) on lands subject to a mineral or land estate property interest, entry by a person other than the holder of a property interest, or the holder's authorized representative, must be made in a manner that prevents unnecessary or unreasonable interference with the rights of the holder of the property interest."

9. Material Sale Contract (DMLW)

If the operator proposes to use state-owned gravel or other materials for construction of pads and roads, DMLW requires a material sale contract (11 AAC 71). The contract must include, at a minimum, a description of the sale area; the volume of material to be removed from the sale area; the method of removal of the material; the bonds and deposits required of the purchaser; and the purchaser's liability under the contract. The material sale contract must also include the purchaser's site-specific operating requirements.

The contract must state the material will be extracted. A contract may be extended before its expiration if the DMLW director determines the delay in completing the contract is due to unforeseen events beyond the purchaser's control, or the extension is in the state's best interests.

In connection with a material sale, the DMLW director may require the purchaser to provide a performance bond that guarantees performance of the terms of the contract. If required, the bond amount will be based on the total value of the sale. The performance bond must remain in effect for the duration of the contract unless released in writing by the director.

10. Office of History and Archaeology (OHA)

OHA does the work of the State Historic Preservation Office (SHPO) (OHA 2012a). OHA follows the state's Historic Preservation Plan in maintaining the Alaska Heritage Resources Survey (AHRS), an inventory of all reported historic and prehistoric sites within the state. This inventory includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction (OHA 2012b). Before beginning a project, information regarding important cultural and historic sites can be obtained by contacting the OHA. The AHRS data sets are "restricted access documents" and specific site location data should not appear in final reports or be distributed to others.

AS 41.35.010 declares it is the policy of the state to preserve and protect the historic, prehistoric, and archeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in these resources may pass undiminished to future generations. Further, the historic, prehistoric, and archeological resources of the state are properly the subject of concerted and coordinated efforts exercised on behalf of the general welfare of the public in order that these resources may be located, preserved, studied, exhibited, and evaluated.

It is unlawful for a person to appropriate, excavate, remove, injure, or destroy, without a permit from the Commissioner, any historic, prehistoric, or archaeological resources of the state (AS 41.35.200(a)).

A person may be charged with criminal mischief in the third degree if a person knowingly:

(A) "defaces, damages, or desecrates a cemetery or the contents of a cemetery or a tomb, grave or memorial regardless of whether the tomb, grave, or memorial is in a cemetery or whether the cemetery, tomb, grave, or memorial appears to be abandoned, lost, or neglected;" and

(B) "removes human remains or associated burial artifacts from a cemetery, tomb, grave, or memorial regardless of whether the cemetery, tomb, grave, or memorial appears to be abandoned, lost, or neglected" (AS 11.46.482(a)(3)).

A person convicted of violating a provision of AS 41.35.010 – .240 is guilty of a class A misdemeanor. In addition to other penalties and remedies provided by law, a person who violates these provisions is subject to a maximum civil penalty of $100,000 for each violation.

11. Bristol Bay Fisheries Reserve (BBFR)

AS 38.05.140(f) established the BBFR. This includes both submerged and shorelands. A surface entry permit to develop an oil and gas lease may not be issued on state owned or controlled land until the legislature by appropriate resolution specifically finds that the entry will not constitute a danger to the fishery.

B. Department of Environmental Conservation (DEC)

DEC has statutory responsibility to conserve, improve, and protect Alaska's natural resources and environment, by regulating air, land, and water pollution, and oil spill prevention and response. DEC implements and coordinates several federal regulatory programs in addition to state laws (DEC 2012d).

1. Interference with Salmon Spawning Permits

DEC is responsible for granting or denying permits for activities that interfere with salmon spawning streams and waters. If a person plans to obstruct, divert, or pollute waters of the state utilized by salmon in the propagation of the species, they must first apply for and obtain a permit before beginning any activities (AS 16.10.010).

Permits may be granted if DEC finds the purpose of the permit is to develop power, obtain water for civic, domestic, irrigation, manufacturing, mining, or other purposes tending to develop the state's natural resources. The applicant may also be required to construct and maintain adequate fish ladders, fishways, or other means by which fish may pass over, around, or through the dam, obstruction, or diversion in the pursuit of spawning.

2. Air Quality Permits

DEC administers the federal Clean Air Act (42 USC 85 §§7401-7761q) and the state's air quality program under a federally-approved State Implementation Plan (AS 46.14; 18 AAC 50) (EPA 2012b). Through this plan, the state is responsible for compliance with Clean Air Act requirements found in the National Ambient Air Quality Standards (NAAQS), New Source Review (NSR), New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and Prevention of Significant Deterioration (PSD). Additionally, DEC monitors air quality and compliance.

The NAAQS limits pollutants considered harmful to public health and the environment (EPA 2012d). Limits have been defined for principal pollutants, or criteria pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter (PM10), particulate matter (PM2.5), ozone, and sulfur dioxide. NSR, a permitting program required for new construction projects, ensures that air quality is not degraded by the new project, and that large new or modified industrial sources will be as clean as possible (EPA 2012g). NSPS promotes use of the best air pollution control technologies available, and it accounts for the cost of technology and any other non-air quality, health, and environmental impact and energy requirements (EPA 2012f). NESHAPs are set for air pollutants that are not covered by NAAQS, but that may be harmful (EPA 2012e). The standards are categorized by type of source, and require the maximum degree of reduction in emissions that is achievable, as determined by the EPA.

The two primary types of permits issued to meet these requirements are Title I Construction Permits and Title V Operation Permits (DEC 2012a). Permits specify what activities are allowed, what emission limits must be met, and may specify how the facility must be operated. Permits may contain monitoring, recordkeeping, and reporting requirements for assessing whether the applicant meets the permit requirements (DEC 2012a).

a. Title I (NSR) Construction Permits

Title I permits incorporate air quality requirements for the PSD as well as other requirements of the Clean Air Act. This permit must be obtained before onsite construction can begin. Title I permits are required for projects that are new major sources for pollutants, or major modifications at existing sources. PSD requires installation of the "Best Available Control Technology (BACT)"; an air quality analysis; an additional impacts analysis; and public involvement (EPA 2012j).

The permitting process includes a pre-application meeting between the applicant and DEC, several DEC reviews, a Technical Analysis Report, and a 30-day public comment period, after which DEC may issue a final permit. The final permit includes a final Technical Analysis Report and response to comments. The Title I process can take up to three years, depending on the amount of meteorological data collection required.

b. Title V Operations Permits

The EPA has authority, under the Clean Air Act, to limit point-source emissions (EPA 2012i). EPA regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit to operate the facility, known as a Title V permit. In Alaska, DEC issues Title V permits and inspects for compliance (AS 46.14; 18 AAC 50; DEC 2012a). The permit limits the type and amount of emissions allowed, establishes requirements for pollution control devices and prevention activities, and for monitoring and record keeping (DEC 2012a).

Operators have one year after beginning operations to submit their completed Title V permit application. Operations can continue while DEC processes the application. However, significant revisions to an existing permitted facility cannot be made until DEC approves the permit revision. Processing time for permit revisions can take up to six months. Title V permits and revisions can be processed concurrently with Title I permits.

3. Solid Waste Disposal Permit

DEC regulates solid waste storage, treatment, transportation, and disposal under 18 AAC 60. EPA administers the Resource Conservation and Recovery Act (RCRA) relating to hazardous wastes and UIC Class I injection wells. A different state agency, the AOGCC, regulates UIC Class II oil and gas waste management wells.

DEC requires a comprehensive disposal plan for all solid waste disposal facilities it regulates. Solid waste disposal permit applications are reviewed for compliance with air and water quality standards, wastewater disposal, and drinking water standards, and their consistency with the Alaska Historic Preservation Act before approval.

Non-drilling related solid waste must be disposed of in an approved municipal solid waste landfill (MSWLF). MSWLFs are regulated under 18 AAC 60.300 – .398. All other solid waste (except for hazardous materials) must be disposed of in an approved monofill (18 AAC 60.400 – .495).

Drilling waste disposal is specifically regulated under 18 AAC 60.430. Design and monitoring requirements for drilling waste disposal facilities are identified in 18 AAC 60.430(c) and (d).

All produced waters must be reinjected down well or treated to meet Alaska Water Quality Standards before discharge.

Hazardous substances to be disposed have a separate permitting and review process by both DEC under 18 AAC 62 and 63 and the EPA.

4. Wastewater Disposal Permit

Domestic graywater must be disposed of properly at the surface and requires a wastewater disposal permit (18 AAC 72). Monitoring records must be available for inspection, and a written report may be required upon completion of operations.

5. APDES Discharge Permits and Certification

DEC administers the Alaska Pollution Discharge Elimination System (APDES) program. This program regulates discharges of pollutants into U.S. waters by "point sources," such as industrial and municipal facilities. Permits are designed to maximize treatment and minimize harmful effects of discharges.

APDES covers a broad range of pollutants, which are defined as "any type of industrial, municipal, and agricultural waste discharged into water" (18 AAC 83.990).

There are two basic types of APDES permits: general permits and individual permits. General permits cover multiple facilities that are similar. Individual permits are issued for a defined time period, not exceeding five years, and the facility must reapply for the permit before it expires.

6. Industry Oil Discharge Prevention and Contingency Plans

DEC regulates spill prevention response under AS 46.04.030 (DEC 2012e). ADF&G and DNR support DEC in these efforts by providing expertise and information. Contingency plans (C-plans) must be filed with DEC before beginning operations. DNR reviews and comments to DEC regarding the adequacy of these C-plans (DEC 2012c).

C-plans for exploration facilities must include a description of methods for responding to and controlling blowouts, the location and identification of oil spill cleanup equipment, the location and availability of suitable drilling equipment, and an operations plan to mobilize and drill a relief well. Holders of approved plans are required to have sufficient oil discharge containment, storage, transfer, cleanup equipment, personnel, and resources to meet the response planning standards for the particular type of facility, pipeline, tank vessel, or oil barge (AS 46.04.030(k)). If development and production follow, additional contingency plans must be filed for each facility before beginning work.

Discharges of oil or hazardous substances must be reported to DEC recording the volume released, whether the release is to land or to water, and whether the release has been contained by a secondary containment or structure. The discharge must be cleaned up to DEC's satisfaction. DEC will modify proposed cleanup techniques or require additional cleanup techniques for the site as DEC determines to be necessary to protect human health, safety, and welfare, and the environment (18 AAC 75.335(d)).

C-plans must describe existing and proposed means of detecting oil discharge, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). C-plans must include: a Response Action Plan, a Prevention Plan, and Supplemental Information to support the response plan, including a Best Available Technology Section (18 AAC 75.425). Operators must also provide proof of financial ability to respond in damages (AS 46.04.040).

C. Alaska Department of Fish and Game (ADF&G)

1. Fish Habitat Permit

Under AS 16.05.871(b) a Fish Habitat Permit is required before doing any work that would affect an anadromous fish stream, including operating vehicles or equipment in the stream bed, blasting, or using, diverting, obstructing, polluting or changing the natural flow or bed of an anadromous river, lake or stream. Under AS 16.05.841, a permit is required to ensure that any stream frequented by any fish is not obstructed in any way that would block fish passage.

2. Hazing Permit

Under AS 16.05.920, a permit to haze that may include the actual taking of some species may be issued for public safety or spill response.

3. Special Area Permit

Any land or water use activities in a special area that may impact fish, wildlife, habitats, or existing public use may require a permit (5 AAC 95.420) (ADF&G 2013). Examples of activities requiring a permit include, but are not limited to: construction or placement of structures; damaging or clearing vegetation; detonation of explosives (other than firearms); surface or shoreline altering activities; natural resource development or energy exploration; off-road use of wheeled or tracked equipment; boat storage; waste disposal; andy any activity likely to have a significant effect on vegetation, drainage, water quality, soil stability, fish and wildlife, or their habitat, or which disturbs fish or wildlife. Special areas are described as refuges, sanctuaries, or critical habitat areas.

D. Alaska Oil and Gas Conservation Commission (AOGCC)

The Alaska Oil and Gas Conservation Act, AS 31.05, created the Alaska Oil and Gas Conservation Commission (AOGCC). AOGCC was established to prevent waste, protect correlative rights, improve ultimate recovery, and protect underground freshwater.

Among its other duties, AOGCC issues permits and orders, and administers the Underground Injection Control (UIC) Program for the State of Alaska, as the delegated authority of the federal Safe Drinking Water Act.

1. Permit to Drill

A permit to drill from AOGCC is often the last step in the overall approval process of drilling a well, and usually occurs after all of the other agencies have given their approval. The application must be accompanied by the items set out in 20 AAC 25.005(c).

AOGCC will notify the applicant if there are any deficiencies in the application. The operator will either supplement the original application with revised or additional information, or, in the event that substantive changes are needed, resubmit the entire application (AOGCC 2012a).

2. Underground Injection Control Program (UIC)

The AOGCC regulates Class II wells in Alaska through a Memorandum of Understanding with the EPA. The goal of the UIC program is to protect underground sources of drinking water from contamination by oil and gas (Class II) injection activities. The three types of Class II wells are oilfield waste disposal wells, enhanced oil recovery (EOR) wells, and hydrocarbon storage wells. AOGCC reviews and takes appropriate action on proposals for the underground disposal of Class II oil field wastes (20 AAC 25.252). Before receiving an approval, an operator must demonstrate that injected fluids will not move into freshwater sources. Disposal or storage wells must be cased and the casing cemented so it will isolate the disposal or storage zone and protect oil, gas, and freshwater sources (AOGCC 2012a).

Once approved, liquid waste from drilling operations may be injected through a dedicated tubing string into the approved subsurface zone. The pumping of drilling wastes through the annular space of a well is an operation incidental to drilling the well, and is not a disposal operation subject to regulation as a Class II well.

3. Annular Disposal of Drilling Waste

An AOGCC permit is required if waste fluid is to be injected into a well annulus. The material must be muds and cuttings incidental to the drilling of a well. AOGCC considers the volume, depth, and other physical and chemical characteristics of the formation designated to receive the waste. Annular disposal is not permitted into water bearing zones where dissolved solids or salinity concentrations fall below predetermined threshold limits. Waste not generated from a hydrocarbon reservoir cannot be injected into a reservoir (AOGCC 2012a).

4. Disposal Injection Orders

Operators may apply for disposal injection orders to dispose of waste in individual wells. After the public review process and AOGCC analysis, an order may be issued that approves the proposed disposal project (AOGCC 2012a).

5. Area Injection Orders

Injection orders may be issued on an area basis rather than for individual wells in areas where greater activity is anticipated. The area injection orders describe, evaluate, and approve subsurface injection for enhanced oil recovery and disposal purposes (AOGCC 2012a).

E. Department of Labor and Workforce Development (DOLWD)

The Alaska Department of Labor and Workforce Development (DOLWD) administers the Alaska Employment Security Act under AS 23.30 and 8 AAC 85.

DOLWD also administers some delegated authorities of the Occupational Safety and Health Administration (OSHA), PL-91-596, 1970. Section 18 of the law, State Jurisdiction and State Plans, allows states to obtain approval to assume responsibility for development and enforcement of federal occupational safety and health standards. DOLWD has obtained approval from OSHA for administration of some of the federal OSHA standards (OSHA 2012; DOLWD 2012).

Federal

F. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) implements, administers, or oversees programs and federal environmental regulations. These programs, some of which are delegated to the states, safeguard the nation’s air, land, and water.

1. Air Quality Permits

DEC administers the federal Clean Air Act and the air quality program for the State of Alaska under a federally-approved State Implementation Plan (see Section B2) (EPA 2012a).

2. Hazardous Waste (RCRA) Permits

The federal Resource Conservation and Recovery Act (RCRA) manages hazardous wastes. Regulations set the parameters for transporting, storing, and disposing of hazardous wastes, and for designing and operating treatment, storage, and disposal facilities safely. Regulations are enforced through inspections, monitoring of waste handlers, taking legal action for noncompliance, and providing compliance incentives and assistance (EPA 2012c).

Some states may receive authorization to administer parts of the program, which requires that state standards be at least as strict as federal standards. EPA administers the RCRA program in Alaska.

3. NPDES Discharge Permit

DEC administers this EPA program, now titled APDES (see section B). Permits specify the type and amount of pollutant, and include monitoring and reporting requirements, so that discharges do not harm water quality and human health.

4. Underground Injection Control (UIC) Class I and II Injection Well Permits

EPA regulates injection wells used to dispose of fluid wastes pumped into the well (EPA 2012k). Authorized as part of the federal Safe Drinking Water Act of 1974, EPA's Underground Injection Control (UIC) program protects underground sources of drinking water from being contaminated by the waste injected in the wells. Injection wells are categorized into five classes; Classes I and II are most common in the oil and gas industry. EPA administers the program for Class I wells in Alaska, and authority for Class II oil and gas wells has been delegated to AOGCC.

All injections falling into Class I must be authorized through EPA's UIC Class I program. Class I wells operate under a permit that is valid for up to 10 years. Permits stipulate requirements for siting, construction, operation, monitoring and testing, reporting and record keeping, and closure. Requirements differ among wells depending on whether they accept hazardous or non-hazardous wastes (EPA 2012k).

G. U.S. Army Corps of Engineers (COE)

1. Section 10 and Section 404 Permits

The COE regulates construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work which would affect the course, location, condition, or capacity of those waters (Rivers and Harbors Acts of 1890 [superseded] and 1899 [33 USC 401, et seq.; Section 10 [33 USC 403]; COE 2012b). Section 10 permits cover oil and gas activities, including exploration drilling from jack-up drill rigs and installation of production platforms.

Section 404 of the Clean Water Act regulates discharge of dredged and fill material into United States waters and wetlands. This program is administered by COE, which is authorized to issue Section 404 permits for discharging dredge and fill materials.

Permits issued for specific projects are the basic type of permit issued. General permits (including programmatic, nationwide, and regional general permits) authorize activities that will result in minimal individual and cumulative adverse effects. General permits carry a standard set of stipulations and mitigation measures. Letters of permission, another type of project authorization, are used when the proposed project will not have significant individual or cumulative environmental impact, and appreciable opposition is not expected (COE 2012a; COE 2012b).

Section 404 and Section 10 permits follow a similar three-step review process: pre-application consultation for major projects, formal project review, and decision making.

In making a final decision to issue a permit, COE considers conservation, economics, aesthetics, wetlands, cultural values, navigation, fish and wildlife values, water supply, water quality, and other factors judged important to the needs and welfare of the people (COE 2012a; COE 2012b).

The process for letters of permission is shorter. In this situation, the proposal is coordinated with fish and wildlife agencies and adjacent property owners who might be affected by the project, but the public at large is not notified (COE 2012a; COE 2012b).

DEC reviews Section 404 and 10 permit applications for compliance with Alaska water quality standards. If the applications comply, DEC approves the permit.

Permits may also be reviewed by other agencies, such as USFWS and NMFS, to ensure compliance with the Endangered Species Act, the National Environmental Policy Act, and Essential Fish Habitat Provisions of the Magnuson-Stevens Act.

H. Pipeline and Hazardous Materials Safety Administration (PHMSA)

The Federal Office of Pipeline Safety (OPS) in the Pipeline and Hazardous Materials Safety Administration (PHMSA), an agency of the U.S. Department of Transportation regulates movement of hazardous materials by pipeline (PHMSA 2012b). Federal PHMSA inspectors review technical issues on hazardous liquid pipelines in Alaska (PHMSA 2012a). The 2006 PIPES Act requires hazardous liquid pipeline operators to develop integrity management programs for transmission pipelines.

I. Fish and Wildlife Service (USFWS)

USFWS is a part of the Department of the Interior and dedicated to the conservation of natural resources. It has management authority for migratory birds, threatened and endangered species, the national wildlife refuge system, and on lands under their jurisdiction, landscape conservation and aquatic resources (USFWS 2012b). USFWS issues permits related to migratory birds and endangered species, with the goal of managing risks and benefits of projects by using best available science and expertise. Permits may authorize activities consistent with conservation, protection and enhancement of wildlife, plants, and their habitats (USFWS 2012a)

J. National Oceanic and Atmospheric Administration (NOAA) Fisheries

Formerly known as the National Marine Fisheries Service, NOAA Fisheries manage species under the Marine Mammal Protection Act and issue permits for the incidental take or harassment of marine mammal species (NOAA 2014a). NOAA Fisheries' Alaska Region oversees sustainable fisheries that produce about half the fish caught in U.S. waters, covering 842,000 square nautical miles off Alaska (NOAA 2014b).

K. U.S. Coast Guard

The U.S. Coast Guard has authority to regulate offshore oil pollution under 33 CFR §§153-157 and to make a determination of a hazard to navigation under 33 CFR §64.31.

L. Regulations of Oil Spill Prevention and Response

Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC §9605), and §311(c)(2) of the Clean Water Act, as amended (33 USC §1321(c)(2)) require environmental protection from oil spills. CERCLA and the Clean Water Act require a National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300; 33 USC

§1321(d)). Under these regulations, the violator must plan to prevent and immediately respond to oil and hazardous substance spills and be financially liable for any spill cleanup. If the pre-designated Federal On-Scene Coordinator (FOSC) determines that the response is neither timely nor adequate, the federal government will respond to the spill, and then seek to recover cleanup costs from the responsible party.

The Oil Pollution Act of 1990 (OPA 1990) requires the development of facility and tank vessel response plans and an area-level planning and coordination structure to coordinate federal, regional, and local government planning efforts with the industry. OPA 1990 amended the Clean Water Act (§311(j)(4); 33 USC §1231(j)) and established regional citizen advisory councils (RCACs) and area contingency plans as the main parts of the national response planning structure.

The Alaska Regional Response Team (ARRT) is an advisory board to the FOSC. It provides processes for participation by federal, state and local governmental agencies to participate in response to pollution incidents (DEC 2010). The Unified Plan is the area contingency plan for Alaska. Since Alaska is so large and geographically diverse, the federal agencies have found it necessary to prepare subarea contingency plans.

M. Alaska National Interest Lands Conservation Act (ANILCA) Title VIII. Section 811

ANILCA ensures that rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public land.

N. Native Allotments

Lessees are subject to applicable federal law concerning Native allotments. Activities proposed in a plan of operations must not unreasonably diminish the use and enjoyment of lands within a Native allotment. Before entering lands subject to a pending or approved Native allotment, lessees must contact the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) and obtain approval to enter.

Local Government

O. Borough Governmental Powers

1. Aleutians East Borough (AEB)

The Aleutians East Borough (AEB) has adopted a Municipal Code, as authorized under Section 29.26.010 of the Alaska statutes, and is published as Ordinance 88-1, Section 1.04, 1987 (AEB 1987a). The planning, platting and land use ordinances are under Title 40, to implement the policies of the Borough’s Comprehensive Plan, and establish land use regulations (AEB 1987b). The comprehensive plan was adopted and consists of several reports, maps and documents (AEB 1987b).

2. Bristol Bay Borough (BBB)

The Bristol Bay Borough (BBB) has adopted Title 18, Land and Land Development, through Ordinance 2010-07, as authorized under Section 29.25.050 (prior law Section 29.48.180) of the Alaska Statutes (BBB 2010). The Borough’s Code is published as Ordinance 76-37, Section 1, 1977. Any oil and gas exploration activities that include clearing, grading, excavation or fill require an approved clearing and grading permit (BBB 2010). Detailed planning and approval is required for activities in areas located in critical habitats, important streams, lakes or wetlands, and may require review and approval by other state and federal agencies. Marine facilities, ports and transportation uses are subject to Chapter 19.04, Marine Facilities. BBB may assert its land management powers to the fullest extent permissible under law to address any outstanding concerns regarding impacts to the area's fish and wildlife species, habitat, and subsistence activities.

3. City of Dillingham, Dillingham Census Area

The City of Dillingham adopted the Dillingham Municipal Code, through Ordinance 2011-08 (City of Dillingham 2012). Title 18, Planning and Land Use Regulation manages land, water and resource related activities in the municipality, as authorized under Section 29.25.050 of the Alaska Statutes. The Dillingham Municipal Code is published as Ordinance 78-7, Section 3, 1978; Ordinance 84-8, 1984; and Ordinance 86-7, Section 1, 1986. The Planning Commission prepared a comprehensive plan, adopted in 1985, that guides land use and development in Dillingham, Chapter 2.68.180 and Chapter 18.04. Construction oversight requires prior notification to the city for new construction, new electrical, heating, wood, oil, and propane-burning equipment. Land use permits are issued under Title 18, Planning and Land Use Regulation.

The Port of Dillingham is administered under Title 2.42.010, for the purpose of protecting and preserving lives, health, safety and well-being of the users and property owners. Oil and gas vessel and port activities are subject to municipal codes for the port.

4. Lake & Peninsula Borough (L&PB)

The Lake & Peninsula Borough (L&PB) adopted a Municipal Code, as authorized under Section 29 of the Alaska Statutes (L&PB 2009a). The Lake and Peninsula Municipal Code is published as Ordinance 89-01, 5/20/89. The planning powers are administered under Title 9. This directs implementation of the Comprehensive Plan through systematic development of the Borough, as adopted October, 2009 (L&PB 2009a). The Borough enforces mitigation for land and water use activities to prevent and reduce adverse effects and/or cumulative impacts on resources (L&PB 2009b). The Borough has an active coastal management program that guides land and water use in coastal areas. The planning commission has oversight for capital improvements, land use regulations, and overall economic and physical development of the communities and Borough (L&PB 2012).

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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. <u>Effects of Seismic Surveys, Construction, Discharges, and Other Activities on Habitats</u>

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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Chapter Nine: Mitigation Measures

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Chapter Nine: Mitigation Measures

To ensure that these lease sales are in the state's best interest (AS 38.05.035(e)), operations will be conditioned by mitigation measures which will be attached to any leases issued and are binding on the lessee. These measures were developed to mitigate potential effects of lease-related activities, considering all information made known to the director. Additional measures may be imposed when the lessee submits a proposed plan of operations (11 AAC 83.158(e) and 83.346(e). The director may consult with local government organizations and other agencies in implementing the mitigation measures below. Lessees are subject to applicable local, state, and federal laws and regulations, as amended.

The director may grant exceptions to these mitigation measures. Exceptions will only be granted upon a showing by the lessee that compliance with the mitigation measure is not practicable and that the lessee will undertake an equal or better alternative to satisfy the intent of the mitigation measure. Requests and justifications for exceptions must be included in the plan of operations application as specified by the application instructions, and decisions of whether to grant exceptions will be made during the plan of operations review.

A. Mitigation Measures

1. Facilities and Operations

a. To ensure system integrity, oil and gas facilities, including pipelines, must be designed using industry-accepted engineering codes and standards. Technical submittals to the Division that reflect the "practice of engineering", as defined by AS 08.48.341, must be sealed by a professional engineer registered in the state of Alaska.

b. The siting of facilities, other than docks, roads, utility or pipeline corridors, or terminal facilities is prohibited within one-half mile of the coast and 500 feet of all fish bearing waterbodies. Additionally, siting of facilities is prohibited within one-half mile of the banks of Igushik, Naknek, Egegik, King Salmon (tributary to Egegik River), Ugashik, King Salmon (tributary to Ugashik River), Cinder, Meshik, Ilnik, Sandy, Bear, Nelson, Caribou, and Sapsuk rivers, Becharof and Ugashik lakes. Facilities may be sited, on a case-by-case basis, within the one-half mile buffer if the lessee demonstrates that siting of such facilities outside this buffer zone is not feasible or prudent, or that a location within the buffer is environmentally preferable, but in no instance will a facility be located within one-quarter mile of the river bank. ADF&G consultation is required for siting within the one-half mile buffer. Road and pipeline crossings must be aligned perpendicular or near perpendicular to watercourses.

c. Exploration roads, pads, and airstrips must be temporary unless the Director approves a proposed alternative. Use of gravel roads, pads, and airstrips may be permitted on a case-by-case basis by the director, in consultation with DMLW and ADF&G. Approval for use of existing structures will depend on the extent and method of restoration needed to return these structures to a usable condition.

d. Pipelines must use existing transportation corridors where conditions permit. In areas with above ground placement, pipelines must be designed, sited, and constructed to allow for the free movement of wildlife. Gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

e. Drilling in offshore tracts will only be conducted directionally from onshore locations.

f. Pipelines that must cross marine waters will be constructed beneath the marine waters using directional drilling techniques. Offshore pipelines must be located and constructed to prevent obstruction to marine navigation and fishing operations.

g. Exploration activities must utilize existing road systems, where practicable, or vehicles that do not cause significant damage to the ground surface or vegetation. Construction of temporary roads may be allowed on a case-by-case basis.

2. Fish and Wildlife Habitat

a. The Director, in consultation with ADF&G, will impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important moose and caribou calving and wintering areas during approval of a plan of operations.

b. To minimize impacts to migrating birds and to important water fowl habitats in Kvichak Bay, Egegik Bay, Ugashik Bay, Cinder River Estuary, Port Heiden, Seal Islands, Lagoon, Port Moller, Herendeen Bay, and Nelson Lagoon, exploration, development, and major maintenance within these areas will only be allowed between November 16 and March 31. Routine maintenance and emergency repairs will be permitted on a year-round basis during the production phase. A detailed plan describing routine maintenance activities between April 1 and November 15 in these areas must be included in the plan of operations.

3. Subsistence, Commercial and Sport Harvest Activities

a. Lease-related use will be restricted if necessary to prevent unreasonable conflicts with fish and wildlife harvest activities.

4. Fuel and Hazardous Substances

a. During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to five gallons, must be on hand during any transfer or handling of fuel or hazardous substances.

b. Vehicle refueling will not occur within the annual floodplain, except as addressed and approved in the plan of operations. This measure does not apply to water-borne vessels.

c. New solid waste disposal sites, other than for drilling waste, will not be approved or located on state property for exploration.

5. Access

a. Public access to, or use of, the lease area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related structures. Areas of restricted access must be identified in the plan of operations.

B. Definitions

Facilities- Any structure, equipment, or improvement to the surface, whether temporary or permanent, including, but not limited to, roads, pads, pits, pipelines, power lines, generators, utilities, airstrips, wells, compressors, drill rigs, camps, and buildings.

Hazardous substance- As defined under 42 USC 9601 – 9675 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980).

Plan of operation- A lease plan of operations under 11 AAC 83.158 and a unit plan of operations under 11 AAC 83.346.

Practicable- Feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the mitigation measure.

Temporary- No more than 24 months.

Appendix A: Additional Geological Information for the Alaska Peninsula

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Appendix A. Additional Geological Information for the Alaska Peninsula

A. Description of Stratigraphic Units

Formations known or expected to underlie the State lease sale area are described below in stratigraphic order. The amount of detail provided here is in proportion with the amount of new work conducted beyond the detailed stratigraphic descriptions provided in Detterman and others (1996) and Wilson and others (1999). The discussion of the Cottonwood Bay Greenstone is from Detterman and others (1996). The discussion of the Kamishak Formation and reservoir and petroleum systems properties are based on the work of Whalen and Beatty (2008). The discussion of source rock potential is based on the work of Decker (2008). The description of potential hydrocarbon seals is based on the work of Bolger and Reifenstuhl (2008). Results of petrographic analyses by Helmold and others (2005, 2008) and Finzel and others (2005) are included within the formation descriptions. Additional information about the hydrocarbon reservoir and source rock potential of the lease sale area for the Bear Lake and Milky River formations is based on the work of Finzel and others (2005).

References in text reference citations are listed at the end of Chapter 6.

1. Mesozoic Units

Mesozoic sedimentary rocks of the Chignik subterrane form most of the exposed portion, or upland outcrop belt, along the Alaska Peninsula. The Mesozoic strata (layers) range in age from Late Triassic to Late Cretaceous with a maximum combined thickness of about 8,500 m (Detterman et al. 1996). The Mesozoic units known or expected to underlie the proposed lease sale area ascend in layers or stratigraphic order (sequence of deposition) beginning with the Kamishak Formation from the Upper Triassic period. The other formations and ages include the Talkeetna Formation (Lower Jurassic), Kialagvik Formation (Middle Jurassic), Shelikof Formation (Middle Jurassic), Naknek Formation (Upper Jurassic), Staniukovich Formation (Lower Cretaceous), Herendeen Formation (Lower Cretaceous), Chignik Formation (Upper Cretaceous), and the Hoodoo Formation (Upper Cretaceous). Unconformities are numerous among these stratigraphic units, representing episodes of erosion and/or non-deposition during portions of Early Jurassic, early Late Jurassic, and mid- to Late Cretaceous time (USGS 1996).

Where the base of the Mesozoic succession is exposed at Cape Kekurnoi near Puale Bay, limestones of the Upper Triassic Kamishak Formation inconsistently overlie an unnamed Permian agglomerate, volcaniclastic sandstone, and fossiliferous limestone unit (Blodgett and Sralla 2008). The Kamishak limestones were deposited under tropical conditions (Blodgett and Sralla, 2008), and contain exceptionally rich oil-source potential (Wang 1987; Decker 2008). The remainder of the Mesozoic sedimentary succession consists primarily of clastic rocks rich in volcanic and plutonic framework components deposited adjacent to an island arc (Detterman et al. 1996).

The Mesozoic sedimentary rocks are predominantly marine in origin. In the lower part of the section, the Lower to Middle Jurassic formations (Talkeetna, Kialagvik and Shelikof) consist primarily or significantly of volcanic components. In the upper part of the section, most of the Upper Jurassic through Upper Cretaceous formations (Naknek, Staniukovich, Herendeen and Chignik) consist of feldspathic to arkosic sandstones. The provenance (source area) for the clastic (fragmental) sediments was originally an early Mesozoic volcanic arc. The provenance then shifted with time to the Alaska-Aleutian Range batholith (Middle Jurassic) and included some recycled older sediments (Detterman et al. 1996).

a. Cottonwood Bay Greenstone: Late Triassic (Norian)

The Cottonwood Bay Greenstone is composed of dark green to gray metavolcanicrocks along the south shore near Cottonwood Bay on the western side of Lower Cook Inlet. It appears a similar sequence of metavolcanic rocks is exposed near the northeast end of the Alaska Peninsula. These rocks are suggestive of greenschist facies, (epidote-albite-actinolite) and probably metamorphosed from porphyritic basalt. These rocks are interpreted to be preserved roof pendants in the Alaska-Aleutian Range batholith just west of the Bruin Bay fault. The Cottonwood Bay Greenstone is associated with the basal member of the overlying Kamishak Formation suggesting its age is probably Norian (Detterman et al. 1996).

b. Kamishak Formation: Late Triassic (Norian)

The Kamishak Formation is the oldest sedimentary Mesozoic unit on the Alaska Peninsula at about 800 meters thick (Detterman et al. 1996).

i. Lithology

Detterman and others (1996) subdivided the Kamishak formation into three members consisting of limestone, chert, and volcanic rocks. Whalen and Beatty (2008) described the Kamishak Formation in the Paule Bay area as four distinct units (from oldest to youngest): biostromal; nodular limestone and conglomerate; rhythmically bedded limestone; and siliceous limestone units. The upper portion of the Kamishak Formation contains basalts and volcaniclastic rocks that are interbedded with the carbonate sediments. The two subsurface penetrations of the Kamishak Formation were in the ARCO Wide Bay Unit 1 well east of State acreage and the Amoco Cathedral River Unit 1 well located in the southwest corner of the State sale area.

ii. Lower Contact

Contact relations with other stratigraphic units are obscure. The base of the Kamishak Formation is commonly a fault contact (Wang et al. 1988; Detterman et al. 1996) but locally the unit appears to onlap an angular unconformity atop the underlying greenish volcaniclastic unit (Hanson 1957; Blodgett and Sralla 2008; Whalen and Beatty 2008, page 126). Greenish clasts identified in the deformed interval at the base of the nodular limestone and conglomerate unit and greenish sands within the siliceous limestone unit indicate that the volcaniclastics were locally exposed to erosion during deposition of much of the Kamishak Formation (Whalen and Beatty 2008, page 128).

iii. Upper Contact

There is a gradational contact with the overlying Talkeetna Formation (Detterman et al. 1996; Decker 2008).

iv. Depositional Environment

It appears to be a shallow water carbonate shelfal environment with localized reef and biohermal buildups. Rhythmically bedded biostromal layers are interpreted as deposition below wave base. Siliceous limestone units are interpreted as deposition above wave base on a carbonate ramp with localized areas of syndepositional folded and mass wasted carbonate sediments deposited at the edges of the steepened ramp slope. Synsedimentary folds and deformed limestones are present indicating active tectonic deformation during deposition of the Kamishak Formation (Whalen and Beatty 2008, page126).

v. Petrography

Whalen and Beatty (2008) describe a variety of carbonate facies containing lime mudstone, wackestone, packstone, grainstone, and rudite fabrics. Some units contain skeletal fragments, pelloids, and volcaniclastic sandstone.

vi. Reservoir Quality

Reservoir quality appears generally poor from outcrop samples taken at the time of the study. The carbonate facies present are pervasively cemented with calcite; the more clastic facies contain both calcite and quartz cement. The only facies present in the Puale Bay area with some macroscopic porosity are contained in the conglomerate and coarse grained rudstone beds within the nodular limestone and conglomerate unit. Secondary porosity could exist in the subsurface, with solution enhancement of fractures or as a result of dolomitization in the biostromal unit (Whalen and Beatty 2008).

vii. Hydrocarbon Generating Potential

The Kamishak formation contains good to very good source rock potential. Organic geochemical analysis consisting of total organic carbon (TOC) and Rock-Eval pyrolysis suggest that the best source rock potential lies in the siliceous limestone and rhythmically bedded units. TOC analysis yielded Type I, II, and III results; average values were predominantly in the Type II oil-prone range. Rock Eval data analyses indicate the source rocks range in the boundary between immature and mature (Whalen and Beatty 2008). Decker (2008) discusses and compares outcrop samples analyzed for source rock characteristics from Puale Bay collected by DO&G and DGGS with previous work. Based on total organic carbon, rock-eval pyrolysis, kerogen petrography, and vitrinite reflectance data from Puale Bay outcrop samples, Decker (2008) concludes that the Kamishak Formation present at Puale Bay is highly oil-prone.

viii. Seal Potential

Four samples from crystalline limestones within the Kamishak formation were analyzed and classified as Sneider Type A (best quality seal potential) in the study area (Bolger and Reifenstuhl 2008).

c. Talkeetna Formation: Early Jurassic (HEttangian – Sinemurian)

i. Lithology

The Talkeetna Formation consists of clastic sedimentary and volcanic rocks. Tuffaceous sandstone and tuff are exposed in the Puale and Alinchak Bays; volcanic conglomerate and sandstones are present northeast of Becharof Lake. In the southwestern part of the Alaska Peninsula, the unit consists of a sequence of tuffaceous siltstone, sandstone, and limestone (based on the AMOCO Cathedral River #1 well) that is similar to the rocks exposed at Puale Bay (Detterman et al. 1996). The ARCO Wide Bay #1 well is the only other Alaska Peninsula area well that penetrated the Talkeetna Formation (Finzel et al. 2005).

ii. Lower Contact

There is a gradational contact with the underlying Kamishak Formation (Detterman et al. 1996).

iii. Upper Contact

The Talkeetna formation is generally conformable with the overlying Kialagvik Formation. It is disconformable in places where section is missing due to nondeposition or erosion (Detterman et al. 1996).

iv. Depositional Environment

The depositional environment is considered open shelf due to the presence of ammonites in places (Detterman et al. 1996).

v. Reservoir Potential

Reservoir potential is low due to the abundance of volcanic ash, tuffs and other volcanic rocks interspersed with conglomerates, sandstones, and shales.

d. Kialagvik Formation: Middle Jurassic (Late Toarcian – Early Callovian)

i. Lithology

The lower part of the formation consists of cross-bedded sandstone, lenses of conglomerate, shale, and in places bivalves, abundant wood and carbonaceous debris exposed along Wide Bay. The upper part of the formation contains rhythmically bedded thin gray siltstone and sandstone sequences; locally containing limestone nodules and lenses. At Puale Bay the section is approximately 790 meters thick. It is composed of deep water turbidite assemblages consisting of rhythmically bedded thin gray siltstones and tan sandstones and conglomerates. In places these are channelized massive (Bouma C sequences), and in other places disorganized (debris flow) deposits. The Bear Creek well (located between Wide Bay and Puale Bay) encountered around 1,000 meters of siltstone and shale assigned to the Kialagvik Formation. The Cathedral River #1 well, located on the southern end of the Alaska Peninsula contained about 530 meters of the Kialagvik Formation (Detterman et al. 1996; Decker 2008).

ii. Lower Contact

Contact with the underlying Talkeetna Formation at Puale Bay is an unconformity (Detterman et al. 1996).

iii. Upper Contact

The upper contact is unconformable with the overlying Shelikof Formation (Detterman et al. 1996).

iv. Depositional Environment

The lower part of the unit is nearshore and contains thick-shelled bivalves indicating a high energy shallow-water environment. The upper unit contains features which represent deposition due to a deeper water turbidite environment. The Kialagvik Formation is only present in outcrop on State acreage at Wide and Paule Bays (Detterman et al. 1996).

v. Reservoir Potential

Reservoir potential is low. Overall the formation's depth of burial has likely physically compacted the interbedded finer grained layers and ductile grains, as well as chemically unstable lithics, within the sandstone bodies. This would greatly reduce the original porosity. Helmold and Brizzolara (2005) reported permeabilities of 0.005 to 0.7 md for a small set of outcrop samples from the formation.

vi. Hydrocarbon Generating Potential

Hydrocarbon generating potential for this formation is considered good. The Kialagvik Formation is correlated with the middle Jurassic Tuxedni Group along the west side of Cook Inlet that is considered the source rock for most of the oil produced in Cook Inlet (Magoon and Anders 1992). Decker (2008) concluded that the Kialagvik Formation present at Puale Bay is highly oil-prone based on Puale Bay outcrop samples analyzed for the following source rock characteristics: total organic carbon, rock-eval pyrolysis, kerogen petrography, and vitrinite reflectance data.

vii. Seal Potential

Depending on the geometry of the rhythmically bedded thin gray siltstone and sandstone sequences there is seal potential. No samples were studied for seal potential.

e. <u>Shelikof Formation: Middle Jurassic (Callovian)</u>

i. Lower Contact

It is believed the contact between the Shlikof and underlying Kialagvik Formation is conformable (Detterman et al. 1996).

ii. Upper Contact

The upper contact is unconformable with the overlying Naknek Formation (Detterman et al. 1996).

iii. Lithology

Detterman (1996) hypothesized the Shelikof Formation underlies the entire Alaska Peninsula. The formation contains abundant coarse volcanic debris and attains up to 1,402 meters in thickness. The lower part of the formation consists of thick-bedded to massive, dusky-yellowish-green graywacke and conglomerate that is dominated by volcanic clasts. The upper part of the formation consists mainly of brownish-gray siltstone containing limestone nodules (Detterman et al. 1996). In the subsurface the Shelikof Formation is recognized in the Cathedral River 1 and Painter Creek 1 wells.

iv. Depositional Environment

The Shelikof Formation consists of abrupt lateral facies changes that indicate deep to shallow water deposition (Detterman et al. 1996). From the rock descriptions, the formation appears to represent turbidite sequences consisting of channelized conglomerate (Bouma A) sequences fining (grain size decreasing) upward into variations of Bouma ABDE sequences. The presence of ammonites locally in the upper part of the formation suggests an open marine environment throughout deposition of the Shelikof Formation.

v. Reservoir Quality

Reservoir quality is low. This is indicated by samples of Shelikof Formation sandstones scatter plotted by Helmold and others (2005).They plot as low porosity/low permeability. The presence of abundant volcanic rock fragments and the relatively deep burial would suggest the loss of porosity is due to alteration of the volcanic lithics through both diagenesis and compaction. This is a result of burial deep enough to compact ductile grains and matrix.

vi. Seal Potential

Depending on the geometry of the brownish-gray siltstone containing limestone nodules (Detterman et al. 1996), there appears to be some seal potential, although no samples were collected. The diagenesis and compaction of the volcanic lithic grains degrading reservoir quality could also aid in forming a hydrocarbon barrier or seal.

f. <u>Naknek Formation: Late Jurassic (Oxfordian – Tithonian)</u>

The uplifting Alaska-Aleutian Range batholith was the main provenance (origin) for the Naknek Formation. It is believed the batholith was uplifted and eroded shortly after it solidified (Detterman et al. 1996).

i. Lower Contact

Regionally, where it is exposed in the Alaska Peninsula, the Naknek formation is disconformable with the Middle Jurassic Shelikof Formation (Detterman et al. 1996).

ii. Upper Contact

The upper contact of the Naknek formation is conformable with the overlying Staniukovich Formation (Detterman et al. 1996).

iii. Lithology

Detterman and others (1996) subdivided the Naknek formation into five members. The formation attains a maximum thickness of approximately 3,205 meters in the Alaska Peninsula and averages approximately 1,700 to 2,000 meters (Detterman et al. 1996). Only two members were recognized and described in the State study area (Decker et al. 2008a):

1) The Indecision Creek Sandstone Member (Tithonian – Kimmeridgian): medium gray fine- to medium-grained arkosic sandstone and siltstone. Although not a large percentage of the framework grain composition, the member was recognized by unaltered biotite and hornblende; and
2) Northeast Creek Sandstone Member (Oxfordian): light gray arkosic sandstone, cross-bedded in places, and locally containing magnetite laminae and thin beds of conglomerate.

In the subsurface the Naknek Formation is recognized in the Cathedral River 1 and Painter Creek 1 wells (Finzel et al. 2005).

iv. Depositional Environment

The depositional environment consists of shelf sequences ranging from shoreface to starved deep basin and fan delta environments. Rapid facies changes are due to the rapid uplift and erosion of the Alaska-Aleutian Range batholith (Detterman et al. 1996, page 19).

v. Petrography

The Naknek Formation contains clean well sorted sandstones, conglomerates, lithic sandstones and ammonites, and the bivalve *Buchia* (Detterman et al. 1996).

vi. Reservoir Quality

The reservoir quality shows as having low potential as conventional oil or gas reservoirs, and moderate potential as tight gas sandstones. Porosity and permeability analysis of several Naknek outcrop samples show low porosity and low permeability attributable to extensive zeolite alteration in most areas, indicating lower reservoir quality (Helmold and Brizzolara 2005). The presence of unaltered biotite and hornblende grains suggests that perhaps the depth of burial of the Naknek may not have adversely affected the overall diagenesis and compaction of individual sandstone and conglomerate sequences. Thus, there may be areas in the subsurface where porosity is preserved locally (Detterman et al. 1996),

g. Staniukovick Formation: (Early Cretaceous (Berriasian – Valanginian)

The Staniukovich formation conformably overlies the Naknek and underlines the Herendeen Formation. The type section described by Detterman and others (1996) consists of a light olive gray siltstone containing two light olive-brown sandstone intervals that are overlain by shaly olive-gray siltstone which contains numerous calcareous nodules and concretions. However, only the upper siltstone interval that weathers to form distinctive red-brown slopes is present in the study area (Decker et al. 2008a). The Staniukovich Formation is present in the David River 1A, Hoodoo Lake 2, and Painter Creek 1 wells.

i. Reservoir Potential

Although not studied in detail by DNR, the sandstone intervals are genetically similar to those in the underlying Naknek Formation and are expected to have low potential as conventional oil or gas reservoirs (Bolger and Reifenstuhl 2008; Decker et al. 2008).

ii. Seal Potential

Four samples were analyzed for seal potential. Their lithology ranged from siltstones, sandstones, and argillaceous sandstones. Two of the samples plotted as Sneider Type B and two plotted as Sneider Type C seals, suggesting that the Staniukovich formation has moderate to marginal sealing potential (Bolger and Reifenstuhl 2008).

h. Herendeen Formation: Early Cretaceous (Hautervian – Barremian)

The Herendeen Formation forms a conformable contact with the underlying Staniukovich Formation and forms an unconformable contact with the overlying Chignik Formation. The Herendeen formation consists of thin beds of uniformly medium grained yellow to light brownish yellow calcareous sandstone that contains abundant *Inoceramus* fragments that weathers to light gray platy surfaces with a distinct petroliferous, sulfur odor (Decker et al. 2008a). Samples of the formation studied to date yield little evidence of reservoir quality (Helmold et al. 2005), though the high calcite content could develop secondary porosity under the proper subsurface conditions. In the subsurface, the formation is present in the David River 1A and Hoodoo Lake 2 wells.

i. Chignik Formation: Late Cretaceous (Campanian to Maastrichtian)

The Chignik Formation described in the Staniukovich-Herendeen Area is subdivided by Decker and others (2008a) into the marine Chignik Formation with the non-marine coal bearing Coal Valley Member. In the subsurface, the Chignik Formation is identified in the David River 1A, Hoodoo Lake 2, and Painter Creek 1 wells.

i. Lower Contact

The Chignik Formation’s lower contact is unconformable to the underlying Herendeen, Staniukovich, and Naknek Formations (Detterman et al. 1996).

ii. Upper Contact

In some areas the Chignik Formation forms an unconformable upper contact with the overlying Tolstoi Formation. In others, the Chignik appears to conformably underlie the Hoodoo Formation (Detterman et al. 1996).

iii. Lithology

The dominant lithology consists of interbedded siltstones, sandstones, and conglomerates composed of chert, quartz, granitic, and minor volcanic clasts (Decker et al. 2008a).

iv. Depositional Environment

The Chignik formation consists of cyclic tidal flat, floodplain, and fluvial sequences. The interbedded non-marine coal bearing Coal Valley Member represents fluvial and floodplain deposits. In the State area, the Chignik Formation is a shallow water facies equivalent to the deep water turbidite depositional sequence represented by the Hoodoo Formation (Decker et al. 2008a).

v. Reservoir Potential

The formation was not studied in detail but some samples appear to have nominal oil or gas reservoir potential. In the subsurface, the formation is present in the David River, Hoodoo Lake, and Painter Creek wells.

vi. Source Rock Potential

The coals within the Coal Valley Member could potentially be a source of either thermogenic or biogenic gas (Finzel et al. 2005).

j. Hoodoo Formation: Late Cretaceous (Campanian to Maastrichtian)

The Hoodoo Formation has an unconformable contact with the underlying Herendeen Formation and a disconformable contact with the overlying Tolstoi Formation. In the Staniukovich – Herendeen area the Hoodoo formation is time equivalent to and interfingers with both the Chignik Formation and the Coal Valley member. Generally the formation represents an overall coarsening upward lower slope turbidite succession. It consists of thin bedded splintery dark gray to black shale, siltstone, and fine-grained sandstone that shallows upward to a shelfal succession. The shelfal succession consists of coarser grained sandstones and conglomerates containing ammonites, and clasts of plutonic, volcanic, chert, and quartz clasts in areas of channel development (Detterman et al. 1996; Decker et al. 2008a). The formation has not been studied in detail by DNR geologists, but appears to have minimal oil or gas reservoir potential where encountered in the course of geologic mapping south of Herendeen Bay. The formation was not formerly identified in the subsurface due to its interfingering relationship with the Chignik Formation.

2. Tertiary Units

The Tertiary succession is somewhat thinner than the Mesozoic with a maximum combined thickness of about 5,400 m (17,700 ft.), but a great deal thinner at many other areas due to non-deposition or post-depositional erosion (Detterman et al.1996). The Tertiary units known or expected to underlie the proposed lease sale area ascend in layers or stratigraphic order beginning with the Tolstoi Formation from the Upper Paleocene – Middle Eocene time. The other units and ages include the Meshik Volcanics (Upper Eocene – Middle Oligocene), which interfinger with the volcaniclastic Stepovak Formation of the same age; the Bear Lake Formation (Middle to Upper Miocene); and the Milky River Formation (Pliocene). Many of the stratigraphic relationships are inconsistent. The inconsistencies in rocks separating the Bear Lake and Milky River formations vary greatly between offshore and onshore locations. The offshore seismic data show a more subtle unconformity, but the upland outcrop belt onshore shows a profound angular unconformity (Decker et al. 2005).

The Tertiary rocks are predominantly non-marine and contain a considerable amount of volcanic and intrusive igneous rocks, volcanic debris, and volcanic units lying between different rock beds or strata. The provenance for sediments of the Tertiary formations was volcanic deposits from the same time period and recycled Mesozoic sedimentary and plutonic rocks of the Alaska Peninsula. It appears the Mesozoic sedimentary rocks are the main source for the Tolstoi and Bear Lake Formations. The Stepovak and Milky River Formations consist of lightly reworked volcanic fragments associated with two major pulses of concurrent volcanic arc activity. The first began during the Eocene (48 Ma) and continued into the early Miocene (22 Ma), and is referred to as the Meshik arc (Wilson 1985). Most of the rocks from this prolonged episode of eruptive activity are included within the Meshik volcanics. The second pulse of volcanic activity started during the late Miocene and is continuing at present as the Aleutian arc. Intrusive bodies ranging in size from small stocks and plugs to large batholiths were emplaced throughout the Tertiary (Detterman et al. 1996).

a. Tolstoi Formation: Late Paleocene to Middle Eocene

i. Lower Contact

Throughout most of the Alaska Peninsula, the lower contact of the Tolstoi Formation shows a major unconformity as it overlies the Chignik, Hoodoo, Staniukovich, or Naknek Formations (Detterman et al. 1996).

ii. Upper Contact

Where the Tolstoi Formation is overlain by the Meshik Volcanics, the contact is an unconformity (Detterman et al. 1996).

Regionally, where exposed in the Alaska Peninsula is disconformable with the Middle Jurassic Shelikof Formation.

iii. Lithology

Clast content of the sandstones and conglomerates are predominantly granitic and arkosic. The granitic and arkosic rock fragments and up to 30% of the lithic conglomerate clasts are weathered volcanics, suggestive of a Mesozoic source as opposed to the younger magmatic material that dominates the composition of the other Tertiary formations (Detterman et al. 1996; Decker 2008a). The formation contains a significant amount of carbonaceous mudstone (Detterman et al. 1996; Decker 2008). The Tolstoi Formation was encountered in the Sandy River 1, David River 1A, Hoodoo Lake 2, and North Aleutians Cost wells.

iv. Depositional Environment

The Tolstoi formation onlaps the underlying Mesozoic rocks. Detterman (1996) interpreted Pavlof Bay as a shallow water marine environment. To the northeast toward Chignik Bay the formation progressively becomes more non-marine, consisting of overall coarsening upward shallow marine deltaic sequences that grade into non-marine delta plain, braided fluvial, and flood plain deposits (Detterman et al. 1996; Decker 2008).

v. Reservoir Quality

Reservoir potential is good in the channelized sandstone and conglomerates depending on the degree of degradation and diagenesis of the volcanic lithics. Although the formation contains stable granitic and arkosic clasts, up to 30% of the volcanic clasts present are weathered. Because of this, reservoir quality may be degraded by the chemical alteration and subsequent compaction of unstable volcanic lithic clasts (Detterman et al. 1996). Depending on the amount of diagenesis that has occurred and the depth of burial, the Tolstoi could be a potential reservoir in the more marine sandstone sections as well as the braided stream channels. In the Cook Inlet Basin, the Tolstoi formation is a time equivalent of the Chickaloon and West Foreland formations. Helmold and others' (2008) scatter plotted porosity verses permeability for many outcrop samples. They illustrate that some of the samples have low porosity and permeability, thus poor reservoir properties, but good potential as seals. Many of the outcrop samples demonstrate good porosity and permeability values suggesting good reservoir potential (Helmold et al. 2008).

vi. Hydrocarbon Generating Potential

The presence of carbonaceous mudstones within the Tolstoi Formation indicates that depending on the depth of burial there is potential for the generation of petroleum liquids. However, high matrix adsorption effects would likely limit expulsion efficiency, minimizing the likelihood of a significant Tertiary-sourced oil accumulation within the Alaska Peninsula state acreage (Decker 2008).

vii. Seal Potential

Five samples from the Tolstoi formation were analyzed for seal potential. Three claystone samples analyzed were Sneider Seal Type A, suggesting excellent seal potential. The fourth sample analyzed, sandstone with a compacted matrix, was classified as a Sneider Seal Type C. The fifth sample, an organic-rich, coaly claystone was classified as a Sneider Type D. The variety of Sneider Seal type quality suggests that the Tolstoi Formation may be a good sealing rock in some areas, but not everywhere.

b. Meshik Volcanics: Late Eocene to Early Oligocene

The lower contact of the Meshik Volcanics to the overlying Tolstoi is interpreted as an angular unconformity. Volcanic rock types include andesites, basalts, and dacites. In places the Meshik is interbedded with reworked volcaniclastic rocks of the Stepovak Formation. The Meshik Volcanics are identified in the Port Heiden 1 and Ugashik 1 wells (Detterman et al. 1996).

c. Stepovak Formation: Late Eocene to Early Oligocene

i. Contacts

The Stepovak Formation is structurally conformable, but stratigraphically it is disconformable with the underlying Tolstoi. Similarly it is disconformable with the overlying Unga Formations. Locally, the Meshik Volcanics are interbedded with reworked volcaniclastic rocks of the Stepovak Formation (Detterman et al. 1996).

ii. Lithology

The formation is subdivided into a lower and upper member. The lower member consists of coarsening upward sequences of laminated dark brown laminated shale, siltstone, and sandstone containing graded bedding and rip-up clasts. The upper member contains abundant unaltered volcanic rocks deposited in a shallow water (30 – 50 meters) shelfal environment (Detterman et al. 1996). On the Staniukovich Peninsula the upper member contains vesicular lava flows and flow breccias that grade upward into volcaniclastic sandstone and conglomerate that are locally burrowed and contain bivalves and carbonate concretions. The Stepovak Formation is identified in the Sandy River Fed 1, Port Heiden 1, David River 1A, Hoodoo Lake 1 and 2, Great Basins 1, Becharof 1, and the North Aleutian Shelf COST 1 wells (Helmold and Brizzolara 2005).

iii. Reservoir Quality

The Stepovak is moderately sorted. Numerous samples identified as Stepovak Formation from the offshore North Aleutian Shelf COST 1 well have porosity ranging from 17% to 33% and permeability ranging from 1 to more than 1000 md (Helmold and Brizzolara 2005; Helmold et al. 2008). Reservoir quality measurements from outcrop and the onshore Becharof 1 well indicate significantly lower overall reservoir quality in the formation (Helmold et al. 2008). The formation contains a high percentage of volcanic rock fragments. The presence of Meshik volcanics within the Stepovak formation would generate heat and areas of contact metamorphism that would destroy reservoir quality. Away from the Meshik Volcanics the diagenetic alteration of the unstable volcanic rock fragments, coupled with compaction due to burial, would significantly reduce primary porosity and permeability.

iv. Seal Potential

Two samples were analyzed and plotted as Sneider C seals, suggesting a marginal seal capacity for the Stepovak Formation. One was argillaceous sandstone and the other compacted sandstone (Bolger and Reifenstuhl 2008).

d. Bear Lake Formation: Miocene

i. Lower Contact

The Bear Lake formation overlies the Meshik Volcanics and Stepovak and Tolstoi formations. Most contacts are disconformities and a few are angular conformities. The maximum thickness of the Bear Lake formation is estimated to be about 1,000 meters (Detterman et al. 1996).

ii. Upper Contact

The Milky River Formation overlies the Bear Lake formation at some localities by volcanic and volcaniclastic rocks. Most of the contacts are disconformities and a few are angular unconformities (Detterman et al. 1995).

iii. Lithology

The distinguishing characteristics of the Bear Lake Formation are a greater abundance of nonvolcanic debris; abundant fossils (primarily pelecypods, gastropods, and echinoids); and the sand grains are moderately well sorted and rounded and compared to the underlying Stepovak and Tolstoi formations. The Bear Lake Formation is considerably better sorted, contains a higher percentage of chert and quartz, and a significantly smaller percentage of volcanic detritus than the other Tertiary sandstones in the State acreage area. The provenance of the Bear Creek sandstones appears to be the older Mesozoic sedimentary strata, possibly the Alaska-Aleutian Range batholith (Detterman et al. 1996, page 55). The Bear Lake Formation is present in the subsurface in the Sandy River Fed 1, Port Heiden 1, Great Basins 1 and 2, Becharof 1, Ugashik 1, David River 1/1A/1ARD, Hoodoo Lake 1 and 2, and the OCS North Aleutian 1 well.

iv. Depositional Environment

The Bear Lake formation consists of marine shelfal (up to @ 100 meters), tidal, and non-marine deposits. The area of thickest deposition for the Bear Lake sediments appears to have been isolated from the volcanic-rich sediments deposited of the southeast side of the Alaska Peninsula (Detterman et al. 1996).

v. Reservoir Quality

The Bear Lake subsurface samples vary considerably in framework grain size and sorting due to the varying amount of clay and detrital silt in a given sample. They are enriched in sedimentary grains, chert, monocrystalline quartz, and plagioclase. Some of the Bear Lake samples contain abundant clay minerals that are present as individual laminae or are dispersed as matrix in the rock fabric. The clay laminae are composed of illite and mixed-layer illite/smectite swelling clays, which could adversely affect reservoir quality when exposed to fresh water. Cementation does not appear to be a significant component of these sandstones. The formation contains distinct well sorted sandstone layers. Its framework grain composition is dominated by quartz, chert, and plagioclase, and was not buried too deeply to compact the ductile clay components. Because of this, the Bear Lake formation is a potential reservoir rock (Helmold et al. 2008).

vi. Source Rock Potential

Analysis by Decker (2008) indicates that some of the coals within the Bear Lake formation may possess marginal capacity to generate petroleum liquids. However, high matrix adsorption effects would likely limit expulsion efficiency, minimizing the likelihood of a significant Tertiary-sourced oil accumulation within the Alaska Peninsula state acreage.

vii. Seal Quality

Eleven outcrop samples containing distinctly laminated fabrics from the Bear Lake Formation were analyzed for Sneider Seal type by Bolger and Reifenstuhl (2008). Four of the samples analyzed were classified as Sneider Type A, three as Sneider Type C, two as Sneider Type D, one as Sneider Type E, and one that is not considered a seal, but rather a reservoir rock. The samples suggest that the Bear Lake formation could be both an effective reservoir and seal (Bolger and Reifenstuhl 2008).

e. Milky River Formation: Pliocene

The Milky River Formation was named by Galloway (1974) to describe volcanic and sedimentary rocks along the Milky River overlying the Bear Lake Formation. Detterman and others (1981) officially defined the formation; it varies in thickness from 465 meters thick at its type locality onshore up to 1000 meters in offshore boreholes (Detterman et al. 1996; Finzel et al. 2005).

i. Lower Contact

The lower contacts show disconformities and unconformities with the underlying Bear Lake Formation. In places the unconformity is angular (Detterman et al. 1996; Decker 2008).

ii. Upper Contact

The Milky Formation has unconformable contact with younger volcanic flows and surficial deposits (Detterman et al. 1996).

iii. Lithology

The formation consists of volcanogenic, non-marine sedimentary rocks and interlayered volcanic flows and intrusive sills. The lower part of the unit consists of dark gray to brown poorly indurated coarse-grained cross-bedded sandstone with abundant magnetite and poorly sorted pebble-cobble-boulder conglomerates composed of volcanogenic debris. The upper part of the formation consists of abundant volcanogenic lithics that are interlayered with volcanic flows and intrusive sills (Detterman et al. 1996) and contains abundant clay laminae (Helmold et al. 2008). The Milky River contains the most volcanic detritus of all the Tertiary sandstones in the study area (Detterman et al. 1996). In the subsurface, the Milky River Formation is present in the following wells: Sandy River Fed 1, Port Heiden 1, Great Basins 1 and 2, Becharof 1, Ugashik1, David River 1/1A/, Hoodoo Lake 1 and 2, Painter Creek 1, and the OCS North Aleutian 1 well.

iv. Depositional Environment

The depositional environment consists of a non-marine fluvial system with locally thick pebble to boulder filled braided fluvial channels in the basal part of the unit consisting of cobble-boulder conglomerates. The upper part of the formation fines upward and contains channelized cross-bedded sandstones composed of fluvial volcanic sandstones.

v. Petrography

The Milky River sandstones are predominantly composed of coarse-grained volcanic rock fragments (up to 65% in some samples) plagioclase, quartz, heavy minerals, some detrital matrix (up to 10%) and good porosity (in the range of 15-33%) (Helmold and Brizzolara 2005; Helmold et al. 2008).

vi. Reservoir Potential

Porosity and Permeability cross plot from the subsurface samples for the Milky River Formation demonstrate very high porosity and permeability values (@ 100 md and 35% - 40% porosity). The presence of a high percentage of volcanic rock fragments and heavy minerals as major framework components indicates a chemically and mechanically immature reservoir rock (Helmold et al. 2008). Primary porosity could be preserved due to the relatively low depth of burial that would inhibit the diagenesis of unstable volcanics and prevent the compaction of ductile grains. The Milky River is a potential gas-bearing reservoir rock because it is possible that the coals from the underlying Bear Lake formation could have generate biogenic gas and migrated into the reservoir (Fenzel et al. 2005).

vii. Hydrocarbon Generating Potential

The formation contains little organic material (Helmold et al. 2008).

viii. Seal Potential

Seal potential for the Milky River Formation is considered poor (Finzel et al. 2005). No samples were analyzed for seal potential. The unit does not contain appreciable continuous shale or siltstone layers. The overlying Quaternary deposits could possibly effectively seal potential gas reservoirs within the Milky River formation.

B. Additional Oil and Gas Potential Information

1. Oil and Gas Potential

a. Overview of the Petroleum Systems Approach

Kerogens derived primarily from land plants, which are common in coal-bearing nonmarine rocks and deltaic sequences, are lean in hydrogen relative to carbon, and primarily generate methane (CH_4), or dry natural gas, the simplest of all hydrocarbon molecules. Kerogens made up of algae and other marine microorganisms contain a higher fraction of hydrogen relative to carbon, and when subjected to the proper level of thermal maturity, will form oils (long-chain hydrocarbon molecules) of various complexities, which are more enriched in hydrogen.

Framework grains form the lattice that creates porosity (void spaces) and permeability (connections that allow fluid to flow through adjoining pore spaces). The composition of the framework grains is important in determining whether sandstone is a suitable reservoir. Unstable sand grains that are subject to chemical altering due to interaction with subsurface fluids upon burial recrystallize to form cements in a pore-clogging process called diagenesis that clogs the pore spaces and degrades reservoir potential. The amount of clay, mud, and ductile framework grains, and matrix within a given rock will decrease its overall porosity and permeability as it is buried and compacted, much like squeezing a tube of toothpaste into a jar of marbles.

Depth of burial is an important component to consider for the compaction of ductile grains and the chemical alteration of unstable grains. Chemical alteration of igneous rock fragments commonly forms clays and zeolite minerals that degrade reservoir quality.

Structural traps are much easier to identify on seismic data, especially if only 2-D surveys are available. Stratigraphic traps are more difficult to identify, requiring detailed knowledge of the subsurface gained either from 3-D seismic or numerous previous well penetrations.

2. Source Rock Potential

Based on total organic carbon, RockEval pyrolysis (controlled heating experiments), kerogen typing, and vitrinite reflectance measurements, the Triassic Kamishak and Jurassic Kialagvik formations present in outcrops at Puale Bay are highly oil-prone. The vitrinite reflectance data confirms that these Mesozoic formations lie in the immature to early oil-window thermal maturity previously indicated only by pyrolysis data (Decker 2008). Previous work reaches the same conclusion that potential Mesozoic source rocks contain dominantly oil-prone marine organic matter (Wang et al. 1988; Magoon and Anders 1992; Finzel et al. 2005).

In contrast, the Tertiary backarc basin fill formations encountered in the North Aleutian Shelf COST #1 well are dominated by terrestrially-sourced coaly kerogen and are thus most likely to generate mostly natural gas (Dow 1983; Turner et al. 1988; Sherwood et al. 2006; Finzel et al. 2005). Some carbonaceous mudstones of the Tolstoi Formation yield pyrolysis results that suggest they may be marginally capable of generating light oil or condensate in addition to natural gas (Decker 2008).

3. Reservoir Potential

Mesozoic deposition occurred on the flanks of a magmatic arc, resulting in mostly clastic sediments containing abundant volcanic and plutonic rock fragments (Sherwood et al. 2006). Upon burial, the volcanic rock fragments easily degraded into laumontite, heulandite, and other zeolite minerals that fully blocked the porosity between grains. Other digenetic effects include the formation of cements such as chlorite/smectite, and carbonate (Dutrow 1982). In addition, deep burial of most of the

Mesozoic units resulted in mechanical compaction of ductile grains to form pore-blocking pseudo-matrix. Most of the Mesozoic clastic units are thus unlikely reservoir candidates.

The limestones of the Triassic Kamishak Formation and the carbonate-rich sandstones of the Lower Cretaceous Herendeen Formation could host secondary porosity created by chemical leaching of carbonate components. At or near the top of the Mesozoic succession, the Upper Cretaceous Chignik Formation has some potential for maintaining primary porosity and permeability due to shallower depth of burial.

The younger Mesozoic sediments contain a smaller percentage of volcanic rock and likely contain more stable framework grains. Depending on the timing of hydrocarbon generation and migration relative to pore-filling chemical alteration, it is conceivable that some oil reservoirs may have escaped diagenetic degradation due to sufficient oil saturation to prevent cement formation. However, Magoon (1994) assumes that oil generation within Middle Jurassic source beds occurred mostly during Tertiary time after potential Mesozoic reservoirs underwent compaction and diagenesis that degraded and blocked original porosity, likely excluding them as viable reservoirs.

Compaction and diagenetic alteration of potential Tertiary rocks is more promising due to shallower depth of burial and/or the presence of more stable clastic grain types. In a general way, the Tertiary backarc basin succession may mirror the Tertiary clastic section in the Cook Inlet forearc basin, consisting of the Hemlock, Tyonek, Beluga, and Sterling Formations. In those formations, primary porosity was preserved because of shallower depth of burial and favorable diagenetic history, in which some oil accumulated in porous Hemlock and lower Tyonek sandstones.

The Miocene Bear Lake and Unga Formations and the Eocene-Oligocene Stepovak Formation contain the highest percentage of stable rigid framework grains in the Tertiary section. Numerous samples from these formations yield good to excellent porosity and permeability, marking them as the best candidate reservoirs. The Pliocene Milky River Formation contains the highest amount of unstable volcanic rock fragments, but has been so shallowly buried that nearly all samples yield excellent reservoir quality. However, the same shallow burial makes it unlikely to be overlain by effective seals.

4. Trap Potential

a. Structural – Stratigraphic Complexities

The geology of the Alaska Peninsula includes multiple episodes of tectonic and magmatic activity, resulting in a geologic record punctuated by numerous erosional unconformities (Decker 2008). Many of these surfaces are expressed by angular discordance and contrasts in rock type that may set up trapping configurations in the lease sale area. In addition, both extensional and compressional structures are commonly observed in outcrop and interpreted in the limited seismic data available. The overall tectonic framework and structural style suggests that much of the deformation may be transpressional and transtensional in origin, hybrids resulting from oblique motion of the Pacific Plate relative to the North American Plate (Alaskan block).

Significant variations in structural style and complexity occur along the length of the Alaska Peninsula (Decker et al. 2008a). For example, an area just west of Herendeen Bay referred to as the Sapsuk domain contains a single broad uplift cored by a major thrust or reverse fault with few crosscutting faults. In contrast, just to the east between Herendeen Bay and Port Moller, the Staniukovich domain contains a complicated faulted network of both longitudinal (lengthwise) and transverse (crosswise) faults that form a doubly-plunging, rhomboid-shaped uplift that is broken up into numerous structural compartments, as well as narrower fault-bounded folds to the south.

The prominence of both stratigraphic and structural complexity makes it very likely that trapping configurations are common in the sale area. Additional regional seismic data will be needed to map the location and size of potential structural and stratigraphic traps in the subsurface prior to exploration drilling.

b. Seal Capacity

Bolger and Reifenstuhl (2008) analyzed the seal capacity of 26 samples from the Alaska Peninsula using mercury injection capillary pressure measurements and classified the results according to the Sneider Seal Classification (Sneider 1997). Of the samples classified, 40% are Sneider Type A, the best seal quality seals, capable of holding oil columns of 3,200 feet or gas columns of 2,400 feet. Type A seals are present in the Bear Lake, Kamishak, and Tolstoi Formations. Type A seals consist of claystone (Tolstoi Formation), limestone (Kamishak Formation), and argillaceous (clay-rich) siltstone and sandstone samples with a distinctly thin, laminar fabric (Bear Lake Formation). The porosity in the Type A seals ranges from 1.2% (Kamishak limestone) to 20.2% (Bear Lake argillaceous siltstone). In all cases, Type A seals have a fine scale pore structure that supports high capillary pressures (Bolger and Reifenstuhl 2008).

Type C seals are the next most common, accounting for approximately 30%of the samples, capable of trapping oil columns of 400 feet or gas columns of 300 feet. For the most part, they are moderately argillaceous to argillaceous siltstones. Type C seals were found in the Stepovak and Bear Lake Formations (Bolger and Reifenstuhl 2008). A majority of the Type C seal rocks have a bimodal pore structure and the seal capacity is generally limited by the presence of the larger pores. Where the Type C seals have a laminated fabric that creates the bimodality, the seal quality may be higher if the laminations are oriented perpendicular, or at a high angle, to the hydrocarbon migration direction. In the Type C samples, porosity ranges from 4.8% (Stepovak Formation) to 18.2% (Bear Lake Formation).

Four samples analyzed were classified as Type D (Tolstoi and Bear Lake Formations) and E seals (Bear Lake Formation), with relatively ineffective sealing characteristics. Porosity in these samples ranged from 17.3% to 37% and permeability ranged from 0.285 to 1.3 md. These samples have grain supported fabrics with some porosity between grains, and in some cases are more effective as reservoir rocks than as seals. However, if the laminations are perpendicular to the hydrocarbon migration direction these rocks could function as seals, although perhaps ‘leaky’ ones (Bolger and Reifenstuhl 2008).

5. Resource Potential Summary

- The proposed Alaska Peninsula Areawide lease sale area remains dramatically underexplored. Very little seismic data is available over state acreage. Surveys that do exist consist mainly of low-quality 2-D lines that are inadequate for prospect-level analysis or the rigorous assessment of undiscovered resources.

- The Triassic Kamishak Formation and the Jurassic Kialagvik Formation (age equivalent to the Tuxedni Formation source rock in Cook Inlet) are potentially oil-generative source rocks, though their distribution in the subsurface of the lease sale is uncertain. Further work is required to determine if there is a viable migration pathway from these potential Mesozoic source rocks to potential Tertiary reservoirs.

- Coals within the Tertiary formations may likely generate biogenic gas that could have migrated into adjacent reservoir rocks, similar to the Tyonek, Beluga, and Sterling reservoirs of Cook Inlet.

- Geochemical analyses and inferences regarding subsurface distribution of the various source rock and potential reservoir formations suggest that potential hydrocarbon accumulations on State acreage are more likely to be gas rather than oil reservoirs.

- The Mesozoic clastic formations are reservoir challenged due to chemical alteration of unstable grains and compaction of ductile lithics and matrix. These characteristics stem in large part from the magmatic provenance control on petrology, the history of volcanic and plutonic activity in the area, and the associated diagenesis.

- Tertiary formations contain enough preserved porosity and permeability to function as potential conventional oil and gas reservoirs.

- Given the complex tectonic, structural, and stratigraphic history of the area, it is likely that many potential traps exist, though in places they may be small or compartmentalized. Modern 2-D and/or 3-D seismic will be necessary to define drillable prospects in most areas.

- Reservoir seal capacity studies on outcrop samples indicate that several formations are potential good sealing rocks.

- Field work, subsurface data, and lab analysis indicate that the Ugashik sub-basin, in the vicinity of the Great Basins wells, is a fault-bounded feature that contains a thick sequence of preserved Tertiary strata that appears prospective for a hydrocarbon accumulation.

Appendix B: Summary of Comments and Responses

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Appendix B. Summary of Comments and Responses

AS 38.05.035(e)(7)(A) and (B) requires the preliminary and final written findings include a summary of agency and public comments, if any, and the department's responses to those comments. This appendix summarizes comments received in response to the January 26, 2011 Alaska Peninsula Areawide Request for Agency Information, the June 19, 2014 publication of the Proposed Alaska Peninsula Areawide Oil and Gas Lease Sales best interest finding, and the department's responses.

A. Comment Received from January 26, 2011, Alaska Peninsula Areawide Request for Agency Information

1. DNR Office of History and Archaeology

Anchorage, AK, February 25, 2011, Rachel Dale, Archaeologist

Comment summary: The DNR Office of History and Archaeology (OHA) provided information regarding archaeological sites on the uplands and within the tidal and subtidal areas. OHA recommended DO&G address the prehistoric and archaeological resources in the written findings.

DNR response: The information was incorporated into the Preliminary Finding in Chapter Three, Description of Sale Area and Chapter Seven, Governmental Powers.

2. Aleutians East Borough

Anchorage, AK, March 16, 2011, Mayor Stanley Mack

Comment summary: The Aleutians East Borough (AEB) voiced their support of the areawide lease sales. AEB stated that strict environmental protections were important and offered assistance and cooperation working with DNR on mitigation measures in the future. AEB also suggested information collected by the Minerals Management Service for the Environmental Impact Statement for the North Aleutian Basin Oil and Gas Off-shore Lease Sale may be helpful to DNR if Alaska Peninsula Areawide Lease sales continue.

DNR response: North Aleutian Basin Lease Sale website and accompanying documents were reviewed and considered. All relevant facts and issues within the scope of review that were known or made known to the director were reviewed.

3. U.S. Fish and Wildlife Service

Anchorage, AK, April 29, 2011, Lisa Williams, Realty Specialist

Comment summary: The U.S. Fish and Wildlife Service (USFWS) commented on the Alaska Peninsula Lease Sale Area map regarding lands owned by the United States appearing to be within the lease sale area. USFWS provided a website link of refuge land status maps for ADNR's viewing convenience.

DNR response: The website was reviewed and considered. All maps in the Preliminary Finding have been updated. Information has been incorporated into the Preliminary Finding, Chapter Two that explains how and when land status is determined.

4. ADF&G Division of Habitat

Anchorage, AK, April 29, 2011, Brad Dunker, Habitat Biologist

Comment summary: The Alaska Department of Fish and Game, Division of Habitat (ADF&G) provided comments and recommendations regarding new and updated fish and wildlife resource information, maps, current and projected uses, and mitigation measures.

DNR response: Information provided by ADF&G was reviewed and considered. Relevant information was incorporated into Chapter Four, Habitat, Fish and Wildlife; Chapter Five, Current and Projected Uses; Chapter Seven, Governmental Powers; Chapter Eight, Foreseeable Effects; and Chapter Nine, Mitigation Measures.

B. Comments Received from June 19, 2014, publication of the Proposed Alaska Peninsula Areawide Oil and Gas Lease Sales Best Interest Finding

1. Dick Mylius

Anchorage, AK, July 25, 2014

Comment Summary: Mr. Mylius provided comments and recommendations regarding language used to discuss the Bristol Bay Fisheries Reserve (BBFR).

DNR response: Mr. Mylius' suggestions and language have been incorporated into Chapter Four, Habitats, Fish, and Wildlife, clarifying the statute's intent. An asterisk was also added to Map 4.2 to clarify the governance of the BBFR and its boundaries.

2. Changing Tides Consulting

Juneau, AK, August 27, 2014, Lisa Weissler

Comment Summary: Ms. Weissler provided comments regarding DNR statutes and regulations and her concern that the regulations were lacking in regards to phasing requirements and associated public notice and public comment opportunities. Ms. Weissler also asked what DNR is approving.

DNR response: The disposal phase process has complied with all notice and comment requirements set out in regulation (11 AAC 82.415). Ms. Weissler speculates that DNR may fail to meet notice and comment requirements in a future phase process and speculates about potential future phase issues. Neither of these speculations is relevant to this disposal phase decision. DNR is aware of and will comply with legal requirements including those discussed in *Redoil*.

3. ADF&G Division of Habitat

Anchorage, AK, August 29, 2014. Michael Daigneault, Regional Supervisor, Central Region Office

Comment Summary: The Alaska Department of Fish and Game, Division of Habitat, (ADF&G) provided comments and recommendations regarding relevant fish and wildlife information, technical edits, and mitigation measures. Suggested mitigation measures and edits include: (1) dismantlement, removal, and rehabilitation (DR&R) requirements; (2) human-bear interaction plans; (3) consulting with ADF&G regarding subsistence, commercial, and sport harvest activities; and (4) blocking access to or along navigable and public waters.

DNR response: Information provided by ADF&G was reviewed and considered. Technical edits and relevant information was incorporated into Chapter One, Finding and Decision; Chapter Four, Habitats, Fish, and Wildlife; and Chapter Seven, Governmental Powers. Regarding the mitigation measures, DO&G incorporated language requiring consultation with ADF&G into mitigation measure 3.a. in Chapter Nine, as requested by ADF&G.

The other mitigation measure requests will not be included. Dismantlement, removal, and rehabilitation and blocking access to or along navigable and public waters are already covered under state and federal law. As stated in Chapter Seven, Governmental Powers, lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances.

In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires, under paragraph 26, that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases are subject to all future laws and regulations in effect after the effective date of the leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

ADF&G's request regarding human-bear interaction plans will not be included because such requirements are in the purview of ADF&G.

4. Peter Lowney

Valdez, AK, August 29, 2014

Comment Summary: Mr. Lowney provided comments regarding his concern with oil and gas development in the Alaska Peninsula region and possible environmental disasters such as oil spills.

DNR response: Chapter Nine, Mitigation Measures, addresses such things as system integrity, the siting of facilities, fuel and hazardous substance transfer, and drilling waste.

Chapter Seven, Governmental Powers, discusses how lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances.

In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires, under paragraph 26, that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases are subject to all future laws and regulations in effect after the effective date of the leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

5. U.S. Department of the Interior, National Parks Service, Katmai National Park & Preserve

King Salmon, AK, September 2, 2014, Diane Chung, Superintendent

Comment Summary: The National Parks Service (NPS) provided comments regarding the impacts that oil and gas activities may have on park resources, information regarding the process if drainage of an adjacent NPS unit were to occur, and recommended a mitigation measure to include. NPS also commented on direct and indirect impact that oil and gas activities may have on park resources over short and long term time frames. The suggested mitigation measure addressed the protection of nearby park resources by adding a one to three mile buffer from the Katmai park border.

DNR response: DNR will not be adding a new mitigation measure as suggested by NPS. Other mitigation measures along with state and federal requirements are sufficient to protect park resources as discussed below. Regarding concerns about drainage, AOGCC statutes were established to, among other things, protect correlative rights.

Chapter Four, Habitats, Fish, and Wildlife, discussion includes state and federally managed refuges, critical habitat area, parks and preserves, and other designated areas. Chapter Four also states that specific legislation provides additional protection of habitat that is important to fish and wildlife populations and recreational opportunities.

Chapter Seven, Governmental Powers, discusses how lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances.

In addition to existing laws and regulations applicable to oil and gas activities, the state's standard oil and gas lease contract requires, under paragraph 26, that leases are subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases are subject to all future laws and regulations in effect after the effective date of the leases to the full extent constitutionally permissible and are affected by any changes to the responsibilities of oversight agencies.

Chapter Eight, Reasonably Foreseeable Effects of Leasing and Subsequent Activity, discusses how oil and gas activities may affect 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.

Chapter Nine, Mitigation Measures, addresses such things as system integrity, the siting of facilities, seasonal restrictions on oil and gas activities, fuel and hazardous substance transfer, and drilling waste.