
Chapter Three: Description of the Alaska Peninsula Sale Area

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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.

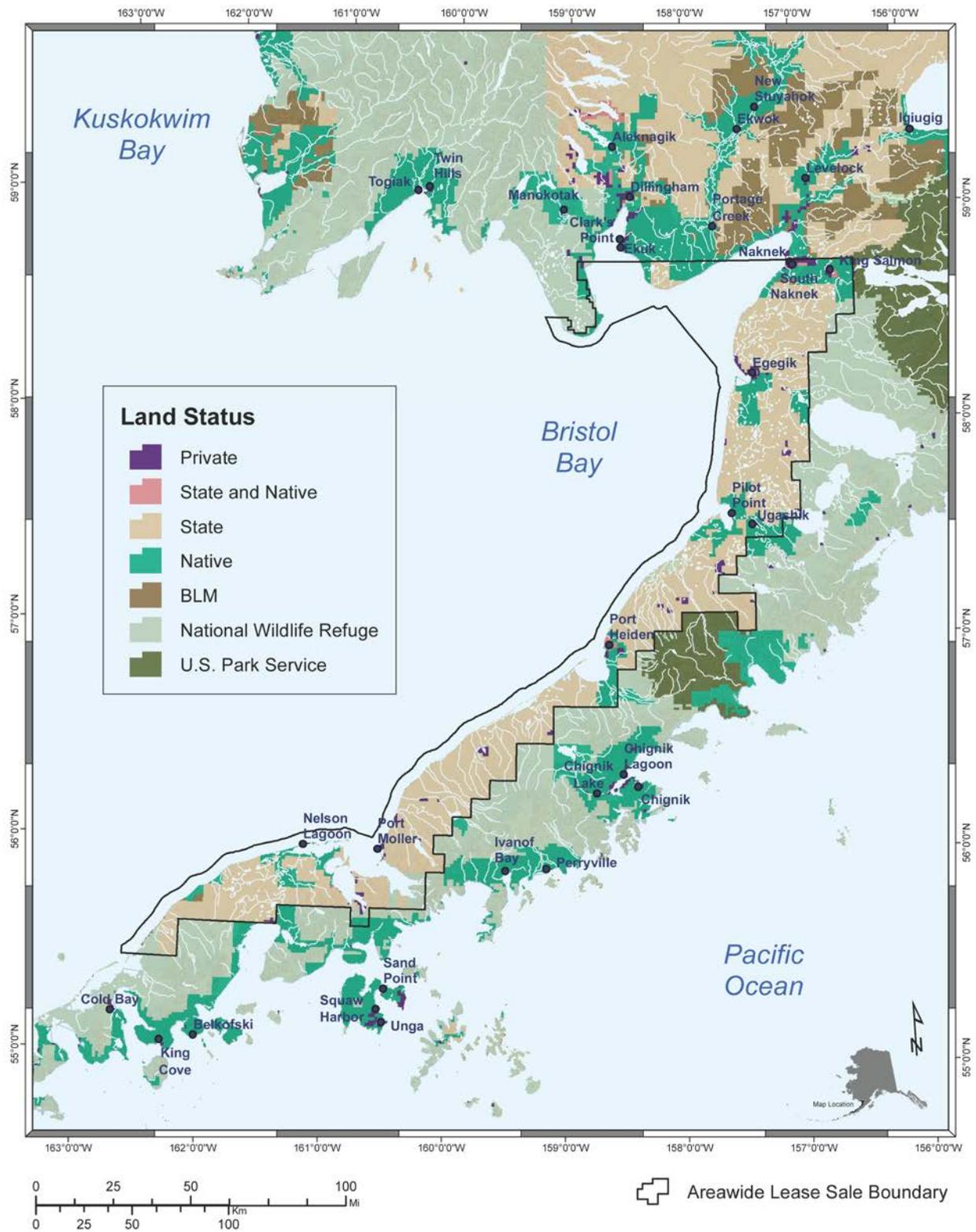
The sale area lies within the Aleutians East Borough, Bristol Bay Borough, Lake & Peninsula Borough, and the Dillingham Census Area.

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.

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Map 3.1 Alaska Peninsula General Land Status

Alaska Peninsula Areawide Final Best Interest Finding

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	2000	1990
Aleutians E. Borough	2nd Class Borough	6,988	3,141	2,697	2,464
Akutan	2 nd class city	14	1,027	713	589
Belkofski	Unincorporated	N/A	0	0	0
Cold Bay	2 nd class city	54	108	88	148
False Pass	2 nd class city	27	35	64	68
King Cove	1 st class city	25	938	792	451
Nelson Lagoon	Unincorporated	N/A	52	83	83
Pauloff Harbor	Unincorporated	N/A	0	0	0
Sand Point	1 st 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	2 nd 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	2000	1990
Lake & Penin. Borough	2 nd Class Borough	23,782	1,631	1,823	1,668
Chignik	2 nd 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	2 nd 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	2 nd class city	N/A	190	160	160
Nondalton	2 nd 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	2 nd class city	N/A	68	100	53
Port Alsworth	Unincorporated CDP	N/A	159	104	55
Port Heiden	2 nd 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 Nushagak 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	1 st 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 20th-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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