U.S. Fish & Wildlife Service

Izembek

National Wildlife Refuge
Land Exchange/Road Corridor

Final Environmental Impact Statement

Chapter 3.1 Affected Environment: Physical Environment

U.S. Fish and Wildlife Service Mission Statement

The Mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

Refuge System Mission Statement

The Mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

—National Wildlife Refuge System Improvement Act of 1997

On the Cover: Izembek National Wildlife Refuge, 2007

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3.0 AFFECTED ENVIRONMENT

3.1 Physical Environment

3.1.1 Air Quality

Air quality is a function of the air pollutant emission sources in an area, atmospheric conditions (such as wind direction and speed), and characteristics of the area itself (topography and air shed size). Pollutants transported from outside the area can also affect air quality. Localized sources of emissions include both human-made (anthropogenic) and natural emission sources. Industrial, residential, transportation-related, and construction-related emissions are anthropogenic sources; these sources can be either ongoing or temporary. Natural sources include emissions from windblown dust, wild fires, and volcanic eruptions; these typically contribute only to temporary increases in air pollution. Air quality in the majority of Alaska's coastal region is generally considered very good, because of minimal human habitation and industrial development, along with the distance to population centers such as Anchorage or Fairbanks (ADEC 2010b).

3.1.1.1 Study Area

For air quality related to the proposed land exchange (Alternatives 2 and 3), the parcels (identified in Table 2.4-6) can be divided into 2 groups: national wildlife refuge and non-national wildlife refuge lands. The national wildlife refuge lands (Izembek, Alaska Peninsula, and Alaska Maritime National Wildlife Refuges, which includes Sitkinak Island and areas proposed for land exchange) contain minimal anthropogenic sources of air pollution (short-term [temporary] transportation-related emissions) and natural emission sources. The non-national wildlife refuge lands (including State of Alaska lands and King Cove Corporation lands) also have minimal anthropogenic and natural emission sources.

3.1.1.2 Regulatory Framework and Pollutants of Concern

<u>Air Quality Standards</u>

Air quality in Alaska is regulated by the United States (U.S.) Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation. The EPA has established the National Ambient Air Quality Standards, which specify maximum concentrations for 8 criteria pollutants (EPA 2010c). Nonattainment areas are geographic regions where air pollutant concentrations exceed the National Ambient Air Quality Standards for a pollutant.

The main criteria air pollutants affecting Alaska are carbon monoxide and particulate matter less than 10 microns in diameter (PM10). Outdoor carbon monoxide emissions come from combustion sources, such as automobiles, airplanes, and industrial engines (ADEC 2010c). Fuel combustion is also a source of particulate matter emissions. In rural communities, airborne dust (PM10) can be caused by windblown dust from glaciers, gravel pits, vehicles on dirt roads, dry river beds, and human activity on non-vegetated land (ADEC 2010d). Air quality standards for these pollutants are listed below in Table 3.1-1.

Table 3.1-1 Ambient Air Quality Standards for Carbon Monoxide and PM10

Pollutant	Averaging Time	National Ambient Air Quality Standard
Carbon Monoxide	1-hour	35 ppm (40 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)
Particulate Matter < 10 µm (PM10)	24-hour	150 µg/m^3

µm = microns (for particulate diameter)
µg/m^3 = micrograms of pollutant per cubic meter of air
mg/m^3 = milligrams of pollutant per cubic meter of air
ppm = parts per million
Source: EPA 2010c; ADEC 2010a

Other Air Quality Evaluation Criteria

Mobile Source Area Toxics

The EPA defines air toxics, also known as hazardous air pollutants, as pollutants that cause or may cause cancer or other serious health effects, and has identified a group of 21 of these pollutants as Mobile Source Air Toxics (EPA 2001a). From the list of 21 mobile source air toxics, 6 toxics are identified as the priority: benzene, formaldehyde, acetaldehyde, diesel exhaust (particulate matter/diesel exhaust organic gases), acrolein, and 1,3-butadiene. The EPA has no National Ambient Air Quality Standards for mobile source air toxics and has not established criteria for determining when mobile source air toxic emissions should be considered a significant issue. However, the Federal Highway Administration has identified 3 levels of analysis for mobile source air toxics in environmental documents (FHWA 2009):

- No analysis for projects with no potential for mobile source air toxic effects
- Qualitative analysis for projects with a low potential
- Quantitative analysis to differentiate alternatives for projects with higher potential

Greater potential for mobile source air toxic effects typically occurs for roadways with an annual averaged daily traffic volume of 140,000 to 150,000 vehicles or more per day. The proposed land exchange areas have negligible potential for existing mobile source air toxics, with traffic volumes substantially below this threshold criterion.

Climate Change and Greenhouse Gases

Climate change is a global phenomenon influenced by emissions of greenhouse gases from sources in every nation of the world. The EPA has issued the Final Mandatory Reporting of Greenhouse Gases Rule (EPA 2009b), which requires reporting of greenhouse gas emissions from large sources and suppliers in the United States. The reporting is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of greenhouse gas emissions are required to submit annual reports to the EPA.

Regional Haze

Regional haze refers to haze that impairs visibility in all directions over a large area. In general, visibility is measured by the farthest distance one can see a landscape or feature. The distance that one can see is limited because of tiny particles in the air absorbing and scattering sunlight, which in turn degrades color, contrast, and clarity of the view. Many sources produce the particulate matter that causes haze. Besides the sources of particulate matter discussed above, particulate matter is also formed when gaseous pollutants undergo chemical reactions with sunlight in the atmosphere. Factors such as weather and humidity further influence the formation of haze. The EPA Regional Haze Rule is designed to protect and improve visibility in national parks and wilderness areas throughout the country (EPA 1999). Class I airsheds are federally designated areas under the *Clean Air Act* where no degradation of visibility is allowed. Alaska has 4 Class I areas subject to the rule (ADEC 2010g). The Simeonof Wilderness Area is the closest Class I area to any of the land exchange areas, approximately 125 miles east southeast of the community of King Cove (Wilderness.net 2010). Izembek Wilderness is not designated as a Class I airshed.

3.1.1.3 Existing Air Quality

The national wildlife refuge and non-national wildlife refuge lands included in this analysis are in attainment (unclassifiable) for all criteria pollutants. They are not included in the rural regions of concern for dust problems or complaints, and no air quality monitoring sites are located in the communities of Cold Bay, King Cove, or on national wildlife refuge lands or Sitkinak Island (ADEC 2010b). No criteria air pollutant monitoring data for areas beyond the project areas (such as offshore data from the Bureau of Ocean Energy Management, Regulation and Enforcement) was found; any such data would likely confirm regional attainment, and would potentially not be representative of the local environment for the proposed land exchange.

The major commercial activities in the non-national wildlife refuge areas are commercial fishing in Izembek Lagoon, commercial fishing and seafood processing in the community of King Cove, and air transportation to and from the City of Cold Bay, including between King Cove and Cold Bay airports. Over-water transportation (ferries, cargo/fuel supply vessels, and fishing vessels) is also present across the bay. Although these activities consist of fuel combustion sources, the contribution to decreased air quality from the small population of the area is considered minimal. Residential emission sources (diesel generators, fuel oil stoves, propane heating and/or woodstove) and mobile sources (vehicles) are also minimal due to the small population in the communities. In addition, fairly consistent winds in these coastal areas provide adequate transport and dispersion of these localized emissions.

Federal regulations requiring ultra low sulfur diesel were promulgated by the EPA (EPA 2006b). These regulations are expected to provide an upcoming benefit to air quality in the non-national wildlife refuge lands, where diesel combustion is a source of air pollution. By June 1, 2010, all rural areas in Alaska were to have transitioned to 15 parts per million (ppm) diesel fuel for all highway, non-road, locomotive, and marine engines. By October 1, 2010, retail and wholesale purchaser-consumer transitions were to be complete; and by December 1, 2010, 15 ppm sulfur content diesel fuel was to be in retail facilities in all rural areas (ADEC 2010h).

Based on the physical environment, land uses, and low population density of the parcels associated with the proposed land exchange, existing air quality is assumed to be very good in all of these locations. The switch to ultra low sulfur diesel is expected to show an improvement in air quality, due to reduced emissions of smoke, particulate matter, sulfur dioxide, and toxics from diesel combustion sources.

3.1.2 Climate

3.1.2.1 Introduction

The climate in the northern Gulf of Alaska is categorized as sub-arctic. Frequent storms from the North Pacific and Bering Sea bring moderate temperatures, persistent cloud cover, precipitation, high winds, and variable weather patterns to the region. The areas of interest for the proposed land exchange all fit into this maritime climate category.

The Council for Environmental Quality recommends climate change and impacts of greenhouse gases from proposed projects be evaluated in *National Environmental Policy Act* (NEPA) documents if the proposed action is reasonably anticipated to cause direct emissions of 25,000 metric tons or more on an annual basis. The guidance also requires the assessment of potential climate changes that could affect the proposed alternatives and associated activities (CEQ 2010).

The amount of greenhouse gases in the atmosphere is the cumulative result of past and present emissions (and removals) of greenhouse gases from human and natural processes. Over time, greenhouse gases are removed from the atmosphere due to natural, chemical processes. The removal rate varies between the different gases and can also vary based on conditions such as gas concentration in the atmosphere, changes in vegetation coverage, temperature, or other background chemical conditions (Solomon et al. 2007). Carbon dioxide, methane, and nitrous oxide are considered long-lived greenhouse gases and can remain in the atmosphere from a decade to centuries or more. Due to these properties, cumulative effects to climate change from greenhouse gas emissions are both additive and synergistic in nature. The effects are additive because the more greenhouse gases that are emitted, the higher the greenhouse gas atmospheric concentrations, and consequently the higher the ability to warm the planet which leads to other climate change impacts, such as sea level rise, decrease in snow and ice extent, increase in temperature, ocean acidification, increases in coastal erosion, and increase in storm frequency and intensity. The effects are also synergistic because as the concentration of greenhouse gases in the atmosphere increases, it also affects the ability for these gases to be removed or absorbed by the atmosphere. Therefore, greenhouse gases atmospheric concentrations will continue to increase, and perhaps accelerate, because of the continued increase in emissions and the potential decrease in the removal rate of these gases from the atmosphere (Solomon et al. 2007).

Burning fossil fuels is the largest contributor to carbon dioxide emissions, accounting for approximately $^{2}/_{3}$ of the total since 1750 (Solomon et al. 2007). Scientists have identified specific climate trends that are attributed to these human-caused greenhouse gases emissions, including increases in air temperature, decrease in snow and ice extent, sea level rise, ocean acidification, increases in coastal erosion, and decrease in ice thickness. The past greenhouse gas emissions are expected to lead to warming and climate change in the future, even if greenhouse gases emissions were to halt (Solomon et al. 2007).

Reasonably foreseeable future actions that would contribute to global climate change impacts include but are not limited to actions that emit greenhouse gases, absorb heat, and remove trees that can remove carbon dioxide from the atmosphere. On a global level, the continued use of fossil fuel combustion vehicles, fossil fuel use for manufacturing and energy production, and the continued exploration and development of fossil fuel reserves are some of the major contributors to cumulative climate change effects.

Although emissions resulting from the alternatives being considered within this EIS are expected to be well below the 25,000 metric tons threshold greenhouse gases emissions are calculated for each alternative in Chapter 4 to document the expected levels and to support discussions of climate change effects expected for each alternative.

Best available data for the project area was used to collect baseline conditions for temperature, precipitation, visibility, and wind data. Conditions of proximate waterbodies and associated climate patterns were also considered. It is noted that since this weather data was not available for Sitkinak Island, data from Kodiak Island was used to represent Sitkinak Island. Kodiak Island was chosen because it was identified as the location that best represents Sitkinak Island, due to its proximity, is within the same waterbody as Sitkinak Island, and has available historical weather data.

This weather information is presented below for the Cold Bay area (including Izembek National Wildlife Refuge lands, state lands, and Corporation lands) and the Kodiak area (to represent Alaska Maritime National Wildlife Refuge and Sitkinak Island lands).

3.1.2.2 Cold Bay Area

Temperature and Precipitation

Table 3.1-2 shows the average temperature and precipitation data for the Cold Bay Airport over the last 60 years of records. The annual average temperature is almost 39°F (degrees Fahrenheit), with extremes from -13°F to 77°F. Monthly average temperatures remain stable as the monthly average high and low temperatures vary by 10°F or less. The average rainfall is approximately 38 inches per year and average snowfall accumulates to about 62 inches per year.

Sufficient duration of data is not available at King Cove Airport to generate a historical weather profile. For the community of King Cove, temperatures range from 25°F to 55°F, with extremes from -9°F to 76°F. Snowfall averages 52 inches, and annual total precipitation is 33 inches (AIDEA 2010). Detailed monthly or daily data are not available for the City of King Cove. Even these limited data suggest that notable differences in weather patterns exist between the communities. The mountainous terrain surrounding the King Cove area, with respect to the relatively flat terrain near the City of Cold Bay, influences the different weather patterns at each community.

Table 3.1-2 Average Temperature and Precipitation at the Cold Bay Airport, Alaska

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Temperature (°F)	27.3	29.9	29.3	34.6	40.5	46.8	51.2	52.3	48.0	40.4	34.4	29.2	**38.7**
Average High Temperature (°F)	32.8	32.9	34.4	38.3	44.9	50.6	55.1	55.9	52.3	44.8	38.9	34.8	**43.0**
Average Low Temperature (°F)	23.6	23.5	24.4	28.7	34.9	41.1	46.0	47.4	43.1	35.1	29.9	25.7	**33.6**
Average Total Precipitation (in.)	2.91	2.61	2.46	2.17	2.51	2.42	2.44	3.7	4.3	4.52	4.53	3.69	**38.2**
Average Total Snow Fall (in.)	10.8	10.6	10.8	5.9	1.6	0	0	0	0	2.7	8.3	11.2	**61.8**
Average Snow Depth (in.)	3	2	2	1	0	0	0	0	0	0	1	2	**1**

Source: NOAA 2010c

Visibility and Wind

Persistent cloud cover is common at the Cold Bay Airport. As shown in Table 3.1-3, on average, clouds cover 80 to 100 percent of the sky more than 300 days a year. In addition, visibility can be reduced by dense fog in the summer or blowing snow in the winter. The mean annual wind speed is 16 mph, although maximum wind speeds can exceed 60 mph any month of the year. The prevailing winds at the Cold Bay Airport are from the southeast from January through July, and from the west and north in the fall and early winter.

Wind speeds can vary substantially depending on local terrain. High intensity winds (gap winds) can occur where air is funneled through low-lying areas of mountainous terrain (Pan and Smith 1999). Strong winds, called drainage flows (locally referred to as williwaws), occur when cold, dense air accumulates at higher elevations and flows downslope under the influence of gravity beneath warmer, less dense air (Winstead 2001). The majority of drainage flows result in winds less than 10 mph, but hurricane strength winds can occur (Hines and Bromwich 2008). Given the mountainous terrain of the King Cove area, it is reasonable that wind conditions reported at the Cold Bay Airport may not accurately reflect conditions at the King Cove Airport.

Weather and wind conditions in the King Cove area are likely more influenced by the Gulf of Alaska, while the Cold Bay Airport area is likely to be more influenced by the Bering Sea. This could be a factor in the differences in weather patterns, including wind, between these communities. Specific data to substantiate this are not currently available. A draft King Cove wind assessment report suggests that, while actual wind speeds at King Cove and Cold Bay differ, the pattern of wind speed fluctuations is similar (AEA 2005).

Table 3.1-3 Average Cloud and Wind Conditions at the Cold Bay Airport, Alaska

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Number of Clear Days[1, 4]	2.4	1.9	1.9	0.6	0.5	0.4	0.2	0.2	0.3	0.7	1.1	1.6	**11.9**
Avg. Number of Cloudy Days[2, 4]	23.1	21.8	23.2	25.6	27.7	27.0	28.5	28.9	26.3	25.2	23.5	24.1	**304.7**
Avg. Number of Days with Dense Fog[3, 4]	1.8	1.4	2.0	1.3	1.5	2.0	3.9	3.4	1.0	0.3	0.6	1.6	**20.7**
Average Wind Speed (mph)[4]	15.9	17.2	17.2	17	16.9	14.6	14.1	15	15.4	16.3	17.6	16	**16.1**
Maximum Peak Gust (mph)[4]	83	79	76	79	66	61	63	60	67	67	81	75	**83**
Prevailing Wind Direction[4]	SE	SE	SE	SE	SE	SE	SE	W	W	N	SE	N	**SE**

[1] Clear days indicate 0-30% cloud cover
[2] Cloudy days indicate 80-100% cloud cover
[3] Dense fog indicates less than ¼ mile visibility
Source: NOAA 2010c

Proximate Waterbodies

Waterbodies have a large influence on climate and local weather patterns. The main waterbodies affecting the Cold Bay area are the Bering Sea, Cold Bay, and Gulf of Alaska (North Pacific Ocean).

Bering Sea

The Bering Sea is the water connection between the Arctic Ocean and the Pacific Ocean, constituting a transition between the mid-latitude North Pacific and the Arctic Ocean; it is therefore subject to characteristics inherent to the climate systems of both regions (Bond 2010). The Bering Sea is affected by arctic and continental air masses during the winter and maritime air masses during the summer. An important factor in the climatology of the Bering Sea is the frequency and seasonal change in position and tracks of storm centers across the Bering Sea and the northern Gulf of Alaska (MMS 1985). During winter months, the Bering Sea experiences high winds and frequent storms, which typically occur every 3 to 5 days (McNutt 2010).

Sea ice begins forming in the northern Bering Sea as late as November, and ice may remain into June of the following year. The sea ice affects water temperature, salinity, and ocean currents. The formation, motion, and melting of the ice at the edge play important roles in controlling the heat exchanged between the ocean and the atmosphere, and the amount of salt in the water on the Bering Sea continental shelf (McNutt 2010). During a heavy ice year, the ice edge may advance as far south as Unimak Island and follow the shelf break to the northwest. In average years, the approximate southern limit of the ice edge is in the vicinity of Port Moller, which is north of the Cold Bay area (MMS 1985).

Cold Bay

Cold Bay is situated between the communities of Cold Bay and King Cove. The bay experiences rough waters with uncommonly steep waves and a large number of whitecaps. Conditions closely resemble a fully developed sea, with average wave lengths found to range from approximately 20 to 31 feet long with wave heights to 6 feet (The Glosten Associates 1999).

Detailed information on Cold Bay ice conditions is not available. Six to 10 inches of ice has been known to form on the bay if an extremely cold, calm period exists for several days. Periods of ice cover are typically of short duration (R&M and HLA 1999).

Gulf of Alaska (North Pacific Ocean)

The City of Cold Bay and the City of King Cove are influenced by the Gulf of Alaska weather systems. Storms, called Gulf of Alaska Lows, form southwest of the Aleutians as a frontal wave associated with thermal gradients (cold northern air and warm southern air) (NOAA 2010a). These storms tend to linger, representing major precipitation events and persistent winds, setting the stage for wave generation, with potential to cause direct wind damage along the south and southeast coast of Alaska.

3.1.2.3 Kodiak

Temperature and Precipitation

Sitkinak Island does not have a weather station and climate records for the island are not available. Data for Kodiak Island are being used as a proxy for weather patterns that may occur on Sitkinak Island. Average temperatures on Kodiak Island range between 30°F and 60°F, with average monthly mean temperatures around 40°F (Table 3.1-4). Similar to Cold Bay Airport, temperatures do not vary substantially, as annual mean high and low temperatures are less than 10°F apart.

Table 3.1-4 Average Temperature and Precipitation in Kodiak, AK

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Mean Temperature (°F)	29.4	31.9	31.7	37.7	44.5	50.1	54.8	55.5	49.4	40.3	34.0	29.9	**40.8**
Average High Temperature (°F)	35.5	35.9	38.5	43.6	50.1	55.7	60.3	61.8	56.2	47.1	39.7	36.5	**46.7**
Average Low Temperature (°F)	26.3	25.7	27.6	32.4	38.6	44.3	49.1	49.0	43.4	34.7	28.9	26.0	**35.5**
Average Total Precipitation (in.)	8.64	6.12	5.26	5.53	6.05	5.56	4.68	4.72	7.52	8.61	6.85	8.38	**77.9**
Average Total Snowfall (in.)	14.5	15.8	12.9	7.5	0.4	0	0	0	0	1.3	7.1	15	**74.6**
Average Snow Depth (in.)	2	2	1	0	0	0	0	0	0	0	0	1	**1**

Source: NOAA 2010c

Visibility and Wind

Kodiak Island is frequented by persistent clouds with more than 230 days a year with clouds covering more than 80 percent of the sky (Table 3.1-5). Nearly 60 days annually are clear. Average wind speed is approximately 10 mph, with maximum gusts in excess of 40 mph in any month. Wind speeds can vary significantly depending on local terrain. The prevailing winds at the Kodiak Airport are from the northwest from August through May, and from the east during June and July.

Table 3.1-5 Average Cloud and Wind Conditions for Kodiak, AK

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Number of Clear Days[1, 4]	5.3	6.0	6.4	4.4	3.2	3.4	3.1	4.2	4.0	5.8	7.0	6.0	**58.8**
Average Number of Cloudy Days[2, 4]	20.0	17.6	18.0	19.5	22.3	20.9	22.3	19.8	18.6	17.4	16.4	19.4	**232.4**
Average Number of Days with Dense Fog[3, 4]	1.0	1.2	0.91	0.3	1.3	1.6	3.0	2.5	0.9	0.3	0.2	0.8	**14.1**
Average Wind Speed (mph)[4]	12.2	11	11.9	11	9.8	9.2	7.8	7.9	9.4	10.7	11.4	12.7	**10.4**
Maximum Peak Gusts (mph)[4]	66	62	64	66	52	43	49	60	63	58	60	87	**87**
Prevailing Wind Direction[4]	NW	NW	NW	NW	NW	E	E	NW	WNW	NW	NW	NW	**NW**

[1] Clear days indicate 0-30% cloud cover
[2] Cloudy days indicate 80-100% cloud cover
[3] Dense fog indicates less than ¼ mile visibility
[4] Source: NOAA 2010c

3.1.2.4 Climate Patterns and Trends

The Pacific Decadal Oscillation and the Arctic Oscillation represent patterns of climate variability that are believed to influence the climate patterns and trends of the project area. The Pacific Decadal Oscillation is used to describe the fluctuation in northern Pacific sea surface temperatures that alter between above normal (negative phase) and below normal (positive phase). These cycles operate on a 20- to 30-year time scale (NOAA 2010b). These oscillations have been shown to be associated with dramatic shifts in the climate of the North Pacific around 1948 and 1976 (Bond 2010). The last major shift in the Pacific Decadal Oscillation occurred in 1976-77 and marked a change from cold to warm conditions in Alaskan waters (Bond 2010).

Indications are the Arctic Oscillation also plays a role in the climate patterns of the North Pacific. The Arctic Oscillation exhibits a negative and positive phase. The negative phase is characterized with relatively high pressure over the polar region and low pressure at mid-latitudes (about 45 degrees North); the pattern is reversed in the positive phase. In the positive phase, higher pressure at mid-latitudes drives ocean storms farther north, and changes in the circulation pattern bring wetter weather to Alaska. Frigid winter air does not extend as far into the middle of North America as it would during the negative phase of the oscillation. Weather patterns in the negative phase are in general opposite to those of the positive phase (NSIDC 2010). Over most of the past century, the Arctic Oscillation alternated between its positive and negative phases. Starting in the 1970s, however, the oscillation has tended to stay in the positive phase, causing lower than normal arctic air pressure and higher than normal temperatures in much of the United States.

Recent climate trends in the vicinity of the project area and potential greenhouse gas emissions resulting from the proposed project could also be attributed to global climate change. Since the Bering Sea and North Pacific are subject to changes inherent to the climate cycle systems of both the Pacific Decadal Oscillation and Arctic Oscillation, climate patterns and trends in the project area are complex with several contributing factors.

3.1.3 Geology and Soils

Documents available from local, state, and federal agencies, consultants, and academia were used to identify and describe geologic resources within, adjacent, and in relative proximity to the proposed land exchange areas.

3.1.3.1 Regional Geology Overview

The Cold Bay region lies within the Alaska-Aleutian physiographic province and Alaska Peninsula-Aleutian Islands subprovince (Wahrhaftig 1965). The Alaska Peninsula-Aleutian Islands subprovince includes the southwestern extent of the Alaska Peninsula and the arcuate chain of volcanoes that extend further west out to Attu Island. The chain of volcanoes is commonly referred to as the Aleutian Arc (Nye 1994). The Alaska Peninsula is composed of late Paleozoic to Quaternary age sedimentary, igneous, and minor metamorphic rocks (Wilson, Detterman, and DuBois 1999). Late Pleistocene age glaciation has carved the mountains of the Alaska Peninsula and produced deposits within lowlands bordering the rugged coastlines of the Pacific Ocean to the south and Bering Sea to the north. The glaciated mountains rise 600 to almost 6,000 feet above sea level and are indented with fjords and bordered by cliffs as high as 2,000 feet (Wahrhaftig 1965). Frosty Peak volcano southwest of the project area has an elevation of 5,803 feet. Mount Dutton volcano east of Cold Bay has an elevation of 4,834 feet.

Sitkinak Island lies within the Pacific Border Ranges physiographic province and Kodiak Mountains subprovince (Wahrhaftig 1965). The Kodiak Mountains subprovince includes a group of mountainous islands that are the structural continuation of the Kenai-Chugach Mountains in southcentral Alaska. Sitkinak Island lies southwest of Kodiak Island and is 1 of 3 islands that make up the Trinity Islands. Sitkinak Dome on Sitkinak Island has an elevation of 1,640 feet. Sitkinak Island is composed of Tertiary age sedimentary rocks consisting of sandstones, siltstones, conglomerates, and carbonaceous shale (Clendenen, Sliter, and Byrne 1990). Rocks on Sitkinak Island have a dominant structural trend to the northeast pronounced by normal faults bordering the northwest and southeast edges of Sitkinak Lagoon. Sitkinak Lagoon lies within a down-dropped graben structure (Anderson 1969; Clenden, Sliter, and Byrne 1990). The proposed land exchange areas lie within the down-faulted structure.

3.1.3.2 Geology of the Cold Bay Region

The Cold Bay region includes Tertiary and Quaternary age igneous rocks originated from 3 nearby volcanoes; Frosty Peak and Mount Dutton located west and east of Cold Bay, respectively, and the large Emmons Lake Volcanic Center, including Pavlof and Pavlof Sister volcanoes located northeast of Mount Dutton (Kennedy and Waldron 1955; Wilson et al. 1997; Motyka et al. 1993; Wilson and Weber 1999; Waythomas, Miller, and Mangan 2006). The region also includes Tertiary age sedimentary rocks and Quaternary age surficial deposits of colluvium, alluvium, and glacial sediments. The surficial units mapped within the Izembek National Wildlife Refuge, state lands, and Corporation lands include glacial drift, glacial outwash, dune deposits, alluvium, and undifferentiated moraine deposits (Wilson et al. 1997). The bedrock units mapped within state and Corporation lands include Quaternary and Pliocene age volcanic rocks (Wilson and Weber 1999).

3.1.3.3 Geology of Sitkinak Island

The geology of Sitkinak Island consists of 4 formations (Clendenen, Sliter, and Byrne 1990). The oldest is the Eocene age Sitkalidak Formation of interbedded sandstone and siltstone, mudstone, and conglomerate. Overlying the Sitkalidak Formation is the Oligocene age Sitkinak Formation of conglomerate and sandstone alternating with fine grained sandstone, siltstone, coal, and carbonaceous shale. Overlying the Sitkalidak Formation is the earliest Miocene or late Oligocene age Siltstone of Trinity Islands. The Siltstone of the Trinity Islands is overlain by the Pliocene or late Miocene age Albatross sedimentary sequence of a thick distinctive layer of diamictite and calcareous shale bearing conglomerates (Clendenen, Sliter, and Byrne 1990). The youngest consolidated deposits are Quaternary age raised marine terraces. The unconsolidated surficial deposits that occur along the north and southwest coastlines of Sitkinak Island are Quaternary age alluvium.

The proposed land exchange area includes the Quaternary alluvium and marine terrace deposits, and the sedimentary rocks of the Sitkalidak Formation and younger Sitkinak Formation.

3.1.3.4 Soils of the Cold Bay Region

No recent federal soil surveys conducted by the U.S. Department of Agriculture, Natural Resources Conservation Service were found for the project area. The general soil taxonomy of the region is from the statewide soil survey conducted in 1979 (National Cooperative Soil Survey 1979). The predominant soil types of the region are classified as inceptisol andepts, with typic cryandepts soils within the Cold Bay region and minor occurrence of histosol fibrists, with fluvaquentic cryofibrists soils in the area northwest of Cathedral Valley.

Andepts are inceptisols formed in volcanic ash. Many have buried surface horizons because of repeated deposits of ash. Typic cryandepts are those in which less than half of the soil between depths of 10 and 40 inches exhibits thixotropic properties. Thixotropic is a term that describes a medium that behaves as a solid or semi-solid when undisturbed, but becomes fluid when agitated. Thixotropic soil failure or liquefaction is a common natural hazard associated with earthquake ground shaking. Areas where the proposed road corridor may cross these types of soils will require an evaluation of the susceptibility of the soil to lose its physical integrity due to seismic activity. Typic cryandepts are dark reddish brown or dark brown in color. Some are made up mostly of ash grains of sand or cinder size. Others consist of fine thixotropic ashy material that forms a fairly thin layer over other material (National Cooperative Soil Survey 1979).

Fibrists are histosols in which the subsurface layering consists principally of undecomposed or only slightly decomposed organic material. They are generally confined to low areas, but a few occur on steep north-facing slopes, which receive little direct sunlight. Fibrists in Alaska are composed principally of sphagnum moss peat and sedge peat, either alone or in layers of varying thickness. Fluvaquentic cryofibrists remain unfrozen throughout the year and contain thin layers of mineral material at depths greater than 12 inches. In Alaska, these soils are composed principally of sedge peat. They occur in both floodplains and coastal plains in the Alaska Peninsula where the mineral layers are made up of volcanic ash. The vegetation is almost entirely sedges (National Cooperative Soil Survey 1979).

Private consultants have conducted geotechnical investigations for the Aleutians East Borough and State of Alaska Department of Transportation and Public Facilities (Shannon and Wilson

2003; Miller, Duane and Associates 2003; Golder Associates 2010). The geotechnical investigations gathered information from excavated test pits and drilled soil borings. The investigations for Aleutians East Borough were conducted within surficial deposits similar to those that occur within the lands proposed for exchange. The major soil types encountered include gravelly sands and sandy silts, overlain by soft organic peat and silt. No permafrost was encountered during the geotechnical investigations (Miller, Duane and Associates 2000, 2003; Golder Associates 2010).

3.1.3.5 Soils of Sitkinak Island

No recent soil surveys were found for Sitkinak Island. The general soil taxonomy of the region is from the statewide soil survey conducted in 1979 (National Cooperative Soil Survey 1979). The entire island is composed of loamy dystric cryandepts, an andept inceptisol. Dystric cryandepts exhibit thixotropic properties in more than half of the soil between depths of 10 and 40 inches. Typically, they are strongly acidic and very dark, with a high percentage of organic matter. Other information about soil on Sitkinak Island includes the Quaternary age alluvium that occurs along the north and southwest coastlines of the island. At those areas, the unconsolidated alluvium would likely be sands and gravels.

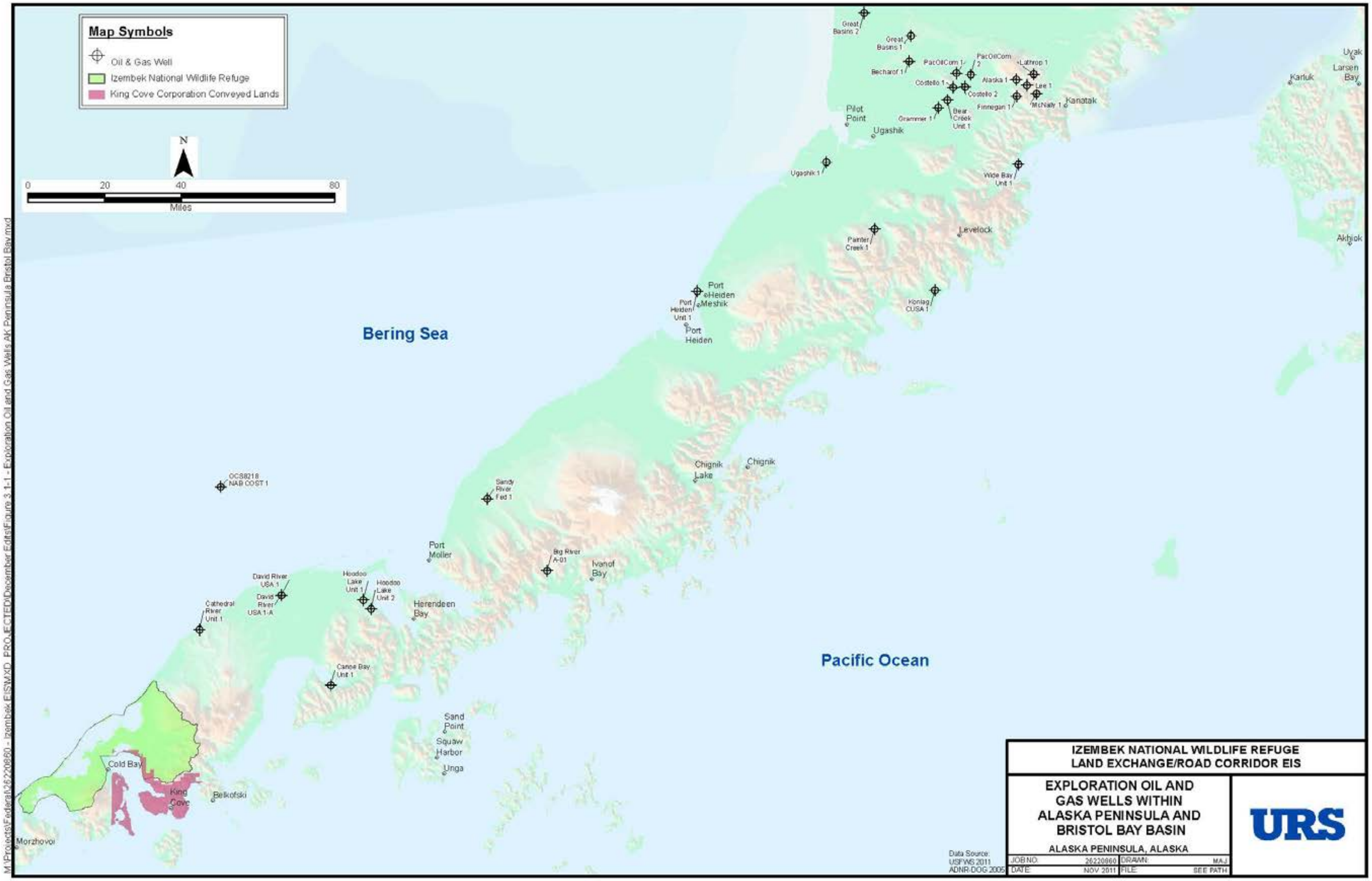
3.1.3.6 Oil and Gas Resource Potential

The northwestern half of the Alaska Peninsula is an alluvium-covered lowland underlain, for the most part, by up to 18,000 feet of Tertiary age sedimentary rocks that thicken to the west to become the Bristol Bay sedimentary basin (ADNR-DOG 2005). The offshore Bristol Bay basin is a sediment-filled structural depression that underlies a large portion of the continental shelf north of the Alaska Peninsula. The Bristol Bay basin lies within the North Aleutian Basin Planning Area. The Alaska Department of Natural Resources, Division of Oil and Gas has offered available state acreage in the Alaska Peninsula and Cook Inlet in area-wide oil and gas lease sales. Twenty-six oil wells have been drilled on the Alaska Peninsula since 1903. The location of oil and gas exploration wells within the Alaska Peninsula and Bristol Bay region are presented in Figure 3.1-1. Hydrocarbon potential for the northern coastal plain between Becharof Lake and a narrow strip of coastline ending northeast of Cold Bay is expected to be moderate to locally high for gas, and low to moderate for oil (ADNR-DOG 2005; Helmold and Brizzolara 2005).

Tertiary age sedimentary rocks within the Kodiak Island Stratigraphic province, including the Trinity Islands, was evaluated by the Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys and the U.S. Geological Survey for their petroleum reservoir and hydrocarbon source-rock potential. The Sitkalidak and Sitkinak formations exposed on Sitkinak Island were included in the evaluation. Both formations were considered the most probable to host hydrocarbon resources off-shore within the Tugidak Basin located southwest of Sitkinak Island, and the Albatross Basin located east of Sitkinak Island (Lyle et al. 1978; Hampton 1982). To date, no exploratory oil and gas drilling has occurred in the basins.

None of the proposed land exchange areas have experienced oil and gas exploration activity. The 2005 best interest finding for the Alaska Peninsula Area-wide oil and gas lease sales was supplemented on February 4, 2010 to defer the tracts in the North Creek Unit because of the proposed land exchange.

Figure 3.1-1 Exploration Oil and Gas Wells within Alaska Peninsula and Bristol Bay Basin



3.1.3.7 Economic Mineral and Non-Mineral Resource Potential

Base and precious metal prospects were identified from U.S. Geological Survey Alaska Resource Data Files for the Cold Bay Quadrangle (USGS 1997) and the Trinity Islands Quadrangle (USGS 1999). Fifteen mineral prospects were identified in the Cold Bay Quadrangle, with 5 occurring within the Izembek National Wildlife Refuge and Wilderness lands. None of the 5 occurrences are within areas of the proposed land exchange. Gold, silver, copper, iron, and zinc were the primary mineral resources identified (USGS 1997). The majority of the findings were identified from reconnaissance mapping and stream sediment sampling and analysis. The location of documented mineral resources in the study area is presented in Figure 3.1-2.

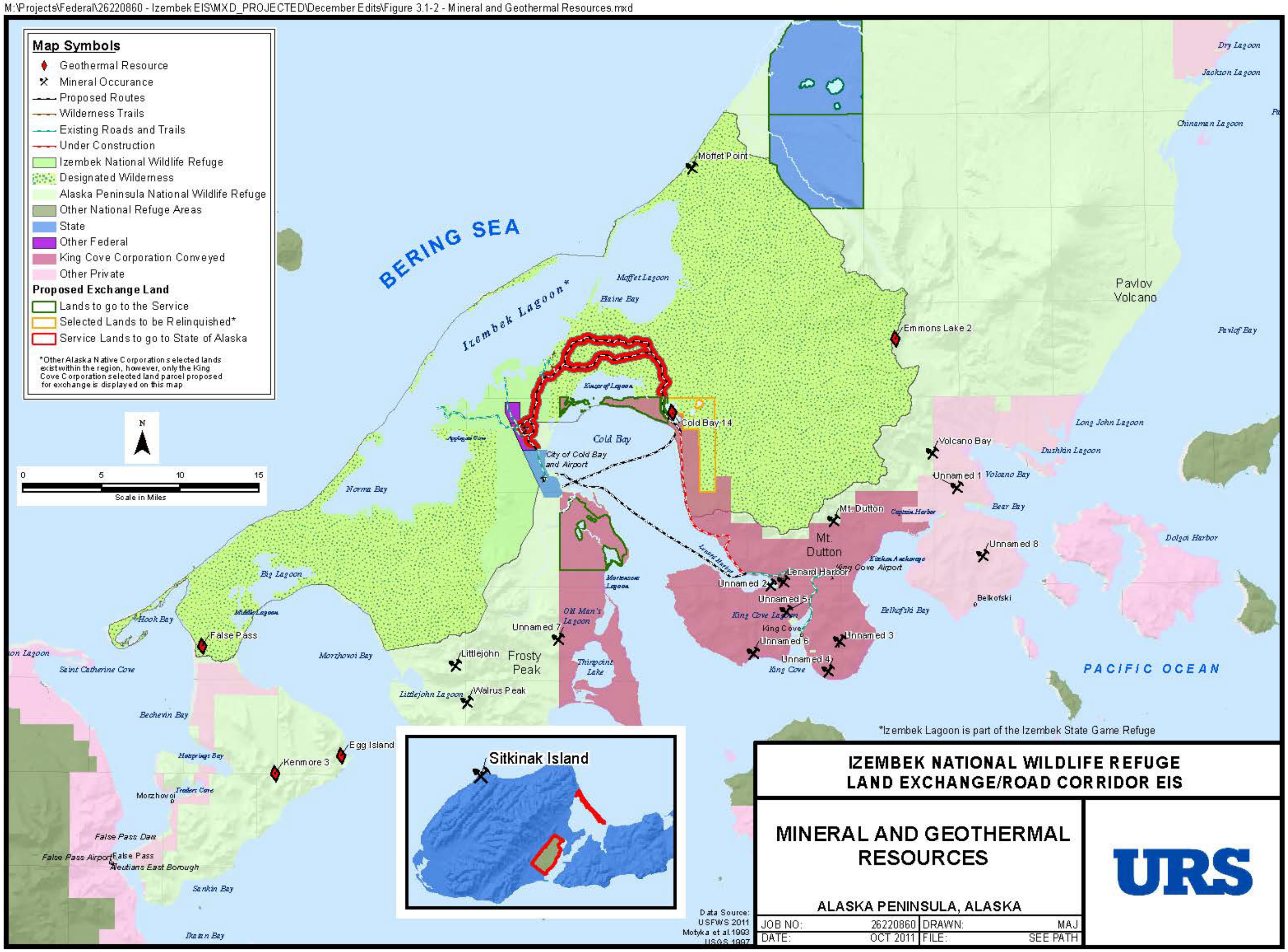
Within the Trinity Islands Quadrangle, 5 mineral prospects were identified, with 1 occurring on Sitkinak Island. The Sitkinak Island prospect consists of the beaches along the north, west, and south coasts of the island. The beach prospects were primarily placer deposits for gold. Active placer claims were reported in 1996 at the beaches on the north, west, and south coasts of Sitkinak Island (USGS 1999). None of the claims were reported within the proposed land exchange areas.

A known geothermal resource consisting of 14 thermal springs along the southwest flanks of Mount Dutton are adjacent to King Cove Corporation lands proposed for exchange (Motyka et al. 1993). The location of known geothermal resources in the study area is presented in Figure 3.1-2.

Industrial mineral resources of sand and gravel aggregate and hard rock crushed stone were identified from geological mapping and potential quarry site evaluations conducted for the King Cove Access Project (Golder Associates, Inc. 2010). Four quarry sites and five borrow material stockpile areas were identified in the vicinity of the City of King Cove. The four quarry sites identified include King Cove Airport Access Road, King Cove Crab Pot, King Cove Landfill, and Lenard Harbor Lower/Mid-Slope. The Airport Access Road quarry is also referred as the Talus Quarry. The source bedrock at the Airport Access Road and Crab Pot quarry sites is a granodiorite/quartz diorite plutonic rock. The source bedrock for the landfill quarry site is dark green metamorphic sandstone of the Belkofski Formation. The source bedrock at the Lenard Harbor quarry site is a dark gray basaltic andesite volcanic rock (Golder Associates, Inc. 2010). The five borrow material sites investigated by Golder Associates included both unprocessed and processed (crushed) stockpiles. One of the stockpiles was located south of the Northeast Terminal, three other stockpiles were located along the King Cove Access Road, and the fifth stockpile was located northwest of the temporary Lenard Harbor Hovercraft Terminal. The source material for the five borrow sites included both glacial outwash sand and gravel deposits and igneous and metamorphic bedrock (Golder Associates, Inc. 2010).

Figure 3.1-2 Mineral and Geothermal Resources

M:\Projects\Federal\26220860 - Izembek EIS\MXD_PROJECTED\December Edits\Figure 3.1-2 - Mineral and Geothermal Resources.mxd



3.1.3.8 Geologic Hazards

The Aleutian subduction zone to the south of the Alaska Peninsula is one of the most active seismic zones in the world. Great earthquakes are common along the length of the Aleutian Arc and violent ground motion is a major potential hazard (Stevens and Craw 2004). The Aleutian subduction zone has generated multiple great earthquakes and associated tsunamis, including the 1938 Magnitude 8.3 Alaska Peninsula, the 1946 Magnitude 7.8 Unimak, the 1957 Magnitude 8.6 Fox Islands, the 1964 Magnitude 9.2 Great Alaska, and the 1965 Rat Islands earthquakes (Davies et al. 1981; Johnson and Satake 1994; Johnson et al. 1994; Plafker 1969; Christensen and Beck 1994; Beck and Christensen 1991).

Located east of the project area is the Shumagin Seismic Gap, identified in late 1970s (Davies et al. 1981). Seismic gaps are areas along an active fault that have had little or no seismic activity for a long period of time. Stress builds in these seismic gaps and can indicate potential for earthquake activity. Recent studies using updated geodetic measuring techniques indicate a complex dynamic in plate geometry within the region (Mann and Freymueller 2003; Hudnut 2010).

The Cold Bay region has a moderate potential of flooding originating from tsunami waves generated by seismic activity. The 1957 Magnitude 8.6 Fox Islands earthquake generated a tsunami that reached a height of 49 feet that inundated the coastline at Scotch Cap and a 26-foot high tsunami that washed away many buildings and damaged pipelines extensively in Sand Bay. This tsunami continued to cause property damage in Hawaii on Oahu and Kauai islands and at San Diego Bay in California (Johnson et al. 1994). Areas where the proposed road corridor may cross volcanic rich soils will likely require an evaluation of the susceptibility of these soils to lose their physical integrity due to liquefaction generated by seismic activity.

The Aleutian Arc contains 52 currently active volcanoes, and many more that are dormant. Three active volcanoes are within 30 miles (48 kilometers) of the project area (Stevens and Craw 2004); they are Mount Dutton, Pavlof, and Pavlof Sister. Volcanic activity can endanger lives of people and damage property both near and far. Most of the activity involves the explosive ejection or flowage of rock fragments and molten rock in various combinations of hot or cold, wet or dry, and fast and slow. Volcano hazard assessments are conducted by evaluating past volcanic eruption styles and their respective distribution of lava flows, pyroclastic flows, and ash. The assessments are based on the premise that past eruptive histories of volcanoes provide the best basis for judging the most likely kinds, frequencies, and magnitudes of future volcanic events (Hoblitt, Miller and Scott 1987; Tilling 1989).

The six main types of volcano hazards are gases, lahars, landslides, lava flows, pyroclastic flows, and tephra. The primary volcanic hazards within the project area are volcanic ash clouds and volcanic ash fallout (Waythomas, Miller, and Mangan 2006). Volcanic ash clouds and volcanic ash fallout are types of volcanic tephra.

Tephra is a general term for fragments of volcanic rock and lava regardless of size that are blasted into the air by explosions or carried upward by hot gases in eruption columns or lava fountains. These fragments fall back to earth on and downwind from their source volcano to form a tephra (or volcanic ash) deposit. Large fragments fall close to the erupting vent, and progressively smaller ones are carried farther away by wind. Dust-size particles can be carried hundreds of miles from the source. Deposits blanket the ground with a layer that decreases in thickness and particle size away from the source. Near the vent, deposits may be tens of feet thick. Eruptions that produce tephra range from those that eject debris only a few feet to cataclysmic explosions that throw debris several tens of miles into the atmosphere. Explosive eruptions that produce voluminous tephra deposits also typically produce pyroclastic flows. Tephra eruptions generally do not completely destroy facilities or kill people, but may adversely affect both in many ways. (Tilling 1989).

Alaska volcanoes are potentially hazardous to passenger and freight aircraft as jet engines can fail after ingesting volcanic ash (AVO 2011; Casadevall 1994). Mount Pavlof last erupted in 2007 (AVO 2011). Mount Dutton was the site of intense earthquake swarms from 1984-85 and 1988 (Stevens and Craw 2004).

3.1.4 Hydrology/Hydrologic Processes

Documents publicly available from local, state, and federal agencies, consultants, and academia were used to identify and describe water resources within, adjacent, and in relative proximity to the proposed land exchange areas. This summary includes surface water and groundwater information.

3.1.4.1 Regional Hydrology Overview

Hydrology of the project area is typical of coastal Alaska Peninsula locations. Wave-driven transport has resulted in the formation of spits and bars on the Pacific shores of Cold Bay (Rice and Hogan 1995). Broad level intertidal platforms border some islands. A 2-layered estuarine-circulation tidal system is common in the coastal areas of the Alaska Peninsula. This phenomenon is seasonal and begins during the spring thaw with an increase in freshwater discharge. The freshwater flows seaward along the surface and is replaced by saline water that intrudes at greater depths (Rice and Hogan 1995). During the fall and winter, storms and reduced runoff combine to thoroughly mix the layers and destroy the system. Tidal fluctuations also may contribute to the mixing and circulation of fresh water and salt water. Table 3.1-6 lists the tidal fluctuations for Izembek Lagoon (at Grant Point), King Cove, Cold Bay, and Lenard Harbor. Marine characteristics are further described in Section 3.1.7.

Table 3.1-6 Tidal Ranges for Cold Bay Region

Tidal Station	Mean Range (feet)	Spring Range (feet)	Mean Tide Level (feet)
King Cove	4.8	6.8	3.7
Lenard Harbor	5.1	7.2	3.8
Cold Bay	5.2	7.1	3.8
Izembek Lagoon	3.2	4.5	2.6
Kinzarof Lagoon	7.2	N/A	N/A

Streams on the Alaska Peninsula are generally short and swift, and streams within the Kodiak Mountains (representing Sitkinak Island) are less than 10 miles long. Porous rock on the flanks of volcanoes have widely spaced stream courses that are filled with water only during exceptionally heavy rains (Wahrhaftig 1965). Average Cold Bay rainfall is approximately 38 inches per year and average snowfall is approximately 62 inches per year (see Section 3.1.2). Tundra streams originate from lakes or springs in low coastal wetlands and generally have lower gradients and less fluctuation in flow regime. Upland streams that originate on steep slopes have higher gradients and large fluctuations in flow regime.

Hundreds of freshwater ponds, lakes, small streams, and creeks occur throughout the area. Landlocked open lakes generally have stream connections to saltwater. Many small lakes occupy irregular ice-carved basins in rolling topography on the glaciated lands. Many ponds were enlarged when ice, expanding by freezing, shoved banks aside to form ramparts of soil and turf. Lakes fill a few volcanic craters and calderas (Wahrhaftig 1965).

3.1.4.2 Hydrology of the Cold Bay Region

Cold Bay, Izembek Lagoon, Moffet Lagoon, and Kinzarof Lagoon are the main marine waterbodies within the project area. Numerous freshwater lakes and streams also exist throughout the area. The lakes are generally shallow and typically the surfaces freeze for 2 to 3 months on average beginning in mid-January (Rice and Hogan 1995). The 3 largest streams are the Joshua Green River, Trout Creek, and Russell Creek. Joshua Green River drains the northwest flanks of Mount Dutton and discharges to the north into Moffet Lagoon, which makes up the northeast portion of Izembek Lagoon. Trout Creek drains the lowlands west of the Cold Bay Airport discharging into Cold Bay north of the City of Cold Bay. Russell Creek is located roughly 2.5 miles southwest of the City of Cold Bay. It originates on the slopes of Frosty Peak volcano, flowing generally from southwest to northeast, and drains into Cold Bay. Numerous other small streams also discharge into Cold Bay and Kinzarof Lagoon. In addition, several other small streams drain to the north into Moffet and Izembek lagoons. The isthmus between Izembek and Kinzarof lagoons serves as a divide between discharges to the north into the Bering Sea and to the south into Cold Bay and the Pacific Ocean. All surface water drainages within the project area are classified within a single hydrologic unit, U.S. Geological Survey Hydrologic Unit 19030101 (USGS 2010b). An approximate hydrologic boundary between Izembek Lagoon and Kinzarof Lagoon (based upon U.S. Geological Survey 1:63,360 topographical maps) is presented in Figure 3.1-3.

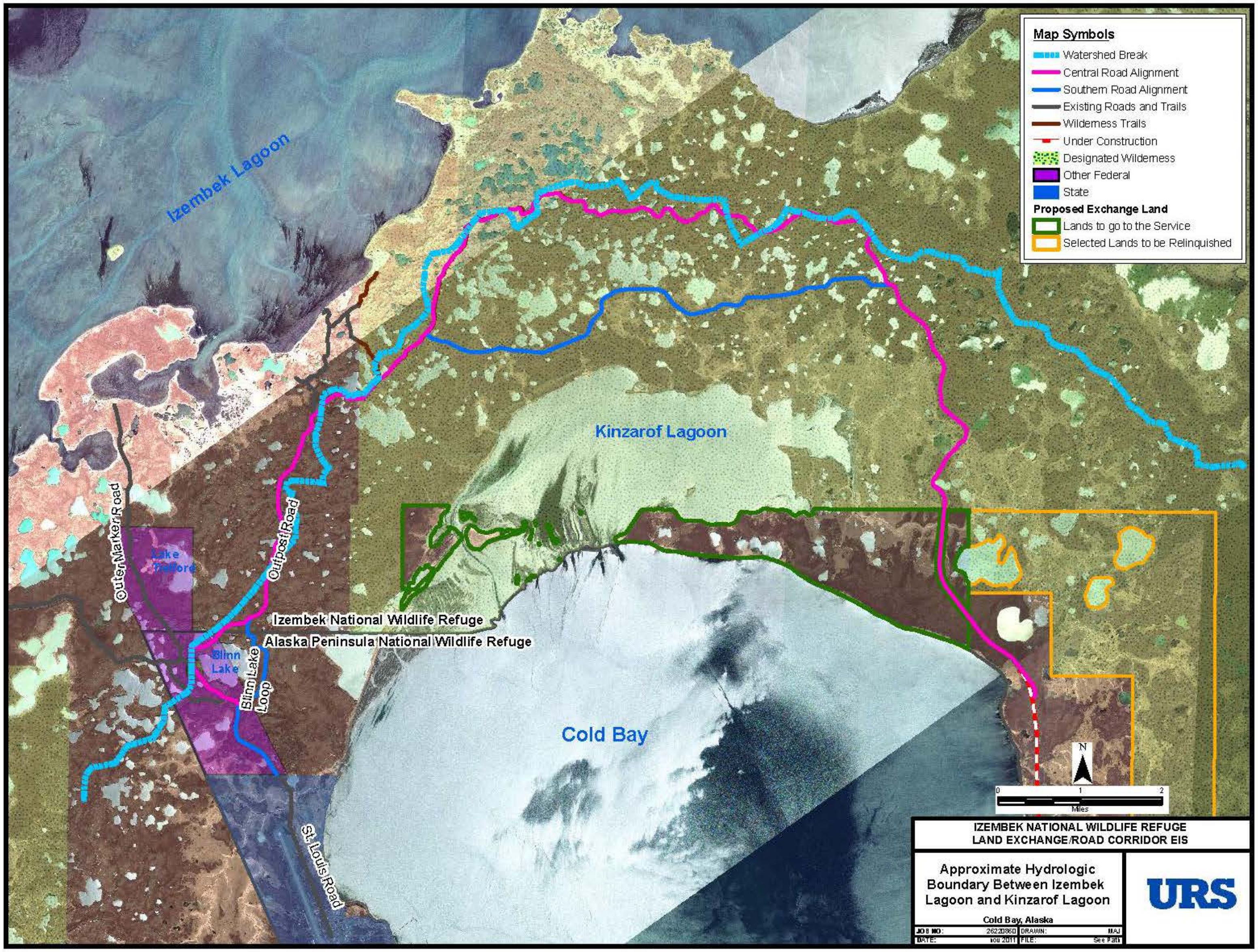
Stream flow data is available for 3 streams in the area. Russell Creek, a stream of notable size, is about 16 miles long and drains an area of approximately 25 square miles. Russell Creek is the only stream within the hydrologic unit that is monitored on a real-time basis by the U.S. Geological Survey at stream flow gaging station 15297610 near Cold Bay. The lowest flows typically occur during March and April and the highest flows typically occur from July to December. Mean flow ranges from 310 to 403 cubic feet per second (Rice and Hogan 1995).

Stapp Creek (gaging station 15297609) located approximately 1 mile south of the City of Cold Bay, has a drainage area of 1.68 square miles. Maximum discharge was recorded on April 28, 2009 at 48.9 cubic feet per second, with a gage height measurement of 16.08 feet (USGS 2010b). For water year 2008 to 2009, discharge ranged from 1.12 to 2.15 cubic feet per second.

Delta Creek near King Cove has been monitored by the Alaska Department of Natural Resources, Division of Mining, Land, and Water. During a peak discharge event in October 1988, flow was measured at 37.6 cubic feet per second. The width of Delta Creek ranges from 14 to 22 feet during peak discharge and depths of 1.9 to 2.1 feet (ADNR-DMLW 2010).

Potential construction water sources include 3 lakes and 1 creek. The creek water source would be at stream system # 283-34-10700, located approximately 2 miles north of the Northeast Terminal. Intake would be limited to 600 gallons per minute. Source lakes include a 128-acre lake mid-way along the southern alternative that is connected to stream system # 283-34-10500, a 33-acre lake on the western side of both road alternatives that is not connected to any anadromous streams, and Blinn Lake (150 acres, not connected to anadromous streams) at the western terminus of the road alternatives. Locations and preliminary estimates of quantities are shown in Appendix E.

Figure 3.1-3 Approximate Hydrologic Boundary between Izembek Lagoon and Kinzarof Lagoon



In the Cold Bay area, groundwater generally exists under unconfined conditions within the sand and gravel lenses associated with glacial deposits. In the underlying volcanic bedrock, groundwater may occur in secondary openings such as fractures and joints. Groundwater is recharged by infiltration of rainfall and snowmelt. Many groundwater monitoring wells have been installed near the Cold Bay Airport as part of environmental investigations related to releases of hazardous waste and petroleum products (Rice and Hogan 1995; USACE 2004, 2005; ADEC 2005). Near the Cold Bay Airport, the depth to groundwater ranges from approximately 7 to 85 feet below ground surface.

Cold Bay has a low flood hazard rating; however, it is subject to potential flooding from storm-surge or tsunami waves generated by seismic activity. Overbank flooding of stream channels may occur during the months from July to October, and is primarily the result of intense rainfall augmented by melting snow (Rice and Hogan 1995).

3.1.4.3 Hydrology of Sitkinak Island

Sitkinak Lagoon and Mark Lake are the main surface waterbodies on Sitkinak Island. The largest unnamed streams drain the northwest flanks of Sitkinak Dome and discharge into Tugidak Passage and Sitkinak Strait. Fluctuations in streamflow are caused by variations in precipitation and temperature. Sitkinak Island is within U.S. Geological Survey Hydrologic Unit 19020701 that includes all of the Trinity Islands and Kodiak Island. No stream gages are located on Sitkinak Island (USGS 2010c).

Geologic factors exert the major control on the occurrence and availability of groundwater. The sedimentary rocks that underlie Sitkinak Island are fairly dense and impermeable. The occurrence of groundwater in such rocks is irregular and unpredictable, and water is generally obtained only from secondary openings. Groundwater is more readily available from unconsolidated materials such as alluvial sand and gravel and unconsolidated coastal and marine deposits that may be in hydraulic connection with surface waters (Jones, Madison, and Zenone 1978).

3.1.4.4 Water Quality of the Cold Bay Region

All waters of the State of Alaska are regulated under Chapter 18 of the Alaska Administrative Code (AAC). Surface and groundwater quality is regulated by the Alaska Department of Environmental Conservation by the authority of 18 AAC 70 (ADEC 2009a) and 18 AAC 75 (ADEC 2008), respectively. Drinking water is regulated by 18 AAC 80 (ADEC 2009b).

In June 1993, Izembek National Wildlife Refuge personnel conducted water resource threat evaluations for 14 streams (Service 1993). Frosty Creek, Joshua Green River, Trout Creek, and Russell Creek were among the streams monitored for the potential for threats from mining, hydropower, oil and gas exploration and development, gravel extraction, agriculture irrigation, logging, aquaculture, public water supply withdrawal, industrial water supply, community waste disposal, and transportation system impacts. Among the criteria, the highest threat was from transportation system impacts, where Frosty Creek, Trout Creek, and Russell Creek had a high threat from existing roads, pipelines, and/or ice roads; and Joshua Green River had a low threat from the potential development of ice roads, roads, and pipelines. Russell Creek also had a high threat from active gravel extraction and a low threat from potential development of aquaculture. Frosty Creek, Russell Creek, and Joshua Green River were evaluated to have medium threat from waterfowl overwintering habitat, whereas Trout Creek was evaluated to have a low threat from waterfowl overwintering. See Figure 3.2-9 for the locations of waterbodies.

Zoonotic protozoa, including *Giardia*, *Cryptosporidium*, and *Toxoplasma*, are parasites from human and animal feces that enter ecosystems via storm run-off. These parasites have been found in estuaries and coastal waters of the United States and have contaminated marine mammals and shellfish, and impacted freshwater streams. *Toxoplasma gondii* antibodies have been documented in marine mammals in Alaska with the highest percentage of occurrences found in bearded seals (Fayer, Dubey, and Lindsay 2004). *Toxoplasma gondii* oocysts can sporulate in sea water and remain infectious for several weeks providing an avenue for contamination of shellfish fed on by marine mammals in this region (Fayer, Dubey, and Lindsay 2004).

Groundwater is the principal drinking water source for the Cold Bay region. The community of Cold Bay is supplied with water extracted from several wells and stored in a 213,000-gallon tank. Residents are either served by a piped system from that source or have individual wells (ADCCED 2010a; ADEC 2010e). The water from the community wells is filtered and chlorinated to comply with drinking water regulations set by Alaska Department of Environmental Conservation and the EPA. The aquifer tapped by these wells is unconfined and shallow, and thus vulnerable to contamination. The City of Cold Bay Public Water System Number AK2260414 serves approximately 100 people and is monitored for total coliform bacteria and residual chlorine on a monthly basis, and for lead and copper every 3 years.

The City of King Cove Public Water System Number AK2260244 serves more than 700 people from several wells and has a similar monitoring program as the City of Cold Bay Public Water System. Water for the City of King Cove is also supplied by Ram Creek with a sheetpile dam that stores about 980,000 gallons of unfiltered water. All King Cove residents are connected to the piped water system (ADCCED 2010a).

Review of the federal *Clean Water Act* Impaired Water Section 303(d) listings indicated that no known impacted watersheds are present on the lands proposed for exchange.

Russell Creek and many small lakes represent alternative drinking water sources. Chemical analysis of samples from Russell Creek has shown that concentrations of major elements, organic nutrients, and inorganic dissolved metals, are within current Alaska Department of Environmental Conservation and EPA drinking water regulations (Rice and Hogan 1995).

3.1.4.5 Water Quality of Sitkinak Island

Surface water is the primary source of water supplies in the Kodiak-Shelikof region (Jones, Madison, and Zenone 1978). No specific information was available for Sitkinak Island water quality. Water in streams and lakes on the Trinity Islands generally has a dissolved-solids concentration less than 60 milligrams per liter. Stream water in the Kodiak-Shelikof region is predominantly the calcium bicarbonate type. The chemical composition of lakes ranges from the calcium bicarbonate to the sodium chloride type. Sodium chloride type lakes are generally those in areas of high precipitation (south side of islands) or near the coast (Jones, Madison, and Zenone 1978). Water with high iron concentrations, exceeding the recommended limits for public water supplies by the Alaska Department of Environmental Conservation and the EPA, may be present in some surface water and especially in groundwater within the Kodiak-Shelikof region (Hogan and Nakanishi 1995).

3.1.5 Hazardous Materials

The Alaska Department of Environmental Conservation Contaminated Sites database lists known contaminated sites throughout Alaska. EPA databases list information regarding environmental cleanup activities for impacted waters designated under the federal *Water Pollution Control Act*, commonly referred to as the *Clean Water Act*, and for impacted lands under the *Comprehensive Environmental Response, Compensation, and Liability Act*.

The objective of the *Clean Water Act* is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and non-point pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands.

The *Comprehensive Environmental Response, Compensation, and Liability Act* was enacted by Congress in 1980. It created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. It also enabled the revision of the *National Contingency Plan*. The *National Contingency Plan* provided guidelines and procedures to respond to releases and threatened releases of hazardous substances, pollutants, or contaminants.

The *Comprehensive Environmental Response, Compensation, and Liability Act* was amended by the *Superfund Amendments and Reauthorization Act* on October 17, 1986 (EPA 2010a). The EPA addresses uncontrolled and abandoned hazardous waste sites throughout the country. Sites perceived to be a significant threat to both surrounding populations and the environment can be placed on the EPA National Priorities List, commonly referred to as the Superfund list, and can qualify for federal cleanup funding. Both non-Superfund and Superfund sites are regulated by the *Comprehensive Environmental Response, Compensation, and Liability Act*. The Comprehensive Environmental Response, Compensation, and Liability Act database provides an annotated list of the Comprehensive Environmental Response, Compensation, and Liability Act sites throughout the United States. The Superfund database (EPA 2010b) provided available information up through July 22, 2010.

The Alaska Department of Environmental Conservation is the lead environmental regulatory agency for the State of Alaska. The department's objective is conserving, improving, and protecting Alaska's natural resources and environment to enhance the health, safety, and economic and social well-being of Alaskans. The Contaminated Sites database provides information regarding the type of contaminant released to the environment, the type(s) of media (air, water, soil, rock) that is impacted by the contaminant, the Potentially Responsible Party for cleaning up the documented release, and the location where the release occurred. The State Contaminated Sites database (ADEC 2010d) provided the most up to date information regarding the areas involved in the proposed land exchange.

A Potentially Responsible Party is any individual or company potentially responsible for contributing to a spill or other contamination onto public and private lands. Under federal law within the *Comprehensive Environmental Response, Compensation, and Liability Act*, a Potentially Responsible Party is required to comply with administrative orders from the EPA to investigate the extent of contamination and clean up the contamination attributed to their actions. If lands previously contaminated are acquired through purchase or land transfer, generally an environmental bond is set up and used by the Potentially Responsible Party as an agreement with the land purchaser for the Potentially Responsible Party to finalize all responsible contamination cleanup, thereby exempting the new land owner from the cost and labor responsibility of cleaning up the contamination.

3.1.5.1 Regulatory Framework

Lands within the Contaminated Sites Program of the Alaska Department of Environmental Conservation are regulated under Title 18 of the Alaska Administrative Code Chapter 78 (18 AAC 78) for underground storage tanks (ADEC 2006) and Chapter 75 (18 AAC 75) for oil and other hazardous substances pollution control (ADEC 2008).

The Alaska Department of Environmental Conservation administers contaminated sites through the site characterization and cleanup process, and authorizes final judgment on the site's regulatory status (ADEC 2009c). Institutional controls are implemented by the Alaska Department of Environmental Conservation under 18 AAC 75.375 to ensure compliance with applicable cleanup criteria and protection of human health, safety, or welfare; the environment; or the integrity of site cleanup activities or improvements. The following provides a summary of the site status rankings:

- **Open Sites –** Sites where characterization, removal, and/or remediation of the contaminated media is ongoing
- **Closed Sites –** Sites where characterization, removal, and/or remediation of the contaminated media is complete and no residual contamination above Alaska Department of Environmental Conservation criteria remains
- **Open with Institutional Controls (Open–IC) Sites –** Sites where characterization, removal, and/or remediation, and long-term monitoring of the contaminated media is ongoing and institutional controls are adopted for the site
- **Cleanup Complete with Institutional Controls (Closed–IC) Sites** – Sites where characterization, removal, and/or remediation of the contaminated media is complete and institutional controls are adopted for the site

Institutional controls may include maintenance of physical measures to limit an activity that might interfere with cleanup or results in exposure to a hazardous substance at the site; maintenance of engineering measures to limit exposure to a hazardous substance; restrictive covenants, easements, deed restrictions, or other measures that limit site use or site conditions over time, or provide notice of any residual contamination; and zoning restrictions or land use plans by a local government with land use authority. The use of institutional controls must, to the maximum extent practicable, be appurtenant to and run with the land so the control is binding on each future owner of the site, and maintained by each responsible person or owner of the site (ADEC 2008).

3.1.5.2 Documented Sites

Review of the federal *Clean Water Act* Impaired Water Section 303(d) listings indicated no known impacted watersheds are present on the lands proposed for exchange. Review of the federal Comprehensive Environmental Response, Compensation, and Liability information system database indicated no known federally funded Superfund sites are present on the lands proposed for exchange.

Review of the Alaska Department of Environmental Conservation Contaminated Sites database indicated 21 identified contaminated sites in the Cold Bay region and 2 sites on Sitkinak Island. Figure 3.1-4 presents the locations of the known contaminated sites in the Cold Bay region. Figure 3.1-5 presents the locations of the known contaminated sites on Sitkinak Island. Table 3.1-7 lists the names and status of the known contaminated sites within the Cold Bay region and Sitkinak Island.

The majority of the known contaminated sites are associated with the Cold Bay Airport. The Cold Bay Airport is a former Department of Defense facility (Fort Randall) operated by the U.S. Army during World War II. After World War II, the facility was known as Thornbrough Air Force Base and Cold Bay Air Field Station operated by the U.S. Air Force. The Cold Bay Air Field Station operated Long Range Radar Stations and later Minimally Attended Radar facilities. Portions of the Cold Bay Airport are also owned and operated by the City of Cold Bay, Federal Aviation Administration, Alaska Department of Transportation and Public Facilities, and the University of Alaska Anchorage (ADEC 2005). The Alaska Department of Environmental Conservation recognizes contaminated site names are based on the Potentially Responsible Party naming convention. The U.S. Army Corps of Engineers and the Air Force Center for Environmental Engineering use different naming conventions of sites identified as Areas of Concern and requiring environmental investigation and cleanup. The naming conventions for the U.S. Army use place name designations while the U.S. Air Force uses an Operational Unit platform developed by the Installation Restoration Program.

Ten of the 23 sites identified on Table 3.1-7 are categorized with an Open status by the Alaska Department of Environmental Conservation, 6 have been granted Closed status, 6 have been granted Cleanup Complete with Institutional Controls (Closed–IC), and 1 is categorized as Open with Institutional Controls (Open–IC).

Seven known contaminated sites are within Izembek National Wildlife Refuge, no sites are within state or Corporation lands proposed for exchange, and 1 site on Sitkinak Island is within lands proposed for exchange. All 7 of the identified sites on Izembek National Wildlife Refuge lands have been authorized as Closed (2) or Closed—IC (5). Of the contaminated sites on Izembek National Wildlife Refuge lands, none are on lands that are proposed for land exchange. The site on Sitkinak Island on lands proposed for exchange is categorized as Open. Summaries of contaminated sites associated with project alternatives and lands proposed for exchange are provided below.

Cold Bay Dock– Intertidal Sediments

In 2002, Oasis Environmental collected marine substrate sediment samples from the intertidal zone at the Northeast Terminal site, Cross Wind Cove, Russell Creek, Cold Bay dock, and the Aleutians East Borough material site at Cold Bay (Oasis 2002). The U.S. Air Force is cleaning contaminated soils on a lot adjacent to the Cold Bay dock. Potential contaminants of concern include gasoline range organics, diesel range organics, benzene, toluene, ethylbenzene, xylenes, semi volatile organic compounds, and inorganic metals. Three sediment samples were collected at the Cold Bay dock site for analysis. The analytical results from the samples indicated detectable concentrations of arsenic, barium, chromium, lead, and mercury. Two of the samples contained detectable concentrations of polynuclear aromatic hydrocarbons. One of the lead detections exceeded the sediment screening criteria (Oasis 2002).

Figure 3.1-4 Contaminated Sites Cold Bay Area

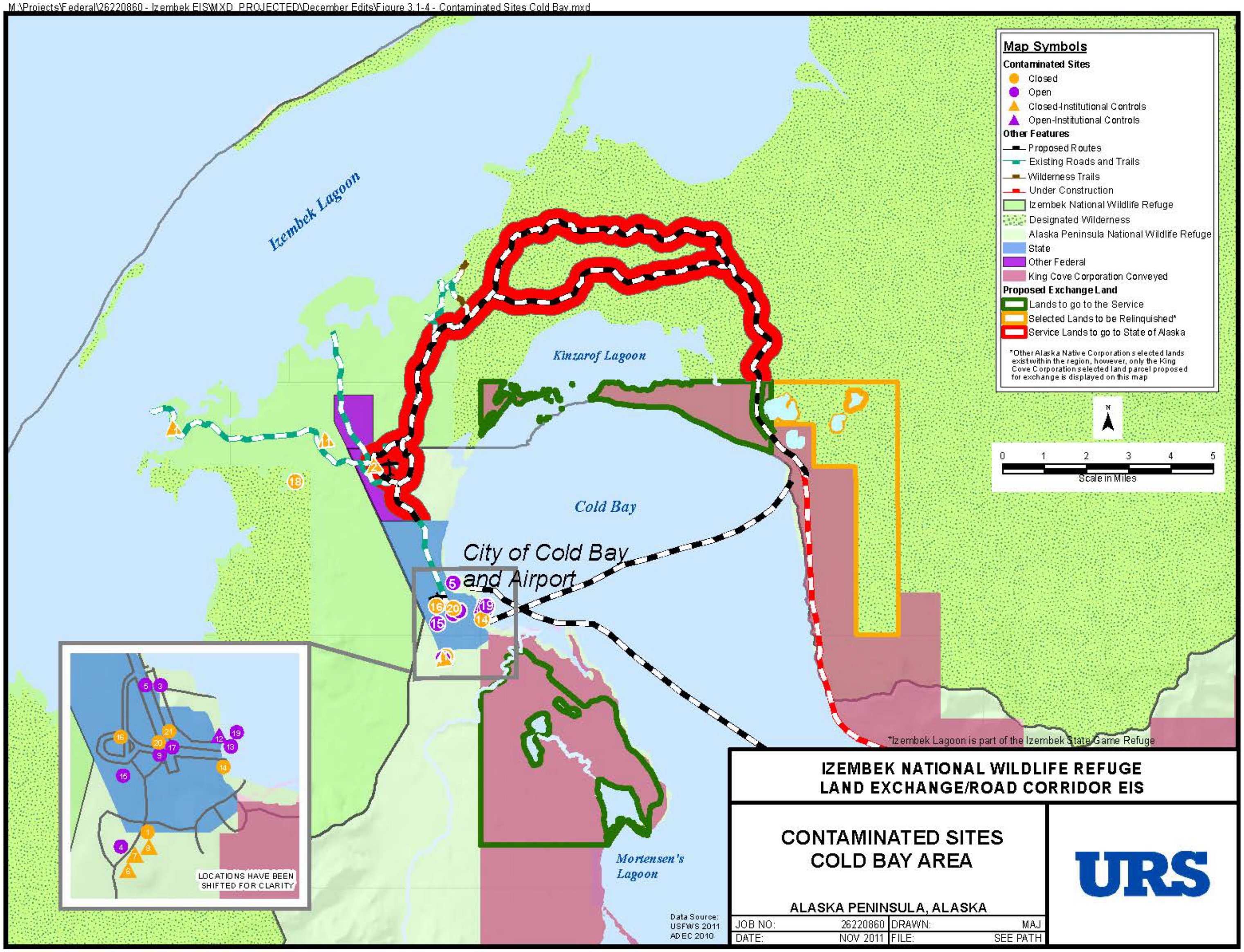


Figure 3.1-5 Contaminated Sites Sitkinak Island

M:\Projects\Federal\26220860 - Izembek EIS\MXD_PROJECTED\December Edits\Figure 3.1-5 - Contaminated Sites Sitkinak.mxd

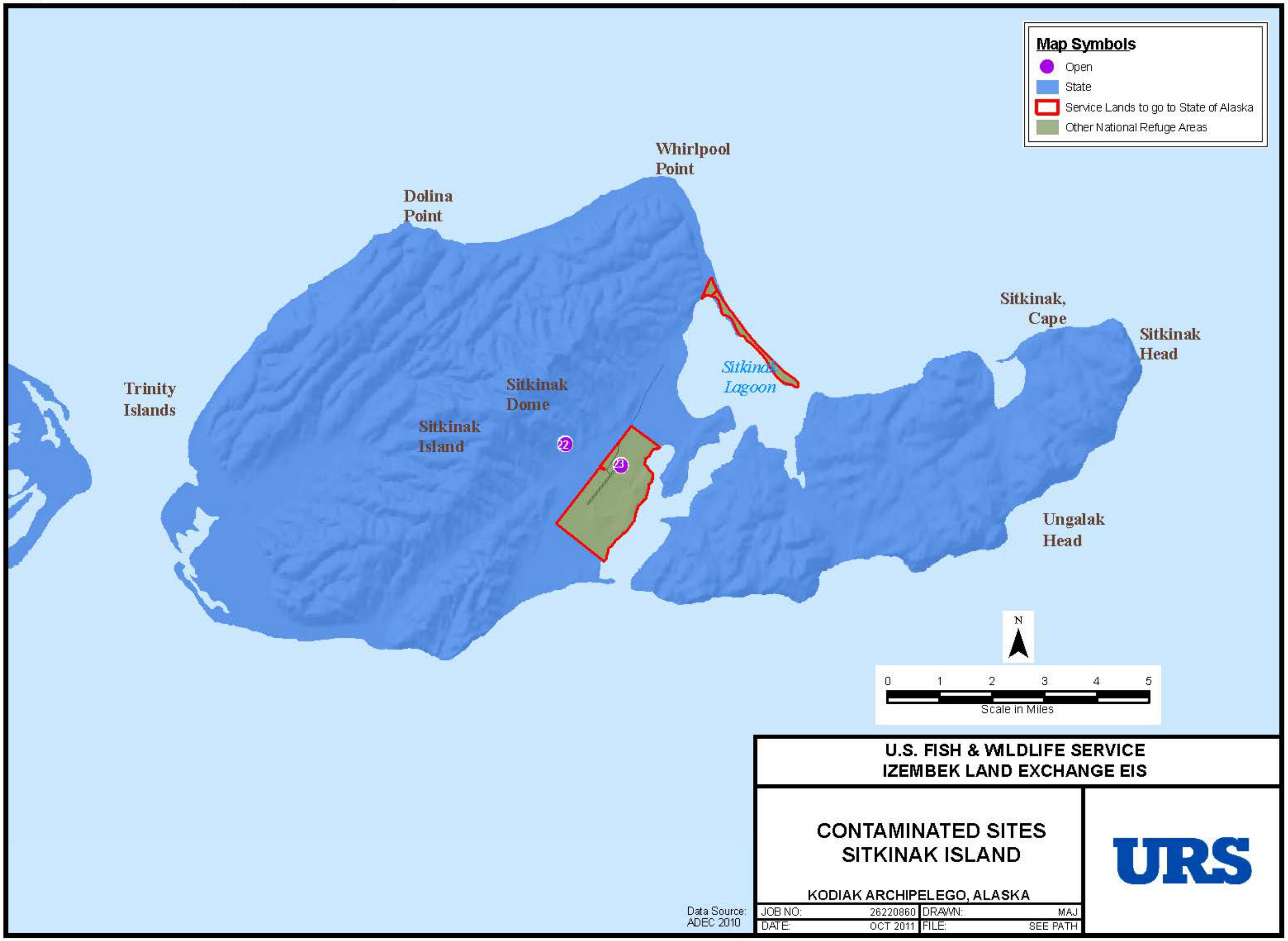


Table 3.1-7 Known Contaminated Sites Cold Bay and Sitkinak Island

Site Number	Site Name	Status
1	Cold Bay Minimally Attended Radar Station Facility	Closed
2	AT&T Alascom	Closed-IC
3	Frosty Fuel Return Pipeline Spill	Open
4	Federal Aviation Administration Cold Bay Station	Open
5	Frosty Fuel Tank Farm	Open
6	Alaska Department of Transportation and Public Facilities Upper Tank Farm	Closed-IC
7	Alaska Department of Transportation and Public Facilities Lower Tank Farm	Closed-IC
8	Frosty Fuel Gas Valve	Closed-IC
9	Alaska Department of Transportation and Public Facilities Cold Bay Airport	Open
10	White Alice Communication Site (OT01)	Closed-IC
11	Landfill Mile 6 (LF02)	Closed-IC
12	Petroleum, Oils, and Lubricants Tank Farm (ST05)	Open-IC
13	Fort Randall-Beach Seep	Open
14	Stapp Creek Tank Farm	Closed
15	Fort Randall-Asphalt Seeps	Open
16	Fort Randall- Collapsed Wooden Building	Closed
17	Fort Randall- East-West Runway	Open
18	Grant Point Road Sinkhole Sheen	Closed
19	Alaska Department of Transportation and Public Facilities Cold Bay Drums	Open
20	Peninsula Airways	Closed
21	Frosty Fuels' Incorporated	Closed
22	Sitkinak Air Field Station	Open
23	U.S. Coast Guard Loran C Station	Open

Note: Closed-IC: Cleanup complete; site close with institutional controls

Known Contamination on Lands Proposed for Exchange

The Sitkinak Island contaminated site is located on lands proposed for exchange. These lands were withdrawn from the Alaska Maritime National Wildlife Refuge by the U.S. Coast Guard (Coast Guard) for the Loran C Station located west of Mark Lake. According to the Alaska Department of Environmental Conservation database, petroleum hydrocarbon contaminated soil resulted from releases associated with 3 aboveground storage tanks and related pipelines and several underground storage tanks.

Sitkinak Island U.S. Coast Guard Loran C Station-ADEC Hazard ID Number 3055

Petroleum hydrocarbon contaminated soil is associated with seven (7) 32,000-gallon diesel aboveground storage tanks, one (1) 324,000-gallon diesel aboveground storage tank, and one (1) 500-gallon diesel aboveground storage tank. Diesel range organics concentrations in soil range from 9.5 to 34,000 milligram per kilogram. In July 2002, cleanup was initiated by excavating a limited amount of diesel range organics impacted soil. In July 2005, the Coast Guard submitted data from groundwater sampling and analysis, which indicated that water at the site is saline and not potable. In 2006, work plans were approved to conduct sampling of soil stockpiles and sampling of up to 8 groundwater monitoring wells. In 2010, the Coast Guard sampled 1,100 cubic yards of fuel-contaminated soil from 3 stockpiles that were determined to all be below site-specific alternative cleanup levels as a result of the 2006 characterization sampling. In 2010, the Coast Guard also conducted ground water and soil data gap sampling. According to the subsequent draft 2011 report, ground water analysis results in all but 2 monitoring wells were below Alaska Department of Environmental Conservation cleanup levels in 2006, and the remaining 2 with 2006 exceedances were below Alaska Department of Environmental Conservation cleanup levels in 2010. Fuel-contaminated soil exceeding the site-specific alternative cleanup level was identified in a wetland and upgradient stream drainage in 2010. The results of soils sampled in 2010 from a former battery disposal area associated with a landfill indicated lead contamination that will also require further characterization and removal. The Coast Guard remains the Responsible Party for all of the known and potentially unknown contamination issues at Sitkinak Loran C Station.

Sitkinak Island Sitkinak Air Field Station-ADEC Hazard ID Number 184

The Sitkinak Air Field Station, which is outside the proposed land exchange area, consists of 3 sites known as the Quonset hut, Dome site, and Dock facility. Seventy 55-gallon drums with unknown substances, batteries, battery acid, paints, and possible asbestos were scattered between the 3 sites. The total extent, amount, and type of contaminants are unknown.

3.1.6 Noise

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and interferes with or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human responses to typical environmental noise exposure levels are annoyance, communication interference, and sleep disturbance. Land uses that influence increases or decreases in noise generally include uses that change the exposure to noise, especially where quiet or limited noise interruptions are an essential element of the intended purpose of the area. Changes in noise can also affect wildlife, and potentially affect subsistence activities (hunting).

3.1.6.1 Noise Background

Basics

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Many abbreviations/units of measure are specific to the discipline of characterizing noise; they are noted in parentheses in the following discussion of noise basics. Use in text is kept to a minimum.

Sound is generally characterized by several variables, including frequency and amplitude. Frequency describes the pitch or tone of the sound and is measured in cycles per second or Hertz, while amplitude describes the pressure or loudness of the sound. Because the range of sound pressures that occur in the environment is extremely large, it is convenient to express these pressures on a logarithmic scale that compresses the wide range of pressures into a more useful range of numbers. The standard unit of sound pressure measurement is the decibel (dB).

Outdoor sound levels decrease logarithmically as the distance from the source increases. This is due to wave divergence, atmospheric absorption, and ground attenuation. Sound radiating from a source in a homogeneous and undisturbed manner travels in spherical waves. As the sound waves travel away from the source, the sound energy is dispersed over a greater area decreasing the sound pressure of the wave. Spherical spreading of the sound wave from a point source reduces the noise level at a rate of 6 dB per doubling of distance.

The weather can also play an important role in noise propagation; wind strength and direction are prominent factors. Winds blowing noise from a source towards a receptor will typically increase noise levels by causing changes in the wave divergence pattern. Stronger wind will have a greater effect, until either the wind becomes the dominant noise source, or it creates turbulence that disperses the noise.

Human hearing is less sensitive at the low and extremely high frequencies than at the mid-range frequencies. The process to adjust for human hearing is termed “A weighting,” and the resulting decibel level is termed the “A weighted decibel (dBA).” A weighting is widely used in local noise ordinances and state and federal guidelines. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve. Unless specifically noted, the use of A weighting is always assumed with respect to environmental sound and community noise even if the notation does not show the “A.”

In terms of human perception, a sound level of 0 dBA is approximately the threshold of human hearing and is barely audible by a healthy ear under extremely quiet listening conditions. This threshold is the reference level against which the amplitude of other sounds is compared. Normal speech has a sound level of approximately 60 dBA. Sound levels above about 120 dBA begin to be felt inside the human ear as discomfort progressing to pain at still higher levels. A list of typical sound sources and levels, listed in dBA, and comparable noise environments are presented in Table 3.1-8.

Table 3.1-8 Typical A-Weighted Noise Levels

Noise Source (at a Given Distance)	Scale of A Weighted Sound Level in Decibels	Noise Environment	Human Judgment of Noise Loudness Relative to a Reference Loudness of 70 Decibels*
Military Jet Take-off with After-burner (50 feet) Civil Defense Siren (100 feet)	140 130	Aircraft Carrier Flight Deck	
Commercial Jet Take-off (200 feet)	120		Threshold of Pain 32 times as loud
Pile Driver (maximum level, 50 feet)	110	Rock Music Concert	16 times as loud
Ambulance Siren (100 feet) Pile Driver (average level, 50 feet) Newspaper Press (5 feet) Power Lawn Mower (3 feet)	100		Very Loud 8 times as loud
Motorcycle (25 feet) Propeller Plane Flyover (1,000 feet) Diesel Truck, 40 mph (50 feet)	90	Boiler Room Printing Press Plant	4 times as loud
Bulldozer, Grader, Loader, Concrete Mixer, Tie Cutter/Inserter, (50 feet)	85		
Garbage Disposal (3 feet)	80	High Urban Ambient Sound	2 times as loud
Passenger Car, 65 mph (25 feet) Vacuum Cleaner (10 feet)	70	(Reference Loudness)	Moderately Loud 70 decibels
Normal Conversation (5 feet) Air Conditioning Unit (100 feet)	60	Data Processing Center Department Store	1/2 as loud
Light Traffic (100 feet)	50	Private Business Office	1/4 as loud
Bird Calls (distant)	40	Lower Limit of Urban Ambient Sound	Quiet 1/8 as loud
Soft Whisper (5 feet)	30	Quiet Bedroom	
	20	Recording Studio	Very Quiet
Rustling leaves in the distance	10		
	0		Threshold of Hearing

* Reference Loudness of 70 Decibels: Passenger Car, 65 mph (25 feet); Vacuum Cleaner (10 feet); Moderately Loud
Source: Compiled by URS Corporation from published sources and widely used references such as Harris (1998) and Beranek (1971).

Humans are much better at discerning relative sound levels than absolute sound levels. The minimum change in the sound level of individual events that an average human ear can detect is about 1 to 3 dBA. A 3 to 5 dBA change is readily perceived. An increase (or decrease) in sound level of about 10 dBA is usually perceived by the average person as a doubling (or halving) of the sound's loudness.

Although dBA may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most ambient environmental noise includes a mixture of noise from nearby and distant sources that creates an ebb and flow of sound, including some identifiable sources plus a relatively steady background noise in which no particular source is identifiable.

The day-night noise level, another commonly used index of noise measurement, characterizes the overall noise experienced during an entire 24-hour period. It includes time-weighted energy averaged noise levels in dBA, where the time-weighting accounts for noise occurring during certain sensitive time periods. In the day-night noise level scale, noise occurring between 10 p.m. and 7 a.m. is penalized by 10 dB. This penalty was selected to account for higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur at night. Day-night noise level is the metric specified by the Federal Aviation Administration and the EPA for use in community and airport noise assessments.

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the roadway and receiver is rarely effective in reducing noise because it does not create a solid barrier.

Regulatory Aspects

In the past, the EPA coordinated all federal noise control activities through its Office of Noise Abatement and Control. In 1981, the Administration concluded that noise issues were best handled at the state or local government level. As a result, the EPA phased out funding in 1982 as part of the shift to transfer the primary responsibility of regulating noise to state and local governments. The *Noise Control Act of 1972* and the *Quiet Communities Act of 1978*, however, were not rescinded by Congress and remain in effect. All federal noise regulations remain in effect and are enforced by either the EPA or a designated federal agency. These regulations cover standards for transportation equipment, motor carriers, low-noise-emission products, and construction equipment (NPC 2010).

No state or local regulations related to noise apply to the proposed land exchange areas. Although no regulations limit overall environmental noise levels, federal agencies have developed guidance documents and regulations for specific sources (for example, the Federal Aviation Administration for airports, and the Federal Highway Administration for federally funded highways). Per EPA guidelines (EPA 1974), outdoor yearly levels on the day-night noise level scale are sufficient to protect public health and welfare if they do not exceed 55 dB in sensitive areas (residences, schools, and hospitals). Inside buildings, yearly levels on the day-night noise level scale are sufficient to protect public health and welfare if they do not exceed 45 dB. Maintaining 55 dB day-night noise level outdoors should ensure adequate protection for indoor living. To protect against hearing damage, 24-hour noise exposure at the ear should not exceed 70 dB.

In addition to the guidelines on protection of health and welfare discussed above, the Federal Interagency Committee on Urban Noise developed guidelines for considering noise in land use planning and control. Land uses in residential areas, schools, and hospitals are not compatible within zones above 65 dB day-night noise level unless measures are taken to reduce interior noise levels by 25 dB. Over 75 dB, noise-sensitive land uses are not compatible (EPA 1980).

Effects on Wildlife

Animals, insects, and birds can use the sound environment to find desirable habitat and mates, avoid predators and protect young, establish territories, and meet other survival needs. Scientific studies have shown that wildlife can be adversely affected by sounds and sound characteristics that intrude on their habitats (NPS 2009). However, the majority of studies are focused on the effects of aircraft noise (Radle 2007).

3.1.6.2 Existing Noise

For noise evaluation and discussions related to the proposed land exchange, the parcels can be divided into national wildlife refuge and non-national wildlife refuge lands. The national wildlife refuge lands (Izembek, Alaska Peninsula, and Alaska Maritime National Wildlife Refuges, including lands on Sitkinak Island) contain very few human-made sources of noise. Human-made noises include infrequent traffic to Grant Point, boats, hunting activities, aircraft access to and from the Cold Bay Airport, aircraft access by sports hunters and recreationists, all-terrain vehicles, and snow machine travel. These noise sources are all temporary and intermittent. This group also includes the wilderness portions of these lands; both wilderness and national wildlife refuge lands are considered noise sensitive, and exhibit similar noise characteristics. The non-national wildlife refuge lands (state and Corporation lands) are also assumed to have very few human-made sources of noise due to their remote location from communities and roads.

National Wildlife Refuge Lands

Based on the lack of significant human activity in the national wildlife refuge areas, the sound levels are assumed to be very low. Some commercial activities in the area that add to the background noise environment on national wildlife refuge lands are commercial fishing in Izembek Lagoon and air transportation from the Cold Bay Airport. This low background sound is in the 40 to 50 dBA range, depending on the specific location and wind and wave conditions. The average annual wind speed in Cold Bay is greater than 15 mph and the average annual wind speed near Sitkinak Island is greater than 10 mph (Section 3.1.2). These wind speeds, along with proximity to water along some of the land exchange areas, are assumed to have an effect of increased ambient noise levels, with estimated ambient noise levels between 50 and 60 dBA. Areas experiencing these wind speeds that are not directly on the water may have slightly lower noise levels, with estimated noise levels between 45 and 55 dBA.

These presumed noise levels correspond to ambient noise levels measurements that were made for the King Cove Access Project, at sites that were dominated by noise from wind (USACE 2003). The ambient noise levels at these 5 sites ranged from 45 to 59 dBA. During lulls in the wind, noise levels dropped to between 38 and 50 dBA. More details about the specific noise measurements are provided below, under the heading 2001 Noise Level Measurements. Overall, the current noise levels in the national wildlife refuge areas are assumed to be well within the EPA and Federal Interagency Committee on Urban Noise guidelines for sensitive receptors.

Non-National Wildlife Refuge Lands

The major commercial activities in the non-national wildlife refuge lands that add to the background noise environment are commercial fishing in Izembek Lagoon, commercial fishing and seafood processing in the City of King Cove, and air transportation from the Cold Bay Airport (including between King Cove and Cold Bay). Noise contours from the 2003 EIS show predicted noise levels from light aircraft departures from the Cold Bay Airport (USACE 2003). Based on these figures, aircraft noise is not assumed to be a dominant noise source at the proposed land exchange areas, except in the area due south of the Cold Bay Airport and a potentially minor contribution near the lands around Kinzarof Lagoon.

Overall, the assumed ambient noise levels at the non-national wildlife refuge lands associated with the land exchange project are assumed to be similar to those in the national wildlife refuge areas, between 50 and 60 dBA. The noise levels are assumed slightly greater at areas near the Cold Bay Airport, or approximately between 55 and 65 dBA. The current noise levels in these non-national wildlife refuge areas are assumed to be slightly greater than the current noise levels in the national wildlife refuge areas, but still within the EPA and Federal Interagency Committee on Urban Noise guidelines for sensitive receptors.

2001 Noise Level Measurements

Noise level measurements were made in August 2001 at 5 locations between the communities of Cold Bay and King Cove as part of the 2003 EIS (BridgeNet International 2001). These measurement sites were located in relatively quiet noise environments that were not exposed to noise sources, such as highways or generators. The ambient noise environment, comprised of noise from wind, waves, roadways, and residential background noise, was quantified from the noise survey at each measurement site. The noise level that is exceeded 90 percent of the time during the sampling period is commonly referred to as residual or background noise when other sources of noise are not present. The average background values exceeded 90 percent of the time for the 5 sites ranged from 45 to 59 dBA.

Boat traffic was included in these background measurements. These short-term events (from a few seconds to several minutes) were also measured, showing noise levels ranging from barely audible up to 75 dBA. Typical boat source events ranged from 60 to 70 dBA. These measurements do not include background noise from the previous hovercraft, which was not in operation when the study was conducted. In addition, aircraft events were not included in the background measurements. However, BridgeNet International used the Federal Aviation Administration Integrated Noise Model to predict the noise contour generated from a commuter aircraft departing to the north over Cold Bay. The noise levels from these aircraft operations are expected to range from 60 to 70 dBA for locations near the aircraft flight paths.

Overall, the study showed that day-night noise levels were generally measured in the mid-50 dBA range. These levels are high for an undeveloped area, but are lower than common for urban areas. The day-night noise levels were dominated by wind noise. During periods of less wind, the background day-night noise levels would be less.

3.1.7 Marine Characteristics

Marine characteristics are not relevant to the proposed land exchange, but they are relevant to the hovercraft and ferry alternatives. The information in this section was compiled from information contained in 2003 EIS.

3.1.7.1 Bathymetry and Circulation

Cold Bay is located on the south side of the Alaska Peninsula and opens to the Pacific Ocean. The bay is oriented roughly north–south. It measures approximately 6 miles from the headlands of Cold Bay to an entrance west of Kelp Point, and then runs about another 11 miles to the 5,100 acre tidal lagoon (Kinzarof) at its head. Cold Bay is 5 to 7 miles wide in most areas.

A deep basin is located in the southern end of Cold Bay, corresponding to steep mountains surrounding that portion of Cold Bay; the deepest spot in this basin is 384 feet (64 fathoms) north of Kelp Point. Cold Bay gradually slopes upward at its northern end, rising to water depths of up to 120 feet in the central portion of the bay. Approaching the shore, the bottom shallows rapidly to 18 feet deep, ascending to a large sand flat across the head of Cold Bay.

The tidal range for the Cold Bay region is from approximately 5 to 7 feet (Table 3.1-6). However, the extreme tide may range up to 10.5 feet (USACE 2003).

3.1.7.2 Waves

Cold Bay often experiences high sustained winds; however, the fetch, or distance the waves have to build within Cold Bay generally limits the size of the waves. Wave heights are less than 8 feet approximately 95 percent of the time and between 8 and 14 feet 5 percent of the time. Average wave lengths range from approximately 20 to 31 feet long. Waves, together with wind and visibility, affect the window of marine vessel operation, particularly hovercraft, and passenger ride comfort (USACE 2003).

The wave climatology for Cold Bay was based on published wind and temperature data, and is described in more detail in Section 3.1.2 Climate, and Appendix M of the 2003 EIS (USACE 2003). The Cold Bay Airport records hourly observations of wind magnitude and direction. No comparable observations or compilation of wave parameters in Cold Bay are known to exist. For the 2003 EIS, engineering wave parameters were hindcast, or based on a number of known factors to calculate wave parameters. These estimates are needed for projecting potential limitations on marine vessel operation. The Corps Automated Coastal Engineering System 7 program suite was used for the 2003 analysis.

The hindcast for Cold Bay resulted in a modeled environment with very steep waves. Virtually the entire annual distribution of Cold Bay sea states falls between the steepness index associated with fully developed seas and that associated with waves of extreme steepness. A typical Cold Bay wave environment would therefore be populated with a large number of breaking waves (whitecaps). Steep and breaking waves are particularly troublesome to small conventional boats with vessel lengths of the same order as the wave lengths.

3.1.7.3 Sea Ice

Sea ice is formed during extremely cold periods with no wind, typically under winter high pressure systems (R&M and HLA 1999). Wind induced waves from the southeast tend to break up the ice and deposit it on the lee shores at the head of Cold Bay, including in the vicinity of the Northeast Terminal. There are no formal records regarding ice in Cold Bay, but information from long time local residents indicates ice forms around the shores of Cold Bay, with the heaviest concentrations occurring on the northwestern area of Cold Bay (2003 EIS). Local residents also reported that the shore ice can frequently extend past the 2,000-foot Cold Bay dock, and in some years the ice is greater than a foot thick. Local residents also reported that on rare occasions, Cold Bay can ice over completely; however, the last time was reported to be in the early 1970s (USACE 2003).

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