3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This section describes conditions in the Portsite area. It focuses on resources of concern identified during the public involvement, agency coordination, and scoping processes described in Section 1. Chief among those concerns was the potential for a project to adversely affect subsistence hunting, fishing, and gathering, and for a project to "open the door" for future development in northwestern Alaska. Existing mining and port operations are part of the environment at and near Portsite and are described in this section. Existing plans for regional development and existing community and regional plans for resource conservation also are summarized in this section.

The information and data discussed in this section were gathered from several sources, including traditional information provided by local people; previous studies and reports on environmental, social, and economic resources of the area; data bases available through several agencies; and field surveys conducted during 1998, 1999, and 2000 that indicated the seasonal abundance and diversity of wildlife species present in the project area. References to sources of information are included throughout this section.

Readers who have lived and worked in Interior and northern coastal Alaska know how vast the land mass is, how few and widespread the people are, and the tremendous challenges they face from the difficult environmental conditions and the limited transportation and community infrastructure that serves them. The remainder of this section looks at those aspects of the Northwest Arctic Borough (NAB). Data in this section is used in Section 4 to evaluate direct and indirect effects of the alternatives considered in detail and cumulative impacts of related and unrelated potential developments in northwestern Alaska.

Portsite and the Red Dog Mine are in the NAB. Boroughs in Alaska are similar to counties in much of the rest of the United States, but with political structure and powers that may be substantially broader. Boroughs in Alaska also are substantially larger than most counties. The NAB is the second largest borough in Alaska. It encompasses almost 36,000 square miles of land and almost 2,000 square miles of coastal waters. That makes the NAB about half the size of the states of Washington or Idaho, and almost exactly the same size as Indiana.

This Indiana-sized borough has a total population of about 7,000 people, about 1 person for every 5 square miles. By comparison, Wyoming, the least populated of the 50 states, has about 5 people per square mile (about 25 times the population density of the NAB) and Indiana has about 170 people per square mile. Native Americans make up about 83 percent of the population of the NAB. The NAB has no railroads, no deepwater ports (and only two ports systems for shallow-draft vessels), no developed harbors, no highways, no paved roads except for two mile-long streets through the middle of Kotzebue, and no improved roads outside the communities and their immediate vicinity except for the 52-mile-long DMTS road. By comparison, Wyoming has about 27,000 miles of roads and highways and Indiana has about 93,000 miles. There is no highway or road connection from the NAB to the rest of Alaska. Essentially all goods shipped to and from the borough are transported by sea or air, and ice limits marine commerce to about 4 months of the year. Two airports in the borough are capable of landing heavy commercial air carriers: one is at Kotzebue and the other is at Red Dog Mine. Transportation between the communities is almost entirely by aircraft and boat during the open water season and by aircraft and snow machine when waters are frozen. The ice goes out on most rivers and lakes in May or June and on the Chukchi Sea in June or July. Rivers and lakes begin freezing in late September and waterborne transportation ends on rivers of the region and in the Chukchi Sea by about the end of October.

The entire NAB is on permafrost up to hundreds of feet deep except adjacent to and under large water bodies that have enough thermal mass to keep the earth near them from freezing. Permafrost, and particularly permafrost that is saturated with ice from groundwater, greatly affects living and non-living resources. It also places huge constraints on construction and community infrastructure. Saturated permafrost soil is impermeable, so when the active layer at the surface melts during the summer, the melt water stays in or on top of the soil, creating extensive wetlands that cover most of the borough. Saturated permafrost melts, freezes, swells, and shrinks, and may even turn into a pond.

Build on permafrost and the building may lean in a year or two, or may even be sitting in a pond of water melted by the building's own heat. Construct water and wastewater utilities through permafrost and the pipes will freeze or melt the surrounding permafrost unless special construction and operating techniques are used, which are expensive. That is why many communities haul water to homes and haul human waste in buckets to disposal sites.

Obtaining raw domestic water also is a problem. Wells do not produce in permafrost. Shallower lakes freeze and are not water sources during the winter, and flows in many rivers slow to a trickle. Many communities store water and operate for the entire winter from a large centralized, insulated, aboveground storage tank. There is no regional electrical grid or any electrical interconnection between settlements. Diesel generators produce the electricity for each community's electrical system.

There is a little gardening in the NAB and small amounts of produce may be exchanged locally, but there is no export agriculture, no commercial timber harvest, no manufacturing other than handicrafts, art, and light fabrication for local use. A few boats fish commercially for local sale to small processors. There is an operating mine at Candle on the northern side of the Seward Peninsula and a few small placer mines operate seasonally, but there is no other mineral resource extraction except for the Red Dog Mine. There is no commercial oil, gas, or coal production. Red Dog Mine represents almost the entire industrial base for the NAB, and the main source of tax and royalty income for both the borough and the regional Native Corporation. The NAB has no income tax, no sales tax, and no real estate tax (DCED 2001, NAB 2003). Other than revenue generated by Red Dog Mine, most of the financial base for the borough and its residents comes from the state and federal governments and from service jobs supporting people and activities in the borough. The sparse economic base, high unemployment, and lack of agriculture are partially offset by the harvest of wildlife, fish, and plant material. This harvest is collectively called “subsistence.” It is the primary source of food for many people and is a significant food source for almost everyone in the borough. Subsistence is also a central element in the tradition and culture of many people in the borough.

3.2 Land Conditions

The land in the Portsite area is mostly undeveloped wetland/tundra. The Portsite ore storage and loading facilities, the DMTS road, and Kivalina are the only major developments along the 160 miles of Chukchi Sea coastline between Kotzebue and Point Hope. Other developments consist of small hunting cabins scattered along the coast and clustered at Sheshalik north of Kotzebue. Most of these cabins are on privately owned Native Allotments, and many are used seasonally for subsistence hunting and fishing.

3.2.1 Land Ownership and Use

Land ownership and use in the vicinity of Portsite is shown in figure 3-1. Portsite was built in 1989 on 450 acres leased by the Alaska Industrial Development and Export Authority (AIDEA) from the Northwest Alaska Native Association (NANA) Regional Corporation for 99 years (Plat 99-3 Kotzebue Recording District). The AIDEA owns all improvements at Portsite. An additional 64 acres of tideland (ADL 412501, Tideland Survey 1425, Plat 94-6 Kotzebue Recording District) are leased from the State of Alaska for the existing DMT facilities at Portsite.

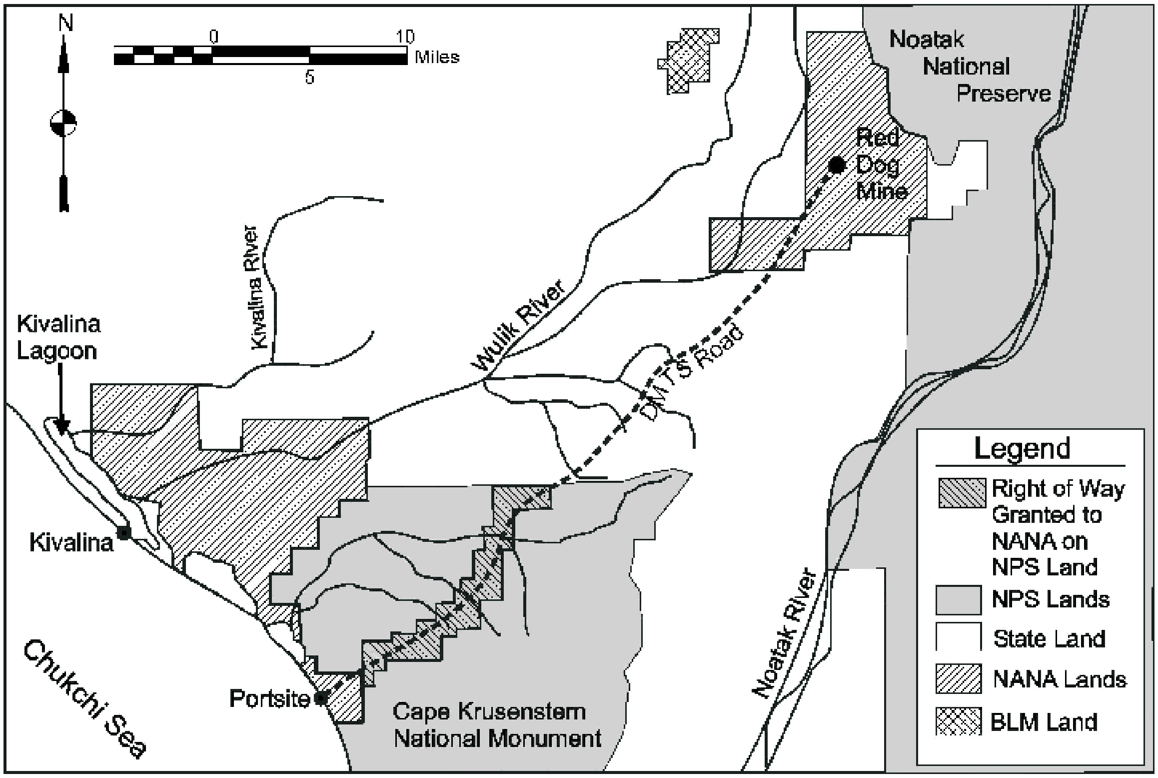


Figure 3-1. Ownership of lands in the vicinity of Portsite.

The 52-mile-long DMTS road connecting Portsite to the Red Dog Mine was constructed in 1989. About one-third of the road passes through Cape Krusenstern National Monument (figure 3-2), which is administered by the National Park Service (NPS). The DMTS road corridor is on an easement granted by Congress to the NANA Regional Corporation for 100 years. NANA subleased that section to ADIEA for 99 years. Most of the remaining two-thirds of the DMTS road is on an AIDEA right-of-way across State of Alaska land.

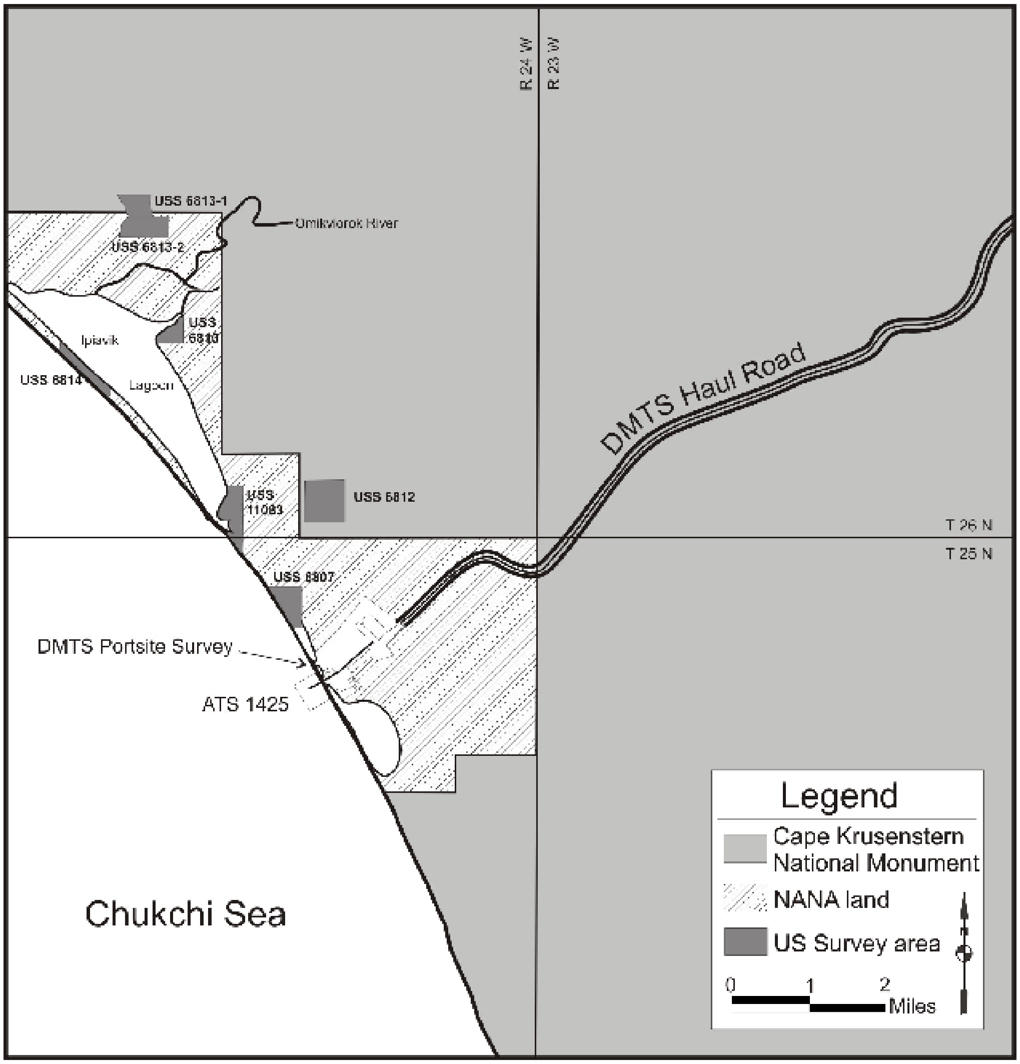


Figure 3-2. Locations of United States Survey (USS) surveyed parcels in the immediate vicinity of Portsite, the Alaska Tideland Survey (ATS), and the DMTS Portsite survey.

The Red Dog Mine is owned by the NANA Regional Corporation and operated by Teck-Cominco Alaska, Inc. (TCAK). TCAK has 50-year priority usage of the 52-mile-long DMTS road and DMT facilities at Portsite to transport and ship zinc and lead ore concentrates.

The Bureau of Land Management (BLM) and the NANA Regional Corporation administer the land north of the Cape Krusenstern Monument, between the Monument and Kivalina. The state owns the land to the east and northeast of the Cape Krusenstern National Monument, and the tidelands to 3 miles offshore. The United States Government claims subtidal lands offshore from 3 to 12 miles, while the 200-mile Exclusive Economic Zone (EEZ) extends westward to the International Date Line (180º W Longitude).

The Cape Krusenstern National Monument is approximately 660,000 acres and is within the much larger, 2.3-million-acre Cape Krusenstern National Historic Landmark. Cape Krusenstern National Monument was placed on the National Register of Historic Places as an archeological district with National Historic Landmark status in 1973. The BLM established the landmark to provide for the preservation and study of archeological remains left by coastal western Alaska people and their precursors. The boundary of the landmark extends north of Portsite almost to Kivalina and encompasses Portsite, the DMTS road, Red Dog Mine, and the subsurface real estate offshore from Portsite. Cape Krusenstern National Monument was established on December 1, 1978. Two years later, December 2, 1980, the monument was altered to the existing boundary. Local residents use the Cape Krusenstern National Monument for subsistence hunting and gathering. Most other visitors come to the monument for camping, hiking, wildlife viewing, and other forms of recreation.

The Alaska Maritime National Wildlife Refuge (AMNWR) extends seaward from the mean lower low water (MLLW) line at the south end of Imikruk Lagoon near Portsite. The refuge includes thousands of miles of shoreline in western and Southcentral Alaska. It was designated primarily for the protection of seabirds and their habitat.

There are numerous mining claims north and east of Portsite and Cape Krusenstern National Monument (USGS 2000). Only the zinc and lead deposits at the Red Dog Mine are currently being mined.

Several United States Surveys, Native land allotments, and a tideland lease are also filed for the immediate Portsite area (DNR 2001). These are shown in figure 3-2. Additional private holdings are north of Imikruk Lagoon, several miles north of Portsite. In addition to the platted surveys, several Native allotments (F17621, 17595, and 14942) are pending near the mouth of Rabbit Creek, about 9 miles southeast of Portsite (DNR 2001). These allotments are mostly undeveloped, but some have cabins used seasonally for subsistence hunting and fishing.

3.2.2 Community Profiles

The four communities closest to Portsite are Kivalina, about 17 miles north; Noatak, about 30 miles east; Point Hope, some 92 miles north, and Kotzebue, about 65 miles south. Point Hope is in the North Slope Borough and is within the boundaries of the Arctic Slope Regional Corporation. The other three communities are in the NAB and within the boundaries of the NANA Regional Corporation.

3.2.2.1 Tribal Governments

The Wheeler-Howard Act (more widely known in Alaska as the Indian Reorganization Act or IRA) was enacted June 18, 1934 primarily to: (1) conserve and develop Indian lands and resources; (2) extend to Indians the right to form businesses and other organizations; (3) establish a credit system for Indians; (4) grant certain rights of home rule to Indians; and (5) provide for vocational education for Indians. Within the context of IRA, “Indian” includes Alaska Natives. Alaska has 229 federally recognized tribal governments. Tribal governments in the vicinity of Portsite include the Native Village of

Kivalina, Native Village of Noatak, Native Village of Kotzebue, and the Native Village of Point Hope. Those tribal governments are organized under the IRA as amended, and are recognized as tribal governments by the United States Government and the State of Alaska.

3.2.2.2 Kivalina

Kivalina is about 95 miles northwest of Kotzebue on the southeastern tip of an 8-mile-long barrier island between Kivalina Lagoon (formerly Corwin Lagoon) and the Chukchi Sea (see figure 3-1). Kivalina is in the boundaries of the NANA Regional Corporation, the NAB, and the Northwest Arctic School District. The USGS coordinates for Kivalina are 67° 43' north, 164°32' west, Sec. 21, T027N, R026W, Kateel River Meridian, Noatak C-6. Kivalina is not connected by roads or utilities to any other community.

Kivalina was founded at its current location in 1905 when a mission school was built on the barrier island near the mouth of the Wulik River and a settlement grew around the school. A post office was established in 1940 and an airstrip was constructed in 1960. It was incorporated as a 2nd class city in 1969, and electric utilities were installed in the 1970's. According to the Alaska Division of Community Advocacy (DCA), the population of Kivalina was estimated at 388 in 2004. The city has a mayor/council form of municipal government.

Principal public facilities in Kivalina are an elementary school, a high school, two churches, a recreation center, a post office, a community hall, a National Guard Armory, an airport, a landfill, a water supply system, a sewage collection center, a Maniilaq-operated health clinic, and a volunteer fire department. Law enforcement is the responsibility of the Alaska State Trooper post in Kotzebue.

Potable water is transported to Kivalina from the Wulik River through a surface line during the open-water season, treated, and stored in community tanks for use throughout the year. Water is hauled from the water tank to the public laundry and homes. About a third of the homes have storage tanks for water.

The school, clinic, and "washeteria" (public laundry and showers) have individual water and sewage systems. Waste and wastewater in other buildings is collected in honey buckets and transported to one of the four waste-bucket collection points. The Arctic Village Electric Cooperative (AVEC) supplies Kivalina with electricity, which is generated in the community. About 140,000 gallons of fuel for electrical generation, heating, and vehicles is delivered each year, typically from Kotzebue, by coastal lightering barge.

Transportation to Kivalina generally is by air, boat, and barge during the open-water season, and by air and snow machine from October thorough May or June. Local transportation is primarily by snow machine during winter and all-terrain vehicles (ATV's) when there is no snow. There are no roads outside Kivalina, but winter snow machine trails connect the community with Noatak, Kotzebue, and Point Hope.
Most of the people in Kivalina depend heavily on subsistence practices for food.

Caribou, marine mammals, and Dolly Varden char are particularly important in diet and traditional use. The school district, Maniilaq Association, village council, local stores, and local air carrier businesses hire people in Kivalina, but unemployment is high and job opportunities are limited. A few residents work at jobs outside the community, including jobs at the Red Dog Mine.

Kivalina is isolated on a barrier island. There is not enough land to allow expansion for modern construction, sewage treatment facilities, or an airport capable of handling larger aircraft. The nearest freshwater source is about a mile up the Wulik River and can only be used in the summer and autumn because the supply line is laid on top of the ground. The community is also threatened by shoreline erosion and storm surge. Electricity is subsidized, but both electricity and fuel costs are high by national standards.

3.2.2.3 Noatak

The unincorporated community of Noatak is on the west bank of the Noatak River just west of the Noatak National Preserve, about 55 miles north of Kotzebue and about 30 miles from Portsite (figure 3-1**)**. Noatak is within the boundaries of the NAB, the Northwest Arctic School District, and the NANA Regional Corporation. Its USGS coordinates are 67º 34’ N latitude, 162º 58’ W longitude, Sec. 16, T025N, R019W, Kateel River Meridian, Noatak C-2. Noatak is the only settlement along the 396-mile-long Noatak River.

Noatak was first established as a *Napaaqtugmiut* hunting camp in the 19th century (DCED 2000) and was the site of a new school in 1908 (Burch 1998). Approximately 80 to 100 people from surrounding areas spent at least part of the first winter in Noatak after construction of the school. More people moved into the area over the next few years and the population grew to 153 persons by 1910. The post office was established in 1940. According to the Alaska Division of Community Advocacy, Noatak had an estimated population of 448 in 2004.

Noatak is not an incorporated city and the Noatak Village Council makes most decisions involving the community. Current public facilities and services in Noatak include an elementary school, community center, post office, airport, landfill, water treatment plant, sewage lagoon, a Maniilaq-operated health clinic, volunteer fire department, and a village public safety officer (VPSO).

Water is taken from the Noatak River, treated, and piped to serve about 77 homes, as well as the school and businesses in Noatak. Less than half the homes in Noatak are connected to the water system (DCED 2000). Residents not connected to the water system haul potable water from a central facility. A piped sanitary sewer collection system serves the same 77 homes and businesses. Those without plumbing haul waste in honey buckets to the sewage lagoon. The Arctic Village Electric Cooperative (AVEC) generates electricity, and the OTZ Telephone Co-op provides telephone service.

Noatak’s economy is heavily subsistence oriented. Caribou, Dolly Varden char from the Noatak River, and marine mammals from seasonal camps on Kotzebue Sound and the

Chukchi Sea are especially important to subsistence. Unemployment is high, but there is some local employment at the school, health clinic, retail stores, and air carriers. Some Noatak residents are employed at the nearby Red Dog Mine, in seasonal fire fighting, and in commercial fishing.

Transportation to and from Noatak is primarily through several small air carriers headquartered in Kotzebue. There is currently no barge service to Noatak and fuel and supplies are air freighted by small local carriers and some larger carriers. Each year, Noatak uses an estimated 550,000 gallons of fuel, which is delivered by air. The airstrip at Noatak is not big enough or constructed heavily enough to regularly handle heavy air carriers that could lower delivery costs. Small boats from Kotzebue can also access Noatak during summer and from Kotzebue and Kivalina by snow machine during winter. No roads or utility lines connect Noatak with other communities.

The Noatak River is a major transportation corridor for the people of Noatak and is a major source of subsistence foods and provides access to subsistence areas. The river also presents some of the biggest problems to the community. Noatak River erosion has damaged property and threatens to cause major damage. The river downstream from the community changed course several years ago. As a result, barges can no longer supply Noatak with fuel or other goods. Supply by air is very expensive and places a great economic burden on the community. A recent Corps of Engineers reconnaissance study could not identify a way to establish a navigable channel that could be economically maintained in the Noatak River. Because Noatak is not connected by road to any other community, goods and fuel cannot be transported by land except for relatively small amounts that are brought to the community by snow machine.

3.2.2.4 Point Hope

Point Hope (population 752) is within the boundaries of the North Slope Borough and the Arctic Slope Regional Corporation near the tip of Point Hope Peninsula, about 92 miles north of Portsite. The peninsula is a large gravel spit that forms the western-most extension of the northwest Alaska coast, 330 miles southwest of Barrow. The community encompasses 6.3 square miles of land and 0.1 square mile of water.

The Point Hope Peninsula is one of the longest continuously occupied areas in Alaska. The peninsula, once called Tigaraq, has been occupied for at least 2,000 years. This may be due to its proximity to marine mammal migration corridors and ice conditions that allow boat launchings into open leads early in the spring whaling season.

Most residents of Point Hope engage in a subsistence economy. Bowhead whales, beluga whales, caribou, polar bears, birds, fish, berries, and other resources are important. Government is the main employer of Point Hope residents. The manufacture of Native crafts also contributes to the local economy.

The city government was incorporated in 1966. In the early 1970’s, the community moved to its present location just east of the old settlement because of erosion and periodic storm-surge flooding. A federally recognized tribe, the Native Village of Point Hope is active in the community government and services.

The North Slope Borough provides all utilities to Point Hope. Water is supplied from a lake 6 miles to the east, and is treated and stored in a central tank. A number of homes have water delivered to individual water tanks; others haul water to their homes. Point Hope has no community sewage system and many residents use honey buckets. Electricity is provided through overhead wires by North Slope Borough Power & Light. Power is locally generated with no connections to power grids of other communities. Point Hope buys almost 1 million gallons of fuel each year. The North Slope Borough subsidizes fuel expenses. Ocean-going barges deliver fuel, which is off-loaded through a transfer line anchored offshore every summer and removed for storage each autumn.

Point Hope has one school attended by 251 students. The Point Hope Health Clinic provides medical assistance. The Point Hope Volunteer Fire Department Auxiliary provides early response health care.

Point Hope has a State-owned 4,000-foot paved airstrip that provides the community's only year-round access. Boats, ATV's, and snow machines are seasonally used for local transportation, and barges deliver goods during summer months. No roads connect Point Hope with other communities.

Point Hope has better facilities than some of the other communities of the region, but has problems with high fuel costs, uncertain transportation, erosion, storm-surge flooding, unemployment, and the need for better utilities.

3.2.2.5 Kotzebue

Kotzebue, about 80 miles south of Portsite (figure 3-1), is incorporated as a 2^{nd} Class City. It is a regional transportation and commercial hub for Northwest Alaska. According to the Alaska Division of Community Advocacy, Kotzebue's estimated population in 2004 was 3,130.

Kotzebue has a full range of public and private facilities that include banks, hotels, restaurants, stores, a paved airport with jet service, a hospital, schools, and modern water and sewage systems that serve the majority of households. Several federal and state agencies have area offices in Kotzebue. Kotzebue is also headquarters for the NANA Regional Corporation and the Maniilaq Corporation, the non-profit regional corporation that provides health and social services to NANA Regional Corporation shareholders.

Kotzebue has a more diverse economy than the surrounding communities, including Kivalina and Noatak, but most residents of Kotzebue depend on subsistence foods as an essential part of their diets.

Water is supplied to Kotzebue from a 150-million-gallon reservoir near the city. The water is treated and stored in a 1.5-million-gallon tank, heated with a waste-heat recovery system at the electric plant, and distributed in circulating mains. Piped sewage is treated in a 32-acre, zero-discharge facultative lagoon west of the airport. Around 80 percent of homes are fully plumbed, and 521 homes are served by the city system. Solid waste is disposed of in a landfill and a new transfer station and landfill with baler has recently been completed. Kotzebue Electric Association generates electricity in Kotzebue. Ten 50-kilowatt wind turbines supplement electricity produced by the diesel generators. Kotzebue buys about 7.5 million gallons of fuel each year. About 1.75 million gallons is distributed to surrounding communities along with other goods and merchandise that flows through Kotzebue. The remainder is used locally.

About 860 students attend the three schools in Kotzebue. Local hospitals or health clinics include Maniilaq Health Center and a state clinic. The Kotzebue Volunteer Fire Department and Maniilaq Air Ambulance provide auxiliary health care.

Kotzebue is the service and transportation center for all communities in Northwest Alaska and is the transfer point between ocean and inland shipping for Northwest Alaska. It is also the air transport center for the region. Activities related to oil and minerals exploration and development have contributed to the economy. The Red Dog Mine is a significant local and regional employer, but the majority of income is directly or indirectly related to government employment. Commercial fishing provides some seasonal employment.

The primary means of year-round transportation to and from Kotzebue is aircraft. Deep-draft vessels call offshore from Kotzebue, but because coastal waters are shallow, they must anchor about 15 miles out and cargo is lightered to shore. The shipping season lasts about 100 days, from early July into October, when the Sound is ice-free. Shallow draft barges transport cargo from Kotzebue to smaller communities in the area.

Cars, trucks, motorcycles, and four-wheelers (all-terrain vehicles) use about 26 miles of local gravel roads and 2 miles of paved roads in and around Kotzebue during summer. Many people use snow machines as the principal means of local transportation when there is snow cover. Kotzebue is not connected to other communities by road.

3.2.2.6 Northwest Arctic Borough

The NAB contains the lands around Kotzebue Sound and along the Noatak and Kobuk rivers in Northwest Alaska (see figure 3-3). It is a home-rule borough encompassing about 36,000 square miles of land. Of the eleven communities in the borough, Kotzebue is the largest with approximately 3,130 residents. Ten of the eleven communities are 2nd class cities, and Noatak is unincorporated.

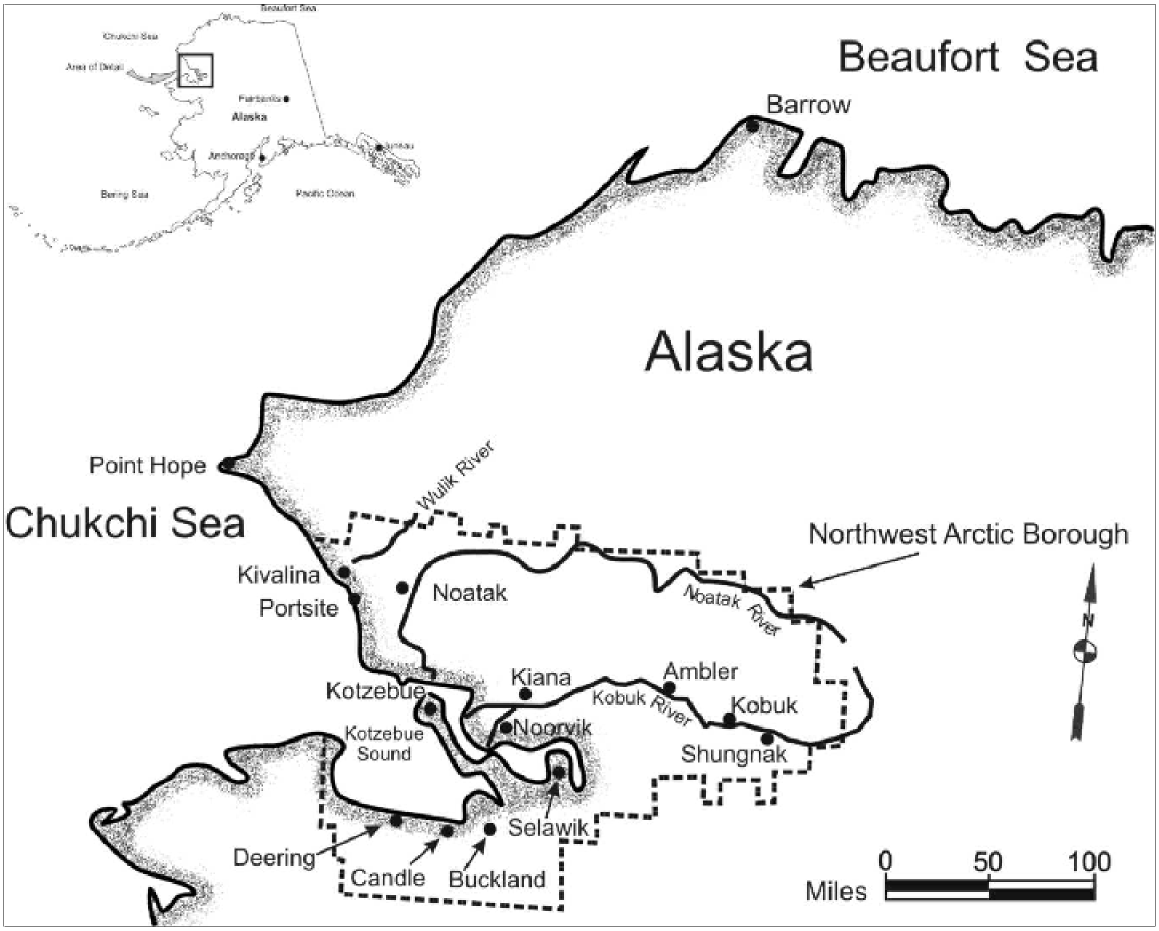


Figure 3-3. Northwest Arctic Borough

The NAB has been occupied for at least the past 12,000 years. *Qikiktagruk* (now known as Kotzebue) was a part of the trading routes that stretched across the Bering Sea to the Chukotka Peninsula for hundreds of miles north and south along the coast of Alaska and deep into the Brooks Range. Admiral Otto von Kotzebue made the first recorded exploration of Kotzebue Sound in 1818 as part of an independent round-the-world voyage funded by Count N.P. Rumiantsev (Pierce 1990). Many settlements in the NAB have existed for thousands of years, but some developed as supply stations for Interior gold mining. The present-day borough government was formed in 1986.

The borough population is about 7,500 residents of which over 80 percent is Alaska Native. The borough population is primarily Iñupiaq Eskimo and subsistence is important throughout the area. Activities related to transportation, retail, services, oil, and minerals exploration and development have contributed to the economy. Government services provide nearly half the employment**.** Transportation services and oil and mineral exploration and development are the focus of economic activity in the borough. The Red Dog Mine, Maniilaq Association, the NAB School District, and the NANA Regional Corporation are the largest employers in the borough.

The NAB has no roads connecting to the rest of Alaska, and no roadways connecting any of the communities with each other. However, during winter an ice road is plowed along the Kobuk River to connect Kotzebue with Noorvik and Kiana.

Kotzebue is the commercial center of the borough, serving as both a shipping hub for Northwest Alaska and a transfer point between Anchorage and the region's smaller communities. The Kotzebue airport supports daily jet service to Anchorage and Nome, as well as smaller aircraft service to communities in the region.

3.2.2.7 NANA Regional Corporation

The NANA Regional Corporation includes about 36,000 square miles of Northwest Alaska, and has the same boundaries as the NAB (figure 3-3). Most of the NANA region is above the Arctic Circle and most of the people inhabiting the region are Iñupiaq.

The NANA Regional Corporation was established by the Alaska Native Claims Settlement Act (ANCSA**)** of 1971, when ANCSA provided a settlement by creating regional corporations of similar Native groups. Twelve regions were identified throughout the state, and each region was to organize as a for profit business corporation. A 13th corporation included Alaska Natives who were not in any of the regional corporations.

NANA Regional Corporation is structured as a Native Corporation and is governed by a Board of Directors selected by its shareholders. The board, as a team, is responsible for seeing that NANA meets the needs of the shareholders and operates as a financially responsible corporation. Shareholder concerns are addressed through the Board of Directors.

3.2.2.8 North Slope Borough

The North Slope Borough was formed in 1972, and covers 89,000 square miles in the northern part of Alaska, north of the Brooks Range. It shares boundaries with the Arctic Slope Regional Corporation (ASRC), which is the regional ANCSA Corporation. Population centers in the borough consist of eight communities, and development at Prudhoe Bay. The borough's population is about 7,555 people, of which almost 70 percent is Alaska Native.

Indigenous cultures have occupied the North Slope Borough for the past 12,000 years. Most of the present population engages in subsistence harvest of marine mammals, caribou, and other wildlife and plants, but the oil industry and government are the major employers and contributors to the local economy.

The borough government has authority over education, taxation, planning, and zoning. The North Slope Borough receives revenue from the oil fields in Prudhoe Bay and provides services such as sanitation, water, fuel, housing, police, fire, search and rescue services, education, wildlife management, washeterias, and transportation services to borough communities. The borough also coordinates and hosts special events and festivals for Arctic people.
Transportation to, from, and within the Borough is primarily by air. The State of Alaska

owns and operates the airport in the major borough communities. No roads connect the communities, but the Dalton Highway connects the oil fields at Prudhoe Bay with Fairbanks and the state highway system. Barrow, the largest city in the borough, has a local, but limited road system. Barges also bring supplies to Barrow, Prudhoe Bay, and other coastal communities in the borough during the ice-free months of late summer. Boats, ATV's, and snow machines serve most local transportation needs in smaller communities.

3.2.3 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-income Populations*, directs federal agencies to identify and consider disproportionately high and adverse human health and environmental effects on minority and low-income populations during the decision making process for federal actions. Demographic information on ethnicity, race, and poverty status is provided in this section to meet that need.

In their publication, *Environmental Justice: Guidance Under the National Environmental Policy Act*, the Council on Environmental Quality provides the following useful definitions:

Minority: Individuals who are members of the following population groups: African American, Hispanic, Asian and Pacific Islander, American Indian, Alaska Native, and other non-white persons.

Minority population: A population where either the percentage of minority individuals in the affected area is greater than 50 percent or where the percentage of minority individuals in the affected area is "meaningfully greater" than in the surrounding area.

Low income population: The CEQ Guidance states that a low-income population should be identified using annual poverty statistical poverty thresholds from the Bureau of the Census Current Population Reports (Series P-60 on Income and Poverty).

Disproportionately high and adverse human health effects: When determining whether human health effects are disproportionately high and adverse, agencies should consider (1) whether the health effects are significant as defined under NEPA or above generally accepted norms; (2) whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard is significant and appreciably exceeds the risk or rate to the general population or other comparison group, and; (3) whether there are health effects caused by cumulative or multiple adverse exposures to a minority population, low-income population, or Indian tribe.

Disproportionately high and adverse environmental effects: When determining whether environmental effects are disproportionately high and adverse, agencies should consider (1) whether there would be an impact on the natural or physical environmental that significantly (as defined under NEPA) and adversely effects a minority population, low-income population, or Indian tribe (including cultural, ecological, human health, economic, and social impacts related to the natural or physical environment); (2) whether environmental effects are significant and may have an adverse impact on a minority population, low-income population, or Indian tribe that exceeds the environmental effect to the general population or other comparison group; and (3) whether the environmental effects would cumulatively occur in a minority population, low-income population, or Indian tribe or result in multiple adverse exposures to environmental hazards.

The potential area of effect for the proposed work includes the communities nearest Portsite (Kivalina, Noatak, and Point Hope). Point Hope is in the North Slope Borough, but Kivalina, Noatak, Portsite, and the Red Dog Mine are in the Northwest Arctic Borough. Generally, all of northwest Alaska could be affected indirectly or cumulatively by navigation changes at Portsite. Comments and concerns throughout the process included the potential for a project to adversely affect subsistence hunting, fishing, and gathering, and for a project to provide a launching point for future development in the region. For that reason, the Northwest Arctic Borough and North Slope Borough are included in the following analysis. Demographic information for the state of Alaska and the United States are also used as a reference population to provide context for readers.

Minority Populations. Table 3-1 lists the percentage of the population in each race category. Compared with the general population of the United States, northwestern Alaska (NAB and NSB) has a significantly larger minority population. The affected communities (Kivalina, Point Hope, and Noatak) have an even larger percent minority population. In such a comparison, the percentage of minority individuals in the affected area is "meaningfully greater" than in the United States. Similarly, the ratio of minority individuals in northwestern Alaska and the affected communities is greater than the state of Alaska as a whole. When comparing racial demographics of the NAB and NSB with those of Kivalina, Point Hope, and Noatak, there is not a meaningfully greater difference.

Table 3-1. Percent minority population in affected area, United States, and Alaska.

	2000 pop.	American Indian/ AK Native	White	African American	Asian American	Native HI/ Pacific Is.	Hispanic	Other
.S.	281,421, 906	0.9%	75.1%	12.3%	3.6%	0.1%	12.5%	5.5%
laska	626,932	15.6%	69.3%	3.5%	4.0%	0.5%	4.1%	1.6%
AB[1]	7,208	82.5%	12.3%	0.2%	0.9%	0.1%	0.8%	0.4%
Ambler	309	84.8%	12.9%	0.3%	0%	0%	0%	0%
Buckland	406	95.8%	3.2%	0%	0%	0%	1.2%	0%
Deering	136	93.4%	5.9%	0%	0%	0%	0%	0%
Kiana	388	92.5%	6.7%	0%	0.3%	0%	0.8%	0%
Kivalina	377	96.6%	3.4%	0%	0%	0%	0%	0%
Kobuk	109	93.6%	4.6%	0%	0%	0%	4.6%	0.9%
Kotzebue	3,082	71.2%	19.5%	0.3%	1.8%	0.1%	1.2%	0.8%
Noatak	428	93.7%	3.7%	0.2%	0%	0%	0.2%	0%
Noorvik	634	90.1%	4.9%	0%	0%	0.2%	0%	0%
Selawik	772	94.8%	3.2%	0.1%	0.8%	0.1%	0.1%	0%
Shungnak	256	94.5%	5.5%	0%	0%	0%	0%	0%

Table 3-1. Percent minority population in affected area, United States, and Alaska (continued).

ome CA[2]	9,196	75.2%	19.3%	0.4%	0.7%	>0.01	1.0%	0.2%
Brevig Mission	276	90.6%	8.0%	0%	0%	0%	0.7%	0%
Diomede	146	92.5%	6.2%	0%	0%	0%	0%	0%
Elim	313	92.7%	5.1%	0%	0%	0%	0%	0%
Gambell	649	95.7%	3.5%	0%	0.5%	0%	0.3%	0%
Golovin	144	84.0%	7.6%	0%	0%	0%	2.8%	0%
Koyuk	297	91.9%	4.7%	0%	0.7%	0%	0%	0%
Nome	3,505	51.0%	37.9%	0.9%	1.5%	0.1%	2.1%	0.4%
Port Clarence	21	0%	90.5%	4.8%	0%	0%	4.8%	4.8%
St. Michael	368	92.7%	6.8%	0%	0%	0%	0.3%	0%
Savoonga	643	95.3%	4.4%	0%	0.2%	0%	0%	0%
Shaktoolik	230	94.3%	5.2%	0%	0%	0%	0%	0%
Shishmaref	562	93.2%	5.3%	0%	0%	0%	0.4%	0%
Stebbins	547	94.0%	5.1%	0.2%	0%	0%	0%	0%
Teller	268	92.5%	7.5%	0%	0%	0%	0.4%	0%
Unalakleet	747	85.3%	11.9%	0.3%	0%	0%	0.3%	0%
Wales	152	83.6%	8.6%	0.7%	0%	0%	0.7%	0.7%
White Mtn	203	93.7%	13.3%	0%	0%	0%	0.5%	0.5%
SB[3]	7,385	68.4%	17.1%	0.7%	5.9%	0.8%	2.4.%	0.5%
Anaktuvuk Pass	282	87.6%	9.6%	1.4%	0%	0%	0.7%	0.7%
Atqasuk	228	94.3%	4.8%	0%	0.4%	0%	0%	0%
Barrow	4,581	57.2%	21.8%	1.0%	9.4%	1.4%	3.3%	0.7%
Kaktovik	293	75.4%	14.7%	0%	0.3%	0%	0%	0.7%
Nuiqsut	433	88.2%	10.2%	0.2%	0.5%	0%	0.2%	0%
Point Hope	757	87.1%	8.7%	0.1%	0.1%	0%	1.7%	0.1%
Point Lay	247	82.6%	113%	0%	0.4%	0%	2.4%	0%
Wainwright	546	90.3%	6.8%	0.2%	0%	0%	0%	0%

Source: 2000 U.S. Census
[1]Northwest Arctic Borough, [2]Nome Census Area, [3]North Slope Borough

Table 3-2 provides a summary of demographic changes from 1990 to 2000 in the United States, the state of Alaska, NAB, NSB, Nome Census Area, Kivalina, Noatak, and Point Hope. This information illustrates changes in minority populations in the affected area, which can help predict demographic changes over time. Data for the United States and the state of Alaska are presented in order to provide context for interpreting the meaning of the numbers for northwest Alaska and the affected communities.

Table 3-2. Summary of Demographic Changes by Race in Northwest Arctic Borough and Kivalina, 1990 – 2000

Race	Community	1990	1990 Percent of Total	2000	2000 Percent of Total	1990-2000 Change	% Change 1990-2000
Total population	U.S.	248,709,873	N/A	281,421,906	N/A	32,712,033	13.2
	Alaska	550,043		626,932		76,889	14.0
	NAB	6,113		7,208		1,095	17.9
	NSB	5,979		7,385		1,406	23.5
	NCA	8,288		9,196		908	11.0
	Kivalina	317		377		60	18.9
	Point Hope	639		757		118	18.5
	Noatak	333		428		95	28.5
American Indian /Alaska Native	U.S.	1,959,236	0.7	2,475,956	0.9	516,720	26.4
	Alaska	85,698	15.3	98,043	15.6	12,345	14.4
	NAB	5,209	85.2	5,944	82.5	735	14.1
	NSB	4,336	58.7	5,050	68.4	714	16.5
	NCA	6,148	66.9	6,915	75.2	767	12.5

	Kivalina	309	97.5	364	96.6	55	17.8
	Point Hope	587	77.5	659	87.1	72	12.3
	Noatak	322	75.2	401	93.7	79	24.5
African American	U.S.	29,986,060	10.7	34,658,190	12.3	4,672,130	15.6
	Alaska	22,451	3.6	21,787	3.5	664	3.0
	NAB	12	0.2	15	0.2	3	25.0
	NSB	41	0.6	53	0.7	12	29.3
	NCA	9	>0.1	35	0.4	26	288.9
	Kivalina	0	0.0	0	0.0	0	0.0
	Point Hope	3	0.4	1	0.1	-2	66.7
	Noatak	0	0.0	1	0.2	1	100.0
Asian / Pacific Islander	U.S.	7,273,662	2.6	10,641,833	3.7	3,368,171	46.3
	Alaska	19,728	3.2	28,425	4.5	8,697	44.1
	NAB	48	0.8	68	1.0	20	41.7
	NSB	285	3.9	499	6.7	214	75.1
	NCA	55	0.6	64	0.7	9	16.4
	Kivalina	0	0.0	0	0.0	0	0.0
	Point Hope	3	0.4	0	0.0	-3	100.0
	Noatak	0	0.0	0	0.0	0	0.0
Some Other Race	U.S.	9,804,847	3.5	15,359,073	5.5	5,554,226	56.6
	Alaska	6,674	1.1	9,997	1.6	3,323	49.8
	NAB	3	0.1	26	0.4	23	766.7
	NSB	43	0.6	37	0.5	-6	14.0
	NCA	53	0.6	18	0.2	35	66.0
	Kivalina	0	0.0	0	0.0	0	0.0
	Point Hope	1	0.1	1	0.1	no	no
	Noatak	0	0.0	0	0.0	0	0.0
Two or More Races	U.S.	Category not used in 1990 Census		6,826,228	2.4	Not applicable	
	Alaska			34,146	5.5		
	NAB			267	3.7		
	NSB			484	6.6		
	NCA			387	4.2		
	Kivalina			0	0.0		
	Point Hope			29	3.8		
	Noatak			10	2.3		
White	U.S.	199,686,070	71.0	211,460,626	75.1	11,774,556	5.9
	Alaska	415,492	66.3	434,534	69.3	19,042	4.6
	NAB	841	13.8	888	12.3	47	5.6
	NSB	1,274	17.3	1,262	17.1	-12	0.9
	NCA	2,023	22.0	1,777	19.3	-246	12.2
	Kivalina	8	2.5	13	3.5	5	62.5
	Point Hope	45	6.0	66	8.7	21	46.7
	Noatak	11	2.6	16	3.7	5	45.5
Hispanic*	U.S.	22,354,059	8.0	35,305,818	12.5	12.951,759	57.9
	Alaska	17,803	2.8	25,852	4.1	8,049	45.2
	NAB	36	0.5	57	0.8	57	0.0

	NSB	124	1.7	175	2.4	51	41.1
	NCA	106	1.2	92	1.0	-14	13.2
	Kivalina	0	0.0	0	0.0	0	0.0
	Point Hope	4	0.5	13	1.7	9	225.0
	Noatak	0	0.0	1	0.2	1	100.0

(source U.S. Census Borough)

The table demonstrates how a slight change in demographics can affect ratios of minority populations in Kivalina, Noatak, and Point Hope. Overall, however, the minority population in Northwest Alaska (NAB, NSB, and Nome Census Area) and the affected communities (Kivalina, Noatak, and Point Hope) grew between 1990 and 2000. Northwest Alaska and the affected communities have large and growing minority groups; however, the growth rate of minorities in the State of Alaska and the United States in general is larger.

Low-income Populations. The threshold for low-income status is best defined using the Department of Health and Human Services poverty guidelines, which are adjusted annually. The per capita income and employment rates in Kivalina and Noatak are significantly lower than in Point Hope, the NAB, and NSB. The per capita income per year was $8,360 in Kivalina and $9,659 in Noatak, but 2 to 3 times that amount in Point Hope and the two boroughs. The number of people living below the poverty threshold in Kivalina and Noatak was also somewhat greater than in Point Hope, NAB, and NSB.

Table 3-3. Percentage of People Living Below the Poverty Level in Northwest Arctic Borough and Kivalina as of 2000

Community	2000 Population	# Individuals below poverty threshold	% Below poverty threshold	2000 per capita income	2000 % employed
U.S.	281,421,906	33,899,812	12.0%	$21,587	n/a
Alaska	626,932	57,602	9.4%	$22,660	71.3%
NAB	7,208	1,243	17.4%	$15,286	63.4%
NSB	7,385	663	9.1%	$20,540	72.2%
NCA	9,196	1,569	17.4%	$15,476	60.6%
Kivalina	377	99	26.4%	$8,360	46.8%
Point Hope	757	112	14.8%	$16,641	65.3%
Noatak	428	93	22.0%	$9,659	55.0%

Federally Recognized Tribes. There are 229 federally recognized tribal governments in Alaska. Northwest Arctic Alaska has 20 federally recognized tribes: 11 in the NAB and nine in the NSB. The affected communities each include a federally recognized tribe: the Native Village of Kivalina, the Native Village of Noatak, and Native Village of Point Hope. Those tribal governments are organized under the IRA as amended, and are recognized as tribal governments by the United States Government and the State of Alaska.

3.2.4 Infrastructure and Transportation

The 52-mile-long DeLong Mountain Transportation System (DMTS) road connecting the Red Dog Mine to the DMT facilities at Portsite is the only roadway in the project vicinity other than local roads in each of the area communities. The nearest contiguous road network connecting Alaska and the 48 contiguous states is the Dalton Highway, about 300 miles east of Portsite. The DMTS road is used primarily to transport ore concentrate in large trucks from the mine to the DMT, and fuels and other materials from the DMT to the mine. The road also serves as a service and supply road.

Fuel, equipment, and supplies are unloaded from barges at Portsite. The terminal is only accessible to barges for about 100 days per year. During those 100 days, the port off-loads about 35,000 tons of freight and nearly 20 million gallons of diesel fuel (Werniuk 2001). It also loads a year's production of ore concentrates (up to about 1.5 million short wet tons) for shipment to the world market.

NANA/Lynden Joint Venture hauls the concentrate from the mine to Portsite, as well as 18 million gallons of fuel and most of the freight from Portsite to the mine. As it is needed, fuel is transported from the storage tanks at Portsite to the mine using trucks and portable 25,000-gallon tanks. Freight is also loaded on trucks at Portsite and transported to the mine. Storage tanks at the port and mine can hold enough diesel fuel to support 9 months of operation.

The zinc and lead concentrates are stored in two separate buildings at the port. Almost 1,100,000 tons of concentrate, about 9 months of production, can be stored. When the buildings have been emptied, ships are loaded directly from production until the shipping season ends.

Because the water is shallow at Portsite, ships must anchor about 3 to 5 miles offshore. Two lightering barges and four tugs operated by Foss Maritime load concentrate at Portsite and transport it to the ships. The lightering barges can carry 6,000 tons of concentrate per load, but they can only be loaded in relatively calm seas.

An average of 27 ships call at DMT to load concentrate from Red Dog Mine each year, and up to 12 barges carrying freight and fuel arrive at the port annually. A large, private airport serves Red Dog Mine. It can handle large cargo and passenger aircraft including jets (Werniuk, 2001).

3.2.5 Industry and Commerce

Governments and the Red Dog Mine are the major employers in the NANA region. Major employers in the NAB are listed in table 3-4. As is the case elsewhere in rural Alaska, government is the largest employer and provides about one third of the employment in the NAB (ADL 1999). The Red Dog Mine is also a significant contributor to the local economy. In 1997, the Red Dog Mine averaged about 370 employees (table 3-4) of which about 60 percent were NANA shareholders. More information about commerce in Northwest Alaska is in Appendix E (Economic Appendix) to the DMT draft interim feasibility report.

Table 3-4. Major employers in the Northwest Arctic Borough.

Rank	Employer	1997 Average
1	Cominco Alaska Inc.	370
2	Maniilaq Association Inc.	369
3	Northwest Arctic Borough School Dist.	356
4	Veco Construction Inc.	96
5	Kikiktagruk Inupiat Corp.	93
6	City of Kotzebue	74
7	NANA/Marriott, joint venture	63
8	Federal Government	62
9	State Government	58
10	Baker Aviation, Inc.	45
11	Arrow Transportation International, Inc.	42
12	Carr Gottstein Foods	37
13	Alaska Commercial Company	34
14	Nullagvik Hotel	33
15	City of Noorvik	30
16	OTZ Telephone Cooperative, Inc.	28
17	Selawik Council	25
17	Lions Club of Kotzebue	25

Source: Alaska Department of Labor, Research and Analysis Section.

3.2.6 Regional Planning

Regional planning includes plans and guidelines adopted by law or regulation that may affect development, for example, coastal zone management plans. Planning also includes studies that help us understand how the region may be developed in the future. There also are possibilities for future development that “everybody knows about,” but that have not been written into a report or planning document. These potential future developments also may be “plans” and may be addressed if those plans could be affected by future development at Portsite.

3.2.6.1 Coastal Zone Management Plans

The Coastal Zone Management Act requires states to make consistency determinations for any federally constructed, licensed, or permitted activity affecting the coastal zone of a state with an approved coastal zone management program (CZMP). Under the Act, the applicants must submit a statement that the proposed activity complies with the state's approved CZMP and will be conducted in a manner consistent with the CZMP. The state then has the responsibility to either concur or object to the consistency determination.

Consistency certifications must include the following information:

Detailed description of the proposed activity and its associated facilities.

An assessment relating to the probable effects of the proposed and associated facilities to relevant elements of the CZMP.

A set of findings indicating that the proposed activity, its associated facilities and their effects are consistent with relevant provisions of the CZMP.

The U.S. Department of Commerce in 1979 approved the Alaska Coastal Management Program (ACMP). The state coastal management policies and guidelines included in the ACMP are intended to be refined by local districts preparing district coastal management plans (CMP). Completed district CMP's must be approved first by the Alaska Coastal Policy Council and then by the U.S. Department of Commerce, either as a routine program implementation or as an amendment to the ACMP. Once approved by the U.S. Department of Commerce, district CMP's become the basis for federal consistency determinations. The proposed project will be evaluated for consistency with the enforceable and administrative policies of the NAB's Coastal Management Program.

Enforceable and administrative policies of the Northwest Arctic Borough Coastal Management Program (DGC 1998) were reviewed for project compatibility and compliance. Existing and proposed facilities are in a Customary Use area.

Recent legislation (House Bill 191 in 2003) has substantially altered the Alaska Coastal Management Program. The NAB CMP is being revised to meet requirements of that legislation. The final EIS will provide information to demonstrate that potential alternatives would be consistent with any revisions to the maximum extent practicable.

3.2.6.2 Kivalina Relocation

Kivalina, 17 miles north of Portsite, is on a barrier island fronted by the Chukchi Sea and backed by the Kivalina Lagoon. The *Kivalliñigmiut* people are indigenous Iñupiaq Eskimos that seasonally occupied the current site of Kivalina before the permanent settlement was established around a mission school in 1905. Since then, the community has grown in size and population, but the island has eroded significantly. Residents of Kivalina recently voted to move to a new 100-acre mainland site approximately 2 miles south of its current location. The new town would be about 15 miles north of Portsite. Funding, permitting, and important elements of community planning are not yet in place for relocation. If Kivalina does relocate to the proposed site, several million yards of gravel may be required as foundation material for buildings, roads, and an airport.

3.2.6.3 Portsite Airport

Personnel change outs, fresh food, and supplies that cannot wait for ocean transportation are supplied to the Red Dog Mine by air. The airstrip at the mine is in a mountain valley that is may be below minimum aviation meteorological limits for days at a time. TCAK and AIDEA have identified the need for an airport accessible from Portsite that might support lower aviation minimums and that might be usable when clouds obscure the mountain valley at the mine. The Federal Aviation Administration funded a feasibility study of potential airstrip sites on NANA land at DMT. The study indicated that an airstrip capable of handling at least some heavy air carriers would be feasible at Portsite. Five airport sites were considered on NANA land at Portsite. The airport site considered the best by that study was 0.75 miles northeast of the concentrate storage buildings.

There is no funding to construct an airstrip, no request for funding by the Alaska Department of Transportation and Public Facilities, and no indication that state or federal transportation agencies will request funds or continue to plan for an airport at Portsite.

3.2.6.4 Red Dog Mine Operations

Lead and zinc in deposits slated for production by the Red Dog Mine are expected to last about 40 years at current production rates. Teck-Cominco Exploration holds additional mineral claims on nearly 400,000 acres of state land (Cominco 2000), with several rich mineral deposits on these claims. Future mining of these deposits could expand infrastructure facilities and production at the mine, or extend the longevity of the existing mine. NANA Regional Corporation, which owns the land being mined, has capped annual mining extraction at 3.5 million metric tonnes. NANA has indicated that they will not agree to substantial increases in mineral extraction. TCAK has capability to mine more ore, but could not increase processing capacity without major additions to production, storage, and support facilities. Neither NANA nor TCAK has stated any plans to increase mineral extraction or production in the foreseeable future.

3.2.6.5 Other Mines in the Region

Huge coal deposits in the North Slope Borough representing more than 10 percent of the world's reserves are likely to be mined eventually. Mining could be phased with a mine-mouth, coal-fired electrical generation at first, followed by export. A profitable mine would require extraction and transportation of far more volume than from the Red Dog Mine. Construction and start-up costs also would be very high. World market prices for coal are far below levels required for feasible export of North Slope coal. Distribution and permitting problems, along with the large capital costs, have prevented development of a mine-mouth electrical generation. There are no plans beyond general conceptual visions for North Slope coal mining.

CH2MHill (2001) identified several major mineral deposits or groups of deposits in the Delong Mountain mineral district (Figure 3-4) that may become feasible to mine when world market prices rise. Capital costs for development, construction, and startup would be extremely expensive and are not justified by current world market prices. Planning is at the conceptual stage for developing these deposits and is likely to remain at that stage until metal prices rise and show stability at the higher metal prices.

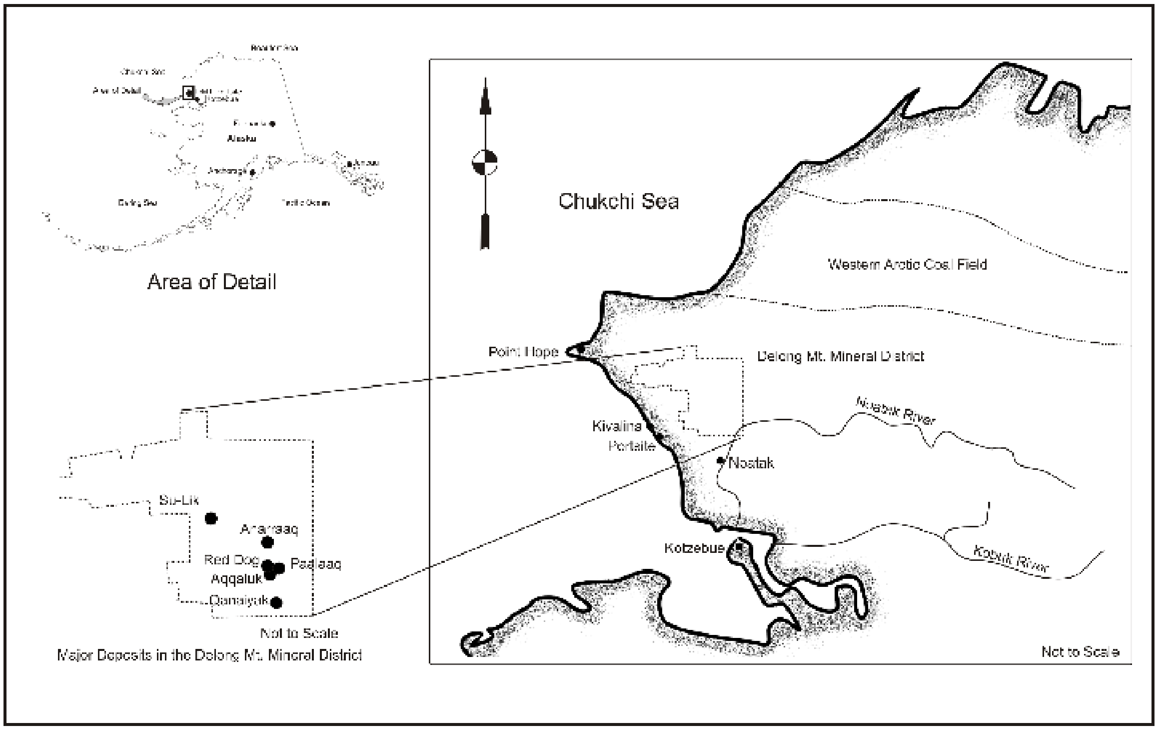


Figure 3-4. Major coal and mineral deposits in the Delong Mountain mineral District, Alaska.

3.2.6.6 Transportation Corridor - North Slope to Nome

Long-range planning for Northwest Alaska identified potential corridors for north-south transportation between the North Slope and Portsite and to the existing, but relatively undeveloped, port at Cape Nome (CH2MHILL 2001). A transportation system of roads, railroads, and/or new shipping facilities in Northwest Alaska might facilitate future mining and transportation of coal and mineral reserves. The report noted that distances from the North Slope to Portsite or the Seward Peninsula would likely require construction of a rail system to handle the large volume that would be required to make coal export viable. The report offered conceptual information to planners, but there have been no funding or advanced planning actions that would be the next of many steps required to begin design of part or all of a new transportation system in Northwest Alaska.

3.2.6.7 Undeveloped Tourism

Kotzebue airport serves as the regional transportation hub and gateway to four major national park or refuge systems (Noatak National Preserve, Kobuk Valley National Park, Cape Krusenstern National Monument, and the Selewik National Wildlife Refuge). The National Park Service tallied over 23,000 visits to these four systems in 1998 (ADL 1999). With improvements in transportation and development of tourism related programs and infrastructure, communities may have access to tourist destinations and may realize more involvement in future tourism.

3.2.7 Visual Resources

National policies (including ER 1105-2-100) require Federal decision makers to consider effects of actions on aesthetic resources, including visual resources. Aesthetic resources include natural resources, landforms, vegetation, and man-made structures in the environment that generate one or more positive sensory reactions and evaluations by the observer. Land use in the area is also an important consideration in evaluating visual resources.

The natural Portsite visual setting is typical of many miles of coastline along the eastern Chukchi Sea. Inland from the sea, a gravel beach topped by tall grass gives way to low tundra covered by low vegetation. Lagoons ranging in size from a few acres to hundreds of acres may be seen behind the beach berm. Taller vegetation outlines the occasional creek or river and small ponds and lakes dot the landscape. Within a few miles of Portsite, the low tundra gains elevation into the 1,400-foot-high Mulgrave Hills. The higher points of the Mulgrave Hills are generally bare rock. During winter, the natural landscape is covered in snow with occasional patches of exposed rock or dormant vegetation. The landscape is green with patches of bare rock during summer. The Mulgrave Hills are within the Cape Krusenstern National Monument.

Within the boundaries of 660,000-acre Cape Krusenstern National Monument, 19,747 acres along the Red Dog Mine System Road, 113 acres in two trail easements between Kivalina and Noatak, 5,760 acres of NANA Regional Corporation land near the Red Dog Portsite, and 600 acres near Mud Lake are not eligible for wilderness designation (National Park Service Final Environmental Impact Statement: Wilderness Recommendation, 1988). The wilderness areas of the monument were designated because they were undeveloped and possessed important wilderness values. Most important to this discussion is the coastal areas of the wilderness. The beach ridge complexes, spits, barrier islands, and lagoons were all deemed important to the wilderness designation of the monument for their scientific, cultural, and scenic values.

3.2.7.1 Man-Made Features

Two large red and white buildings about 1 mile inland from the beach dominate the existing visual landscape at the Portsite. These buildings appear as one building when viewed from the beach. Immediately behind the beach berm is a cluster of six large fuel tanks, several maintenance buildings, living quarters, a storage area for corrugated steel storage and transportation containers, and a low tower. A road and enclosed conveyor connect the inland building with the main facility near the beach. The developed DMT area at Portsite encompasses approximately 160 of the 450 acres leased by AIDEA. .

A small solid-fill dock and a 700-foot-long ore-loading trestle on piers dominate the visual nearshore setting. Several tug boats, barges, and as many as five ocean-going bulk ore carriers may be present during the summer. The ore carriers anchor 3 to 5 miles offshore of Portsite and are visible on the horizon for 10 or more miles on a clear day. The tugs and barges move between the loading facility at Portsite and the anchored ore carriers. The visible marine environment is covered by ice from about late October through most of June.

3.3 Subsistence

Subsistence, as defined in this draft EIS, and based on scoping input from the people of northwestern Alaska and other subsistence users, means the non-commercial hunting, fishing, and gathering of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, and handicrafts, and for trade, barter, or sharing. Subsistence harvests may be authorized by Federal regulations or state permits for personal use, sport hunting, sport fishing, or trapping, or may be based in some other regulation or custom.

During scoping meetings in northwestern Alaska soon after the DeLong Mountain Terminal (DMT) draft EIS process began in 2000, people identified subsistence as one of their major concerns as a resource and way of life that must be protected. People were concerned about all aspects of subsistence, including the plants and animals that are harvested, the ways they are used, how they are stored, and how subsistence practices support and maintain Native and non-Native cultures in northwestern Alaska. People commenting about subsistence showed a very strong awareness of the importance of habitat, water quality, and food chain organisms to subsistence plants and animals and the way the plants, animals, people and their environment are connected. People were concerned that navigation improvements could affect subsistence.

This section of the draft EIS looks at subsistence harvests in the area around Portsite. It does not address every use, or exactly how much is harvested. Instead, it focuses on the most important subsistence resources near places where project facilities might be constructed. The subsistence information in this section, and the discussions of plants and animals in subsequent sections, focuses on resources that:

- Are important in the culture and/or diet of the people of northwestern Alaska;
- Are harvested in an area that might be affected by one of the alternatives considered in detail;
- Are in or pass through the area that might be affected by one of the alternatives considered in detail or;
- Are important in the food chains of subsistence animals and might be affected by one of the alternatives being evaluated.

Plants harvested by the people of northwestern Alaska, although important in both diet and culture, are not given much attention in this section because any of the alternatives considered in detail for a project at Portsite would use less than 5 acres of land above the high water mark and would be in an area where plants are not currently harvested for human use.

The information on subsistence uses comes from a variety of sources, including subsistence data gathered by state, federal, and other agencies, information from histories and accounts of traditional ecological knowledge, hunters' reports to agencies, and information obtained from conversations with the people of northwestern Alaska.

3.3.1 Importance of Subsistence in Northwestern Alaska

Subsistence historically has been, and is today, an essential part of the life and well being of the residents in northwestern Alaska. In addition to its dietary and economic importance, subsistence is a basis for the important cultural practices of cooperative food gathering and food sharing and is at the center of cultural values and social organization in Iñupiaq society. There are various estimates as to how important plants and animals harvested for personal use are in northwestern Alaska. One survey sponsored by NANA about 25 years ago indicates the central role held by subsistence at that time. The survey asked households the question: *"How much of your own food did your family gather, hunt, or fish for this year?"* The responses from Kivalina, Noatak, and Kotzebue households are shown in table 3-5 and indicate the percentage of responses to aforementioned question. The survey showed that 85 percent of households in Noatak, 61 percent of households in Kivalina, and 36 percent of households in Kotzebue reported that they obtained at least half of their food from subsistence activities.

Table 3-5. Importance of Subsistence Foods to Households in NANA Region (indicated by: *"How much of your own food did your family gather, hunt, or fish for this year?").*

RESPONSE	KIVALINA	NOATAK	KOTZEBUE
"All of our food"	5.6%	--	5.6%
"Most of our food"	16.7%	57.1%	14.9%
"Half of our food"	38.9%	28.6%	16.1%
"Some of our food"	38.9%	14.3%	49.1%
"None of our food"	--	--	14.3%
TOTAL	100.0%	100.0%	100.0%

Source: NANA Regional Strategy, Community Survey, 1978, as reported in Red Dog Mine Project EIS, February, 1984.

Relative percentages of use may have changed since that time, but it is clear from less extensive surveys and from statements made repeatedly during scoping that subsistence is at the center of the diet and culture for the majority of people in northwestern Alaska, and that subsistence resources must be protected for their dietary and cultural well being.

Information about subsistence began to be recorded on paper during the earliest visits by Asian and European travelers, and has been kept for a much longer time in the oral histories and practices of the Iñupiaq of the region. Detailed harvest information on species and quantities was first compiled in the 1960's and again in the 1970's and 1980's. More recent studies in the 1990's collected a broader range of information, including harvest practices, locations, traditions, and interactions. Although the researchers and agencies that gathered this information are well qualified, the hunters, fishers, and gatherers of rural northwestern Alaska are the most important source of subsistence information.

Most of the traditional foods the Iñupiaq people harvest today are the same types of plants and animals that were harvested hundreds of years ago, with the notable exception of moose, which are relatively new to northwestern Alaska. The ways they are harvested and the relative abundance of the species in the harvest have changed, but there has been relatively little change in what species are harvested.

3.3.2 Subsistence in this draft EIS

This draft EIS focuses on subsistence resources important in the culture and diets of the people of northwestern Alaska. It looks at possible impacts to these resources, how they can be protected, and how potential impacts to them can be reduced.

The subsistence resources covered in this were either (1) identified as important during the scoping process for the draft EIS, (2) considered to have special cultural significance to the people, or (3) are likely to be directly affected by any expansion of the Portsite loading facilities. Subsistence resources in the Portsite area that meet one or more of these criteria include the following:

Marine Mammals	Fish	Birds	Terrestrial Mammals
bearded seal	char	ducks	caribou
walrus	grayling	geese	moose
beluga whale	salmon	ptarmigan	Dall sheep
bowhead whale	whitefish		
ringed seal	cod		
polar bear			

Some of the terrestrial plants and animals harvested for personal use in northwestern Alaska would not be directly affected by navigation improvements at Portsite because the facilities would be almost entirely in the Chukchi Sea. The area on land that would be used to support an expanded Portsite is already developed. Sourdock, willow, berries, and other plants important to subsistence in northwestern Alaska would not be directly affected outside the developed area at Portsite. Therefore, they are not evaluated further in this discussion.

Caribou, moose, ptarmigan, grizzly bear, musk ox, red fox, wolves, wolverine, and various species of upland birds and waterfowl might be occasionally present near Portsite. However, they would not be affected substantially by navigation improvements. Caribou, moose, Dall sheep, and some species of birds are included in discussions because they may be in the general area of Portsite and could be affected by construction or operational noise and activity, or because they were of particular concern during scoping.

3.3.3 Subsistence Resources and Practices in the Portsite Area

Subsistence Resources Typically Harvested. A representative profile of the subsistence resources historically harvested in the project area is in tables 3-6a, b, c, d, and e. The table was developed using subsistence harvest survey data obtained from Kivalina by the Subsistence Division of the Alaska Department of Fish and Game (ADFG) during 1964-1966, 1982-1984, and 1991-1992. The subsistence harvest data compiled in the tables is summarized by year for each type of subsistence resource harvested. Researchers living in Kivalina recorded daily harvest data from the1964-1966 and 1983-1984 survey periods. Subsistence harvest data from the 1991-1992 subsistence-year surveys were obtained through interviews with each household in the community.

Data collection and presentation here focuses on reporting from Kivalina because Portsite is closer to Kivalina than any other community, and people from Kivalina harvest a large proportion of the plants and animals in the Portsite area. Most of the same plants and animals reported as being important in the Kivalina harvest are also important in other communities in the region.

People in other communities of Northwest Alaska also hunt or gather food in the general region around Portsite or share subsistence resources with those who do. People from Kotzebue, Noatak, and Point Hope, in particular, identified at least some connection with subsistence resources around Portsite. People in each community used the same subsistence resources as at Kivalina, but in different proportions related to availability of resources and cultural preferences. People of Point Hope have less access to anadromous fish, but are in an exceptionally good location to hunt marine mammals. Their subsistence take reflects these differences. People of Noatak are well away from the coast and rely more heavily on anadromous fish and terrestrial mammals, but still participate in marine mammal harvest. People in Kotzebue may travel great distances to participate in hunting, fishing, and gathering and may use a correspondingly broad range of resources. All these communities, with a few relatively minor exceptions, rely on the same subsistence resources. In each community, subsistence is essential to the cultural and nutritional well being of the community.

Table 3-6a. Kivalina Marine Mammal Subsistence Harvests for 1964-1965, 1965-1966, 1982-1983, 1983-1984, and 1991-1992.

Resource	**Number Taken**				
	1964-1965	1965-1966	1982-1983	1983-1984	1991-1992
Bearded seal	153	119	134	60	139
Spotted seal	4	1	1	1	30
Ringed seal	908	467	172	109	110
Ribbon seal	NR	NR	1	NR	8
Walrus	0	3	51	4	28
Beluga	6	12	27	28	10
Bowhead whale[a]	0	0	0	1	1
Gray whale	0	0	0	Part of carcass	0
Polar bear	NR	1	NR	2	8

a. Two additional bowhead whales were taken in 1994.
NR. None reported.

Table 3-6b. Kivalina land mammal subsistence harvests for 1964-1965, 1965-1966, 1982-1983, 1983-1984, and 1991-1992.

Resource	Number Taken				
	1964-1965	1965-1966	1982-1983	1983-1984	1991-1992
Caribou	256	1,010	346	564	351
Moose	NR	4	6	6	17
Grizzly	1	2	NR	2	3
Fox	6	19	47	58	21
Sheep	NR	NR	2	NR	0
Wolf	1	1	NR	1	9
Wolverine	17	21	12	10	23
Lynx	NR	6	1	NR	0
Porcupine	1	1	1	NR	0
Mink	NR	1	NR	NR	2
Otter	NR	NR	1	NR	2
Hare	NR	NR	NR	NR	0
Squirrel	NR	NR	3	53	10

NR None reported.

Table 3-6c. Kivalina Fish Subsistence Harvests for 1964-1965, 1965-1966, 1982-1983, 1983-1984, and 1991-1992

Resource	Pounds Taken				
	1964-1965	1965-1966	1982-1983	1983-1984	1991-1992
Char	93,995	28,140	69,059	68,467	69,792
Cod	NR	6,955	9	4,299	6,095
Burbot	NR	2	2	2	516
Grayling	NR	40	290	968	644
Salmon	1,425	116	464	2,107	5,081
Whitefish	2,500	13	100	1,608	4,662
Sculpin	ND	ND	9	9	ND
Smelt	ND	ND	ND	20	22

ND No data collected.

Table 3-6d. Kivalina Bird Subsistence Harvests for 1964-1965, 1965-1966, 1982-1983, 1983-1984, and 1991-1992

Resource	1964-1965 number taken	1965-1966 number taken	1982-1983 number taken	1983-1984 number taken	1991-1992 number taken
Geese	ND	ND	215	387	944
Ducks	ND	ND	134	210	609
Ptarmigan	ND	16	46	242	637
Cranes	ND	ND	4	4	12
Snowy Owls	ND	ND	15	26	29
Swans	ND	ND	1	NR	0
Murres	ND	10	ND	18	ND

ND No data collected.

Table 3-6e. Kivalina Plant Subsistence Harvests for 1964-1965, 1965-1966, 1982-1983, 1983-1984, and 1991-1992

Resource	1964-1965 lbs taken	1965-1966 lbs taken	1982-1983 lbs taken	1983-1984 lbs taken	1991-1992 lbs taken
Blackberries	550	181	457	591	See mixed
Sourdock	260	213	85	NR	See mixed
Eskimo Potato	ND	ND	40	NR	See mixed
Salmonberries	ND	ND	1,721	14	See mixed
Blueberries	ND	ND	461	488	See mixed
Mixed	370 (Salmonberries, blackberries, sourdock)	283 (Berries)	ND	ND	4,615 (Recorded as berries, not as type)

ND **No data collected.**
NR **None reported.**

Sources of data: .Burch 1985. Also, Alaska Department of Fish and Game Community Profile Database.

The data for Kivalina show that in each period reported in table 3.6, bearded seal, ringed seal, and beluga whale were consistently important among the marine mammals harvested. Caribou were the most important land animal in the harvest, and char (Dolly Varden, also locally known as “trout”) were by far the most important fish in each year that data were collected. Waterfowl and ptarmigan were the most important birds in the harvests.

The data show a great deal of variation in the harvest of individual species from one data reporting period to the next. This may reflect several factors, including natural variations in the populations or abundance of the targeted plants and animals. Those differences also may reflect variations in migratory routes followed by land and marine mammals, timing of migratory and local seasonal movements, and variations in ice and weather conditions that affect the ability of hunters, fishers, and gatherers to harvest those resources. Only two long-term trends are readily apparent in the presentation of the long-term harvest of the principal resources: harvest of ringed seal by Kivalina hunters steadily declined between 1964 and 1992, and the numbers of moose harvested steadily increased. The reasons for these apparent trends and information about the harvest of the most important subsistence resources are presented later in this section.

More recent subsistence data have been collected at Kivalina and at other communities in the region around Portsite, but they focused on areas traditionally hunted and fished, rather than on quantities of specific resources harvested. Conversations with residents of the communities verify that the resources reported in table 3.6 are still being harvested in the region, that they all are considered important in subsistence uses, and that the same animals that provided the bulk of the harvest between 1964 and 1992 were still predominant in recent harvests.

Current Subsistence Practices. Current subsistence practices in the Portsite area associated with the primary subsistence animals are summarized in table 3-6. The table summarizes when harvesting takes place, usual places where the resources are harvested, how harvesters access the resources, typical harvest methods, and factors that may influence the amount harvested. Information in the table focuses on the practices of hunters from Kivalina because Portsite is in an area traditionally and currently used most by people of Kivalina. The hunting and fishing methods, handling, and seasons are generally applicable to harvests by other communities in the region. The table uses information from the available literature and discussions with hunters and fishers in the region around Portsite.

As noted in table 3-7, a variety of environmental factors can individually or collectively influence the size of the subsistence harvests each year. These environmental factors and other information about the current subsistence practices of the people in Northwestern Alaska are discussed below. This information was collected from people throughout the region, but especially from those who use the area around Portsite.

Seals. Ice conditions can dictate the amount of effort required to hunt seals and can affect the success of the hunt. In the case of ringed and bearded seals, the thickness of shore-fast ice can affect the distribution of seals as well as the safety of travel on the ice to harvest them. Although thin ice readily forms leads and cracks that may cause seals to congregate in the leads, thinner ice also tends to pile into pressure ridges that can make travel difficult and dangerous.

The depth of snow on the shore-fast ice also can influence the seal harvest. Deeper snow can make travel by snow machine easier, but it can also help keep female ringed seals hidden from view in lairs under the snow.

Hunting for seals and other marine mammals can begin as early as January or February, but usually is not very active until March or April, when ice and weather conditions are more suitable, and typically peaks in June. Warmer weather is likely to bring seals out onto the ice to bask in the sun, where they are more vulnerable, but also may cause meltwater to pool on top of the ice, which can make access difficult.

During the April-to-June period, when leads typically form in the ice, seals may be hunted from boats. Wind can be an important factor in the success of a hunt in the open leads. Strong easterly winds can drive ice far offshore and take the seals with it; while strong westerly winds can pile drifting ice against the shore and prevent boat launching. Hunters in the region have said that ideal wind conditions are when the prevailing winds are light and variable and oppose the ocean currents to open leads enough to allow hunters to reach the seals by boat.

Table 3-7. Summary of Current Subsistence Practices in the Portsite Area.

Resource	Harvest Time	Peak Harvest Time	Harvest Area Relative to Portsite	Access Methods	Harvest Methods	Factors Affecting Harvest
Marine Mammals						
Ringed seal	November to early July	February to June	North and south of Portsite on shorefast ice or on drifting floes after breakup.	Access is by snowmachine over the ice during winter or by boat after breakup	Seals are shot with a rifle on the ice or in the water. If they are shot in the water, they retrieved with seal hooks and pulled into a boat or on the ice. They are butchered on the ice or back in the village.	Ice conditions (thickness, roughness), snow depth, presence and size of leads and cracks, wind direction and speed, and abundance of animals.
Bearded seal	November to August	June	Same as above	Same as above	Same as above	Same as above
Beluga whale (spring)	Late April to June	Late May and early June	In leads up to 10 miles offshore, north and south of Portsite.	Same as above	Belugas are shot with rifles and recovered with seal hooks. They are pulled onto the ice or towed back to the village and butchered.	Presence of and size of leads, wind direction and speed, abundance of animals.
Beluga whale (summer)	June to August	July	In nearshore water north and south of Portsite.	Summer belugas are hunted from boats among drifting floes or in open water	Summer belugas are shot with rifles and recovered with seal hooks. Belugas are towed to the village or to shore and butchered.	Floating ice, wind, Portsite activity (possibly), abundance of animals.
Bowhead whale	Late April to June	May	In leads up to 10 miles offshore north and south of Portsite.	Snowmachines are used to tow boats on sleds across the ice to open leads where bowheads migrate.	Bowheads are shot with harpoon bombs and speared with harpoons. They are pulled onto the ice with block and tackle, and butchered.	Presence of and size of leads, wind direction and speed, distance of migration route from shore.
Polar bear	December to May	March to May	On shorefast and pack ice north and south of Portsite.	Snowmachines are used to follow tracks to the bear. Native hunters often shoot polar bears incidentally while hunting seals, walrus or whales.	Polar bears are shot with rifles and skinned on the ice or back in the village.	Ice conditions (thickness, roughness), snow depth, availability and size of leads and cracks, wind direction and speed, abundance of animals.

Resource	Harvest Time	Peak Harvest Time	Harvest Area Relative to Portsite	Access Methods	Harvest Methods	Factors Affecting Harvest
Walrus	June and July	June and July	Along the edge of pack ice up to 30 or more miles offshore.	Boats are used to hunt walrus hauled out along the edge of retreating pack ice.	Walrus are shot with rifles from boats. Because they are hunted far from the village, they are butchered on the ice where they are shot.	Distance offshore, wind, currents, weather, visibility (fog), and economics.
Birds						
Ducks	May to October	May and June	In and round lagoons along the beach, and around inland ponds.	Snowmachines, ATV's, or boats are used to access the hunting area.	Ducks are shot with rifles and shotguns and brought back to the village or hunting camp.	Wind, visibility
Brant/geese	May to October	May and June	Same as above	Same as above	Same as above	Same as above
Ptarmigan	February to November	March and October	On the tundra north, south, and east of Portsite.	Snowmachines, ATV's, or boats are used to access the hunting area.	Same as above	Tundra conditions, weather, abundance of animals.
Fish						
Char	Year around	June, August, September	In Kivalina Lagoon, and the Kivalina, Noatak, Wulik, and other rivers of the region.	Snowmachines are used during winter and boats are used during summer.	Char are caught in gill nets, in seines, and by hook and line. They are cached on site or brought back to the village.	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing, presence of grizzly bears and wolverines.
Grayling	Year around	June, August, September	Same as above, in lagoons, rivers of the region.	Same as above	Same as above	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing.
Salmon	June to August	July and August	Same as above.	Same as above	Same as above	Water conditions, run size, preference for char.
Whitefish	June to September	August, September	Same as above.	Same as above	Same as above	Ice and water conditions, size of run, good fish-preserving weather, freeze-up timing.
Cod	October to December, and July (rarely)	November, December	Kivalina Lagoon	Snowmachines during winter and boats during July.	Cod are mostly caught with hook and line through holes chopped in the ice.	Same as above

Resource	Harvest Time	Peak Harvest Time	Harvest Area Relative to Portsite	Access Methods	Harvest Methods	Factors Affecting Harvest
Terrestrial Animals						
Caribou	July to May	October	On the tundra north, south, and east of Portsite.	Snowmachine are used during winter, and ATV's and boats during summer to access the general hunting areas.	Caribou are shot with rifles. They are brought to the village or sometimes cached temporarily on the tundra when more than a few are harvested.	Migration route and timing, abundance of animals.
Moose	Bulls in August and September, sometimes young cows in April.	August, September	Along river and stream banks.	Moose are not generally targeted as a subsistence species. They are mostly opportunistically harvested while hunting caribou.	Moose are shot with rifles and mostly butchered on site because of their size.	Local preference for caribou, animal size, dispersal on range, a need for moose fat.
Dall sheep	June to April	October to April	In the DeLong Mountains near Cape Thompson and the middle Wulik River.	Snowmachines and sometimes boats are used to access the general area where Dall sheep are found.	Sheep are shot with rifles and mostly skinned and butchered on site because of the distance from the village.	Abundance of animals, travel distance to animals, economics, season restrictions.

Ringed Seal. Ringed seals are widely distributed and coastal hunters in northwestern Alaska generally consider them to be less difficult to harvest than other seals. As a result, they are less frequently talked about than the other marine mammals that are more valued in subsistence. Brief accounts of traditional cultural practices, however, have been gleaned from oral histories. A common theme in the accounts is that ringed seals are still important to the northwestern Alaska Native culture and in earlier times were a mainstay in the human diet in addition to being food for sled dogs (W. Adams Sr. personal communication, Braund 1999, Runyan 2001). Ringed seals were so important to the local subsistence economy in past years that they surpassed other species in numbers harvested until the 1990's when more bearded seals were harvested (Table 3-6a).

Ringed seals typically are stalked and shot with rifles while they are basking on the shore-fast ice or drifting floes (table 3-7). They also are sometimes shot in the water and recovered with a grappling hook known to coastal Alaska Natives as a seal hook. Ringed seals may be hunted as soon as the ice forms in November or December, but most of the hunting and harvest of ringed seals now takes place between February and late June, when the seals concentrate to bask on the ice near cracks and leads or on floes. Most hunting for ringed seals is on shore-fast ice, but they sometimes are taken on pack ice in conjunction with hunts for bearded seals and beluga whales in March through May.

Basking ringed seals are easily frightened into the water if they see a hunter approaching. Traditionally, when ringed seals were hunted at breathing holes, hunters made considerable efforts to avoid being seen or heard. A hunter might stand on ice blocks or a stool so the seals could not see the shadow of his through the ice (Nelson 1969). Dogs were tied more than 100 yards away so the noise did not scare the seals (Nelson 1969). In contrast, the seals often became very curious about unusual noises in the open water. Their curiosity was used to bring them closer. People would make noises at open leads by "chopping the ice with an *unaak*, making a raspy 'Donald Duck' sound in the throat, beating the side of a sled or skin boat with a stick, operating a camp stove, whistling, humming, stamping or scraping the ice with one's boot, driving a dog team along the ice apron, or just talking loudly" (Nelson 1969).

Once, almost the entire ringed seal carcass would be used. In addition to food for people and sled dogs, the hides, intestines, and other parts of the ringed seals were used for a variety of traditional purposes including making buoys, water jugs, ropes, toys, windows, rain gear, and sewing thread. Modern goods have replaced many of the traditional uses for ringed seals. With fewer dog teams and the advent of the snow machine, they have lost some of their importance as a subsistence resource. Ringed seals, however, retain a high cultural importance in the project area (W. Adams Sr. personal communication) and are also used for subsistence camp meat during extended stays hunting on the ice.

Spotted Seal. Spotted seals are not as abundant or as heavily hunted in the Portsite area as in some other parts of Northwestern and Northern Alaska. They are larger than ringed seal and are harvested in about the same way as ringed seals or bearded seals along leads in the ice or along the receding edge of the icepack. Spotted seals are known by hunters to be particularly aware of unusual or sudden movements. When hunting spotted seals from shore or ice, the hunter might point the rifle in the area where a seal was expected to surface so that sudden or large movements would not have to be made to sight it on them. Large or sudden movements would frighten the seals into diving again (Nelson 1969). In the kayak or boat "it is important to present an unchanging profile to the seal. With an outboard motor, one should maintain the speed of the engine, since it is a change that will alert the animal (Huntington and Mymrin 1996)." Spotted seals are one of three sea mammals considered dangerous in the traditional knowledge of northern Alaska because they will sometimes intentionally attack humans (Nelson 1969).

Bearded Seal. Historically, bearded seals were harvested in fewer numbers than ringed seals, but are now are harvested in greater numbers (table 3-6a). Adult bearded seals are more than five times as heavy as adult ringed seals, so bearded seals make a far greater dietary contribution than ringed seals. The change in emphasis from ringed seal to bearded seal may have occurred for the following reasons:

- Snow machines and boats have replaced dog teams, reducing the need to harvest large numbers of ringed seals for dog food.

- Modern goods purchased from stores in the DMT area or by mail order have replaced many of the traditional items crafted from ringed seals.

- The value of a ringed seal skin has dropped so much that it is no longer worthwhile to harvested ringed seals for their skins (W. Adams Sr. personal communication).

- Bearded seals are strongly preferred as a source of food and oil over ringed seals and are much more valuable for trading and sharing.

Bearded seals vary in their alertness or wariness depending upon the time of year and are relatively tolerant of aircraft and boats (Burns and Frost 1979). Some hunters say that bearded seals never haul out very far from a lead or crack in the ice, so they can rapidly return to the water (W. Adams Sr. personal communication, Burns and Frost 1979). In the water, however, they may become curious and swim up to hunters to see what they are doing (Nelson 1969).

The following paragraph is an excerpt from the Alaska Department of Fish and Game, Wildlife Notebook Series (Burns 1994) regarding bearded seal behavior:

"In the spring when they are basking on the ice, bearded seals frequently show little concern about the presence of a boat or humans. One might judge that this seal's senses of sight, smell, and hearing are very poor. In fact, bearded seals have good vision and hearing, and at least a fair sense of smell. During late fall when boats are used in the hunt, it is common to see a bearded seal surface several hundred yards from a boat, trying hard to identify the source of disturbance. During winter hunts on the ice, the slightest sound of a hunter will cause a seal to flee amidst a mighty splash of water. A hunter must remain well hidden, and if exposed, move very slowly so as not to alarm the seal. It is a common occurrence to see a bearded seal surface, immediately dive and resurface far out of effective rifle range, obviously aware of something strange in the vicinity."

Bearded seals are hunted from shore-fast and pack ice from November through August near Portsite (table 3-7). The customary hunting area for bearded seals in the Portsite area, as described during interviews with Native hunters (Braund 1999, 2000), is shown in figure 3-5. Bearded seal numbers in the Portsite area peak in June, when large numbers of seals bask along leads and on floes where they are typically stalked and shot with rifles. Bearded seals mostly inhabit thin or broken pack ice, making them difficult or dangerous to reach until spring, when most of the harvest takes place. Like ringed and other seal species, bearded seals that are shot in the water are generally recovered with the assistance of a "seal hook."

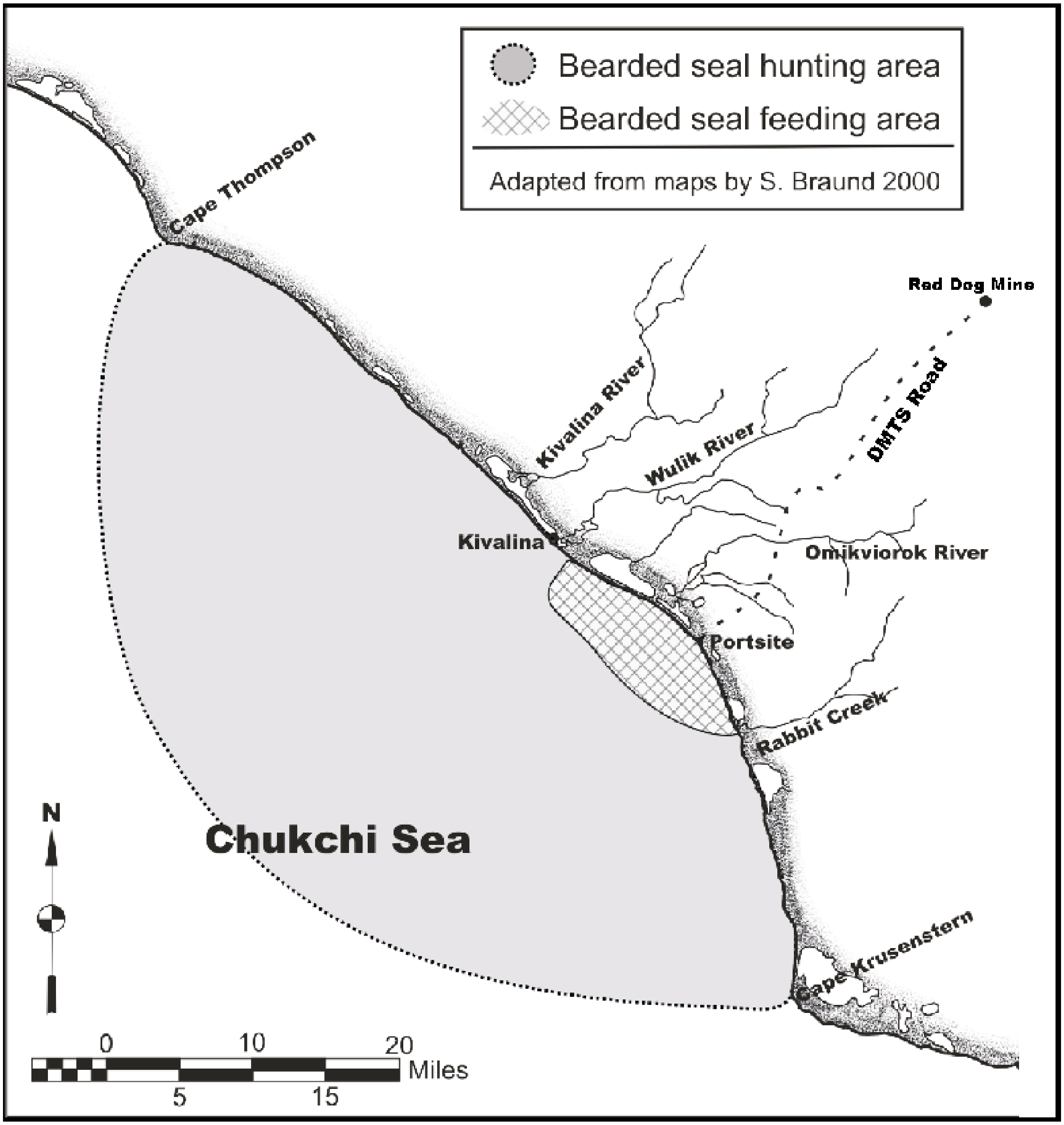


Figure 3-5. The hunting and feeding area of bearded seals near Portsite described by subsistence hunters from Kivalina, Alaska

Bearded seals are the principal species used for rendering seal oil. Seal oil has many traditional uses, including as a preservative for other subsistence foods and as a condiment eaten with foods much as olive oil is used in some Mediterranean cultures. Seal oil also is valued in traditional medicine for curing colds, frostbite, and other ailments and for spiritual value in Iñupiaq culture by promoting a feeling of “well being” and a connection to the culture when eaten. Seal oil is sometimes traded for other traditional foods with inland communities that do not have ready access to coastal hunting areas. The flesh of bearded seals is also dried to make a traditional food known as “dark meat,” and the fermented flipper of bearded seal is a traditional Iñupiaq food. Like the ringed and other seal species, almost the entire bearded seal had traditional uses.

Beluga Whales. Two stocks of beluga whales are hunted near the DMT, a spring stock and a summer stock. The spring hunt can start as early as March in some years when offshore leads are present and ice conditions allow a hunt. These early beluga are from the Beaufort Sea stock that winters in the Bering Sea and summers in the Mackenzie River delta. They migrate through leads offshore of Portsite as early as late March and April, but in most years hunting takes place from late April through May, often coinciding with the hunt for bowhead whales. Spring belugas migrate through leads that recur in most years from one to several miles offshore of Portsite, and generally run parallel to the shoreline. In some years, more than one parallel lead forms, while in other years, leads do not form at all, or form only sporadically through the whaling season. Light aircraft have been used to survey the offshore ice near the Portsite and Kivalina areas to locate leads and open water where beluga (and bowheads) are migrating or have become trapped or temporarily held up in their northward migration (Burch 1985).

Successful hunting for spring beluga is greatly dependant on prevailing ice conditions during the migration. In some years westerly winds close accessible leads, and in other years more than one offshore lead forms, allowing belugas to move past through leads farther offshore and escape hunters. The 2002 whaling season near the DMT and Kivalina was characterized by unstable, “growling,” ice in which the leads formed too far offshore (R. Adams Sr. personal communication).

According to traditional knowledge (Braund 1999), the best spring hunting conditions in the Portsite and Kivalina area occur when a single and accessible lead forms offshore of Portsite and Kivalina and terminates just north of Kivalina. This concentrates the belugas in an area accessible to local hunters. Another ideal situation for hunting beluga occurs when a lead in which the belugas have been migrating closes, and they become trapped in a small patch of open water.

Spring belugas are usually shot with rifles after which the carcass is snagged with a seal hook to keep it from sinking under the ice. The belugas are then pulled onto the ice or taken to shore for butchering and distribution. Snow machines are used for transportation during the hunt and to tow large sleds hauling boats and materials to base camps that are sometimes set up on the ice near the hunting area.

Whaling camp on the shore-fast ice about 5 Miles northwest of Portsite (COE photo).

Summer hunts for beluga usually are in late June and July after breakup. Belugas from summer migrating stock are part of the eastern Chukchi Sea/Eschscholtz Bay stock that migrates north past the Portsite to the Point Lay area. This stock historically migrated close to shore after breakup.

Beluga from the summer stock are intercepted or chased with outboard motor boats, shot with rifles, and snagged with seal hooks or harpooned to prevent their sinking into the turbid water that prevails along the coast this time of the year. Dead belugas are towed to the beach or to the village for butchering.

Figure 3-6 shows the customary hunting areas and the migration path for the summer stock of belugas near Portsite and Kivalina, as described by Kivalina hunters. According to those Native hunters, the hunt for summer beluga took place along a relatively short stretch of coast south of Kivalina prior to construction of DMT at Portsite, but summer belugas are now hunted along a much longer section of coast from Kotlik Lagoon to Cape Thompson.

Although the summer hunt for beluga takes place after breakup, ice conditions can still affect the success of the hunt because there is sometimes enough ice present in the area to disrupt or even prevent hunting. During westerly winds, pack ice floating offshore can be blown inshore and piled along the beaches. This can either positively or negatively affect hunting success. On the negative side, it can block the entrance to Kivalina Lagoon (Singauk Entrance) and prevent boats from going to sea to hunt. On the positive side, if boats can be launched when the belugas are temporarily detained near shore by ice piling, the whales are more accessible.

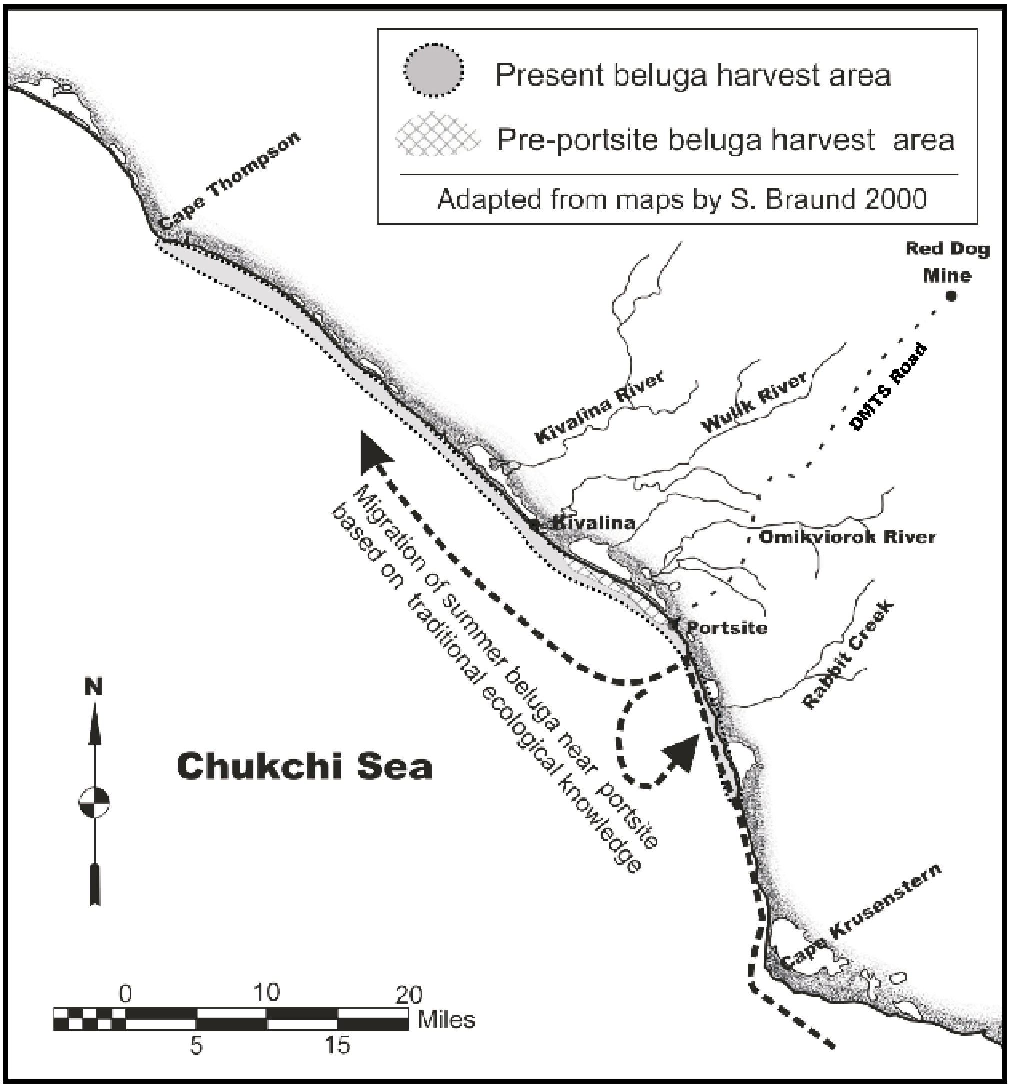


Figure 3-6. The past and present hunting areas for the eastern Chukchi Sea (summer) stock of beluga, and their migration path near Portsite described by subsistence hunters from Kivalina, Alaska (Adapted from Braund 2000).

Table 3-8 summarizes annual beluga harvest data for Kivalina hunters between 1959 and 2000 by stock source. Before 1987, the counts of beluga harvested were not separated by stock source. Subsistence years that had higher harvests of spring beluga (e.g., 1982-1983, 1983-1984, 1999-2000) were generally associated with what hunters considered to be better ice conditions.

Table 3-8. Annual harvest of belugas by Kivalina hunters from 1959 through 2004, by stock source.

Subsistence Year	Spring (Beaufort Sea) Stock	Mixed Stock	Summer (Eastern Chukchi Sea) Stock
1958-1959			7*
1959-1960			14*
**			
1964-1965			6*
1965-1966		12***	
**			
1971-1972		10***	
**			
1982-1983		27***	
1983-1984		28***	
**			
1986-1987	**		0
1987-1988	5		1
1988-1989	0		0
1989-1990	0		1
1990-1991	0		1
1991-1992	10		0
1992-1993	3		0
1993-1994	3		0
1994-1995	3		0
1995-1996	7		0
1996-1997	0		1
1997-1998	0		0
1998-1999	11		0
1999-2000	43		1
2001-2004	6		3

***** Kivalina hunters hunted only summer belugas up to 1966, when emphasis shifted to hunting spring belugas.
****** Data not available, or not recorded.
*** Although mixed stock, these were predominantly spring belugas.
Note 1: In the years prior to the 1987, the counts of beluga harvested were not separated by stock source.
Note 2: Data for subsistence years 1994-1995 through 1999-2000 include beluga struck and lost.
Sources: Alaska Beluga Whale Committee 2001; Burch 1985; Patterson 1974; Saario and Kessel 1996.

Table 3-9, presents beluga harvest data since 1987 from several other communities in northwestern Alaska. The table shows that since 1986, when beluga counts began being separated into spring and summer stocks, Kivalina hunters have taken more spring beluga than the other communities, except for Point Hope, which is close to the migratory pathway of spring beluga. The table also shows that Kivalina hunters have taken considerably fewer summer beluga than the majority of other communities in northwestern Alaska. Table 3-8 shows that there has been a general decline in the harvest of belugas in northwestern Alaska in the same period, except by communities better situated along the migratory path of the summer (eastern Chukchi Sea) stock. Point Hope is well located on the migratory path, and Point Lay and Wainwright are near a summer gathering area on the northern end of the summer beluga range.

Table 3-9. Numbers of Beluga harvested by stock and village for the subsistence years 1986 through 2004.

Location	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2001-2004	Total
Spring (Beaufort Sea) Stock																
Barrow	0	0	1	0	1	0	2	5	0	2	8	1	1	1	5	27
Diomede	10	3	6	5	3	2	1	0	**	0	1	4	0	6	4	45
Kaktovik	0	0	0	10	0	0	0	0	1	0	2	0	0	0	4	17
Kivalina	**	5	0	0	0	10	3	3	3	7	0	0	1	43	1	76
Nuiqsut									0	0	0	1	0	**	0	1
Point Hope	40	59	17	16	39	15	79	53	~40	15	32	52	33	16	98	604
Wales	0	0	2	3	**	1	**	1	**	**	**	1	**	**	**	8
Summer (Chukchi Sea) Stock																
Buckland**	7	17	0	31	0	4	0	0	1	5	1	1	0	1	20	88
Deering	**	**	**	**	**	**	**	**	0	2	0	0	0	**	0	2
Kivalina	0	1	0	1	1	0	0	0	0	0	1	0	0	1	3	8
Kotzebue, Noatak	2	8	37	6	7	5	6	7	4	68	7	4	2	0	14	177
Point Lay	22	40	16	62	35	24	77	56	31	41	3	48	47	0	170	672
Wainwright	47	3	0	0	5	0	0	0	0	0	4	38	3	0	98	198

** Data not available, or not recorded

In addition to the spring and summer harvests, a few belugas have sometimes been taken near Kivalina and Portsite during August and later in the fall (Burch 1985). The belugas harvested during the fall are likely early inshore migrants of the eastern Chukchi Sea/Eschscholtz Bay stock, heading south. The fall (south) migration route of the Beaufort Sea stock is across the Chukchi Sea and down the Russian coast, so they are not harvested in that migration.

Traditional uses of beluga from both stocks include individual family consumption and sharing or bartering with neighbors or nearby communities. Almost all parts of the beluga–the flippers, tail, flesh, blubber, and skin–are used. The skin with a thin layer of blubber, called *muktuk* or *maktak*, is a delicacy that is especially appreciated in the early spring and summer. Beluga meat may be preserved in traditional ice cellars cut into the permafrost, frozen in home freezers, or in some places, dried on racks exposed to the air.

Hunters have identified noise as affecting beluga whales. Noise from any source is traditionally unacceptable in the whaling cultures of northern Iñupiaq and Chukotka peoples (Huntington and Mymrin 1996; Lowenstein 1993, Morseth 1997). A common theme among the Northwest Alaska coastal communities and along the eastern shore of the Chukotka Peninsula is that beluga whales are sensitive to noise, and to the noise of outboard motors in particular (Huntington and Mymrin 1996). The observations about the effects of noise on beluga whales are widespread and probably very old in traditional knowledge. Negative reactions of belugas to outboard engines in the Kotzebue Sound area were recognized in the 1950s and 1960s (Fejes 1996:38, Foote and Cook 1969:30), and reported in scientific literature as early as 1983 (Frost et al. 1983).

Kivalina hunters observed that belugas are intelligent and have learned to associate the sound of an outboard engine with danger. They report that Kotzebue hunters hunt with larger and faster boats, and the beluga have learned to go to deeper water when they hear (outboard engine) noise (Braund 1999). The implication is that beluga experiences with high-speed boats learned in Kotzebue Sound are retained, making them wary of hunters in boats equipped with outboard motors as they approach Kivalina, 80 miles farther northwest on the migration path. Belugas are known to avoid hunters in boats with outboard in Cook Inlet and Kotzebue Sound (Morseth 1997, Huntington 1999) and can recognize the sound of individual motors used to capture beluga near Point Lay for satellite tagging studies (Suydam, personal communication).

Interviews with local Native hunters in Kivalina (Braund 1999, 2000) identified concerns that operational noise, shipping noise, and the presence of the existing Portsite facilities deflects the near-shore migration of the summer beluga stock offshore and around Portsite and Kivalina, making them less accessible to hunters (see figure 3-6). Although the principal cause for the diversion around Portsite and Kivalina is reported to be noise from operations at Portsite, noise from other sources, particularly outboard motors, is also blamed (Braund 1999).

Loading facilities at Portsite are not operated during the spring beluga migration, but ice colliding with the pilings may occasionally produce noise. Repair and maintenance work on the loading facilities also may produce noise that occasionally is transmitted into the water. Some hunters believe this occasional noise, combined with the beluga's memory of noise at the site in the past and the physical presence of the facilities, may cause beluga to avoid coastal waters near Portsite during their spring migration.

Bowhead Whales. Although Kivalina is too far east of the main migration path of bowheads to intercept them in number, bowheads occasionally follow the near-shore leads past Kivalina. For this reason, traditional Kivalina hunters maintained a spring whaling station at Nuvua, a projection of land about 27 miles northwest of Kivalina where the leads and cracks in the ice naturally approach land. This hunt was discontinued in the 1880's, after which most hunters from Kivalina hunted bowheads from Point Hope until the 1960's. Hunting for bowheads from the ice offshore of Kivalina resumed on a regular basis around 1966. The first whale was taken in 1968, with three more taken between 1968 and 1982 (Burch 1985). Three others were reported struck and lost during these years.

In late April, Kivalina hunters usually begin watching for bowhead whales in the leads north and south of Kivalina (see Figure 3-7). Ice conditions are critical to a successful bowhead hunt, and in some years, bad ice conditions prevent bowhead hunting. Bowhead and early belugas sometimes travel together and the same ice conditions that affect the spring beluga hunt can also affect the bowhead hunt. As with spring belugas, snow machines are used for transportation during the bowhead hunt or to tow large sleds hauling boats and materials to a base camp that is sometimes set up on the ice near the hunting area.

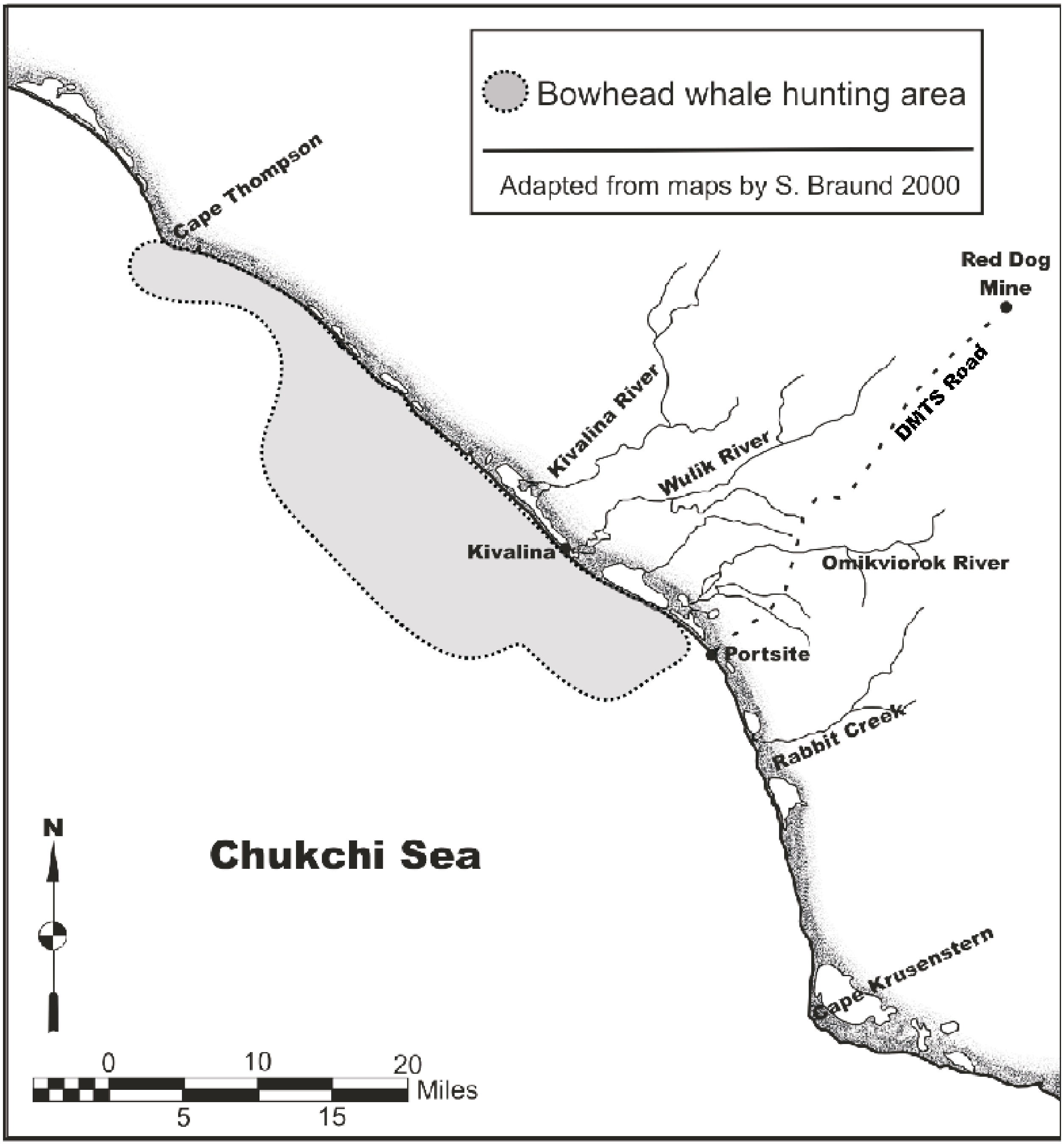


Figure 3-7. Hunting area for bowhead whales near Portsite described by subsistence hunters from Kivalina, Alaska (Adapted from Braund 2000).

Bowhead whales are normally harpooned, first with a harpoon bomb and second with a harpoon attached to a float. The dead bowhead is towed with a boat (if necessary) to a location where the ice is strong enough to support the carcass, pulled onto the ice with block and tackle, and butchered for distribution. Pulling the whale onto the ice is a community affair that is shared by all able-bodied people in the community.

Harpoons Used for Hunting Bowhead Whales Near Portsite.

Many hunters abide by the traditions of the Iñupiaq culture when hunting whales, and especially when hunting bowhead whales. For example, in the story of Katauq, a Point Hope Shaman that took the form of a bowhead, it is stated that a bowhead will give itself only to hunters with clean, light-colored boats. The owners of clean, light-colored boats were considerate people deserving of success, while the owners of dirty, dark-colored boats were considered to be selfish, rude and undeserving of success (Pulu et al. 2001).

The success of a hunter can therefore be determined by an individual's willingness to follow prescribed traditions. The behavior of village residents in traditional beliefs can also determine hunting success for the entire village (W. Adams Sr. personal communication). Thus, the community must work together to be successful. For example, an un-kept village whose residents gossip may not have the same whaling success as an orderly village. This accumulated knowledge has resulted in successful hunting for generations.

A clean, light-colored wooden boat is used for hunting bowhead whales near Portsite.
The large sled is used to haul the boat over the ice to the hunting site.

Some whale hunters also express a traditional belief that whales can detect sounds much farther than can be measured by scientific instruments. This traditional belief implies that whales can perceive sounds and changes in the environment that cannot be detected by hearing, as hearing is defined by science. By traditional terms, whales also may be able to “hear” electromagnetic waves from radio broadcasts, hear sounds in the water or in the air for hundreds of miles, and understand what people are saying about them anywhere in the whale's yearly movements and react accordingly. The end result is that the whales may decide to either make or not make themselves available to hunters based on the sounds they hear or how people behave toward them. This premise is applied to other animal species as well (Burch, 1999). Traditional knowledge about the spiritual ability of whales to “hear” varies from place to place and from person to person, but is held by at least some of the people who hunt in the Portsite area.

Because the whales have excellent underwater hearing, and this trait is recognized, hunters tend to communicate in quiet tones and with hand signals, taking care to make no excessive noise. In Barrow, pilots are asked not to fly their planes over leads in the ice, no outboards are used unless they are towing a whale, and no duck hunting takes place in or near whaling camps or from whaling boats (George 1996). Hunters in the Barrow and Point Hope areas keep dogs, snow machines, and camps behind ice ridges so the noise will not be heard in leads where whales may move (Lowenstein 1980). Hunters in Kivalina chartered planes to search for open leads, but the planes had long since landed before the hunters arrived at the leads (Burch 1985:59). The whaling camp in the Point Hope area was kept clean, and smelly things were kept to the north of the hunters, since the whales migrated from the south. If the hunter had to urinate or defecate, they would do it on the ice to the north of the boat so the whale would not smell the unpleasant odors and avoid them (Lowenstein 1980). At Barrow, burning is not permitted at the dump (George 1996).

Kivalina is currently authorized four bowhead strikes annually by the Eskimo Whaling Commission, but the community rarely takes a bowhead. Kivalina harvested three bowheads between 1991 and 2002: one in May 1991 and two in June 1994 (see table 3-6a). In 2001, 10 Alaska communities landed a total of 49 bowheads and stuck and lost an additional 26 for a total of 75 whales. The bowhead population is estimated to have increased from about 2,000 in 1977 to about 10,000 in 2002.

Strike quotas can be transferred from one community to another, and in years when bad ice conditions prevent whaling near Kivalina, their quota sometimes is transferred to Point Hope. Since the 1880's, the residents of Kivalina have begun sharing the bowhead harvest with residents of Point Hope (Burch 1985).

Polar Bears. Many indigenous cultures of Alaska and eastern Siberia have a history of taking polar bears for subsistence. Alaska Natives are the only people authorized by the Marine Mammal Protection Act to kill them in the United States. Polar bears are often seen and killed during hunts for other species such as beluga and bowhead whales. Sometimes fresh tracks are followed to the animal or a bear might show up at a hunting site where seals or beluga whales are being butchered on the ice. Polar bears also are harvested near communities where they may be a threat to people and property. Unlike seals and whales, the polar bears are attracted by noise and may follow the sound to its source (Napageak 1996).

Polar bear flesh was and still is eaten by some Native people, but it can be infected with trichina and must be thoroughly cooked or otherwise prepared to kill the parasite. Polar bear liver is poisonous because of its high vitamin A content.

Polar bear skins and hair are used in Native artwork, crafts, and for clothing. The skins are sometimes exposed to the sun and weather for a season to dry and bleach before processing. Fishing flies are sometimes tied with polar bear hair and sold as Native crafts.

Polar Bear Skin Drying near Kivalina on a Rack 13 Miles North of Portsite in June 2000.

Most polar bears harvested by Alaska Natives are taken in the Bering Strait/Saint Lawrence Island area and by hunters from Barrow and Point Hope. Comparatively few are killed in the Portsite area (FWS 2002). The number of polar bears reported killed from 1987 through the winter of 2001/02, is shown in table 3-10.

Table 3-10. Polar bear kills between 1987 and 2002.

Community	Number of kills tagged (1987-2001/02)
Bering Straits/St/ Lawrence [a]	526
Barrow	262
Point Hope	161
Kivalina	23

a. Gambell, Savoonga, Little Diomede, Shishmaref, and Wales.

Harvest levels in recent years from the Chukchi Sea stock of polar bears by Alaska Natives have been declining. The 1996 through 2000 mean harvest was about 49 bears per year (USFWS 2001). Polar bears from the Chukchi Sea stock are also taken in Russia. Although it has been illegal to kill polar bears in Russia since 1956, a few hundred bears are believed to be killed each year.

Walrus. Walrus are typically hunted in June or early July when the walrus follow the receding edge of the polar pack ice as it moves north. Walrus are not often hunted from Kotzebue (Georgette and Loon 1993), and are not typically plentiful in the Portsite area compared with the central and western Chukchi Sea (Burch 1985). According to Burch (1985), they appear in higher numbers near Portsite and Kivalina areas once or twice every 20 years or so, when floes bring them close to shore. Hunters from Kotzebue and Kivalina, however, report walrus near Portsite and Kivalina more often (see figure 3-8; W. Goodwin personal communication).

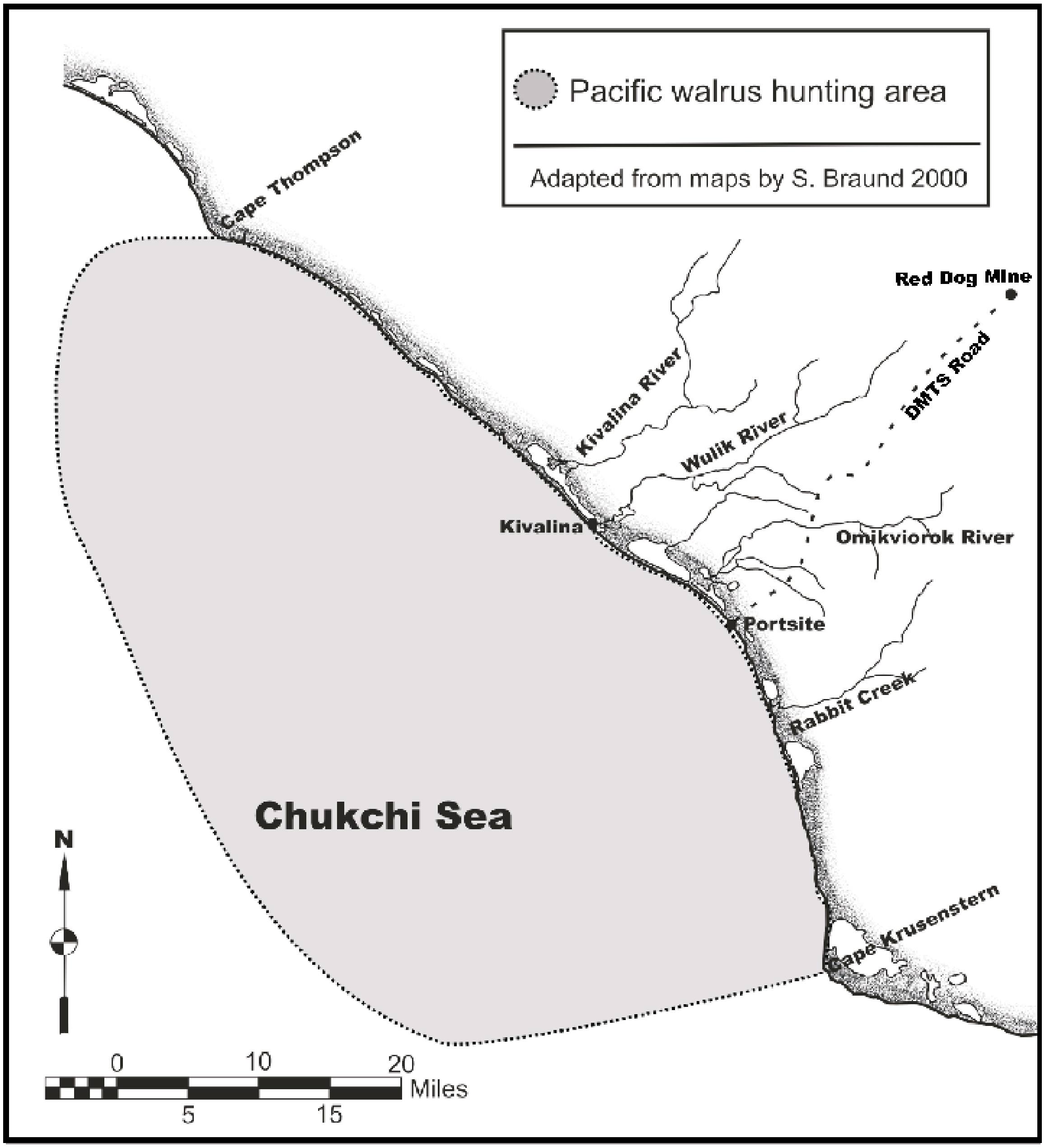


Figure 3-8. Hunting area for Pacific walrus near Portsite described by subsistence hunters from Kivalina, Alaska (Adapted from Braund 2000).

Hunters from Kivalina and nearby coastal communities may travel 30 to 40 miles offshore to harvest small numbers of walrus (table 3-11). Traveling long distances to hunt walrus is not unusual among northwestern Alaska Natives. Some hunters from the Bering Strait area are reported to travel 300 miles to hunt walrus (A. Ahmasuk and W. Goodwin personal communications).

Table 3-11. Numbers of walrus reported harvested by hunters from Kivalina from 1959 through 2001.

Subsistence Year	Number Harvested
1959-1960	1
1964-1965	0
1965-1966	3
1971-1972	3
1982-1983	51
1983-1984	4
1988-1997	76
1997-1998	38
1998-1999	13
1999-2000	2
2000-2001	0

Sources: Burch 1985; Patterson 1974; Saario and Kessel 1966.

Kivalina hunters have harvested more walrus since construction of Portsite (129 were taken from 1988 through 2000) than were harvested in the 25 years prior to construction (62 were taken from 1959 through 1984). The larger harvest in recent years is probably attributable to more hunting effort and better, faster boats. Factors such as travel time, fuel expense required to reach walrus, availability of seaworthy boats and equipment, weather, and visibility influence a hunter's decision whether to hunt walrus in a given year.

Walrus hunters typically approach herds rafted on ice floes and shoot them on the ice with rifles. Dead walrus pushed or pulled into the water by other walrus generally sink, but may be quickly recovered with a seal hook.

Walruses have a reputation of being "mysteriously intelligent and malevolent toward man" (Nelson 1969). They may attack hunters or turn over their boats. Young men being trained to hunt walrus were told not to brag about not being afraid, nor to say that nothing would happen to them during the hunt (Spencer 1976) because the walrus would understand and punish them. The experienced men advised, "Remember when you hunt walrus you must not act like a man. Do not be arrogant; be humble. Always respect the walruses and watch them closely when you hunt them" (Nelson 1969).

Walrus flesh is eaten and the ivory tusks are carved or scrimshawed for Native art objects. Walrus skins are tough and are the best covering for a traditional skin boat. In traditional uses, strips of walrus skin were also woven into rope, and tusks were used for making tools, gaming pieces, toys, and other useful items.

Gray Whale. Alaska Native hunters take far fewer gray whales than Natives of the Chukotka Peninsula in Russia. In Alaska, the flesh and blubber of gray whale is considered inferior to that of the bowhead. Consequently, traditional knowledge about hunting gray whales is not as extensive in Iñupiaq culture as it is in the Siberian Yup'ik culture. Although gray whales are seasonally present offshore of Kivalina and Portsite, whaling captains from Kivalina have taken few gray whales (Burch 1985, O. Knox personal communication).

A Native harpooner's view of gray whales (COE Photo).

Birds. Waterfowl, including ducks, geese, and sometimes swans, are the primary subsistence birds hunted by coastal people in Northwest Alaska, including the Portsite area (table 3-6d). Both the adult birds and the eggs of nesting birds are harvested. Most waterfowl hunting is in the spring as the birds migrate northward through the area to nesting grounds. Waterfowl that nest locally are also harvested. Many people of the region prefer geese, and especially black brant, to ducks (W. Adams Sr. personal communication). Sandhill cranes are present in abundance near the Portsite area, but are not a preferred subsistence species locally and are seldom taken (J. Swan Sr. personal communication).

Northbound geese migrate at low altitude along the beach under northerly wind conditions. They are taken mostly with shotguns as they cross inland from the beach, but they are also taken from tundra ponds with rifles and shotguns (table 3-7, Burch 1985, W. Adams Sr. personal communication). Waterfowl and gull eggs are taken from nests on the tundra or around ponds and lagoons.

Ptarmigan, a grouse-like bird of the tundra, are also hunted for subsistence. Younger boys in particular hunt ptarmigan with shotguns in the fall, winter, and early spring.

Snowy owls are a traditional subsistence bird in the diet of some Natives, but fewer owls are taken in modern times (J. Mitchell personal communication). The traditional method of taking snowy owls consists of placing a leg-hold trap or snare on a stake or mound of dirt to catch them when they land (W. Adams Sr. personal communication).

Waterfowl, ptarmigan, and owls taken for subsistence are preserved using traditional methods, frozen in home freezers, or cooked and eaten fresh. A common method of local preparation is to stew birds in flour gravy with macaroni.

Fish. The principal fish harvested for subsistence in the Portsite area are Dolly Varden char, grayling, whitefish, burbot, and several species of Pacific salmon (table 3-6c). Of these species, more pounds of char, whitefish, and salmon are harvested because they are mostly caught with nets and seines (figure 3-9). Other species, such as saffron cod and smelt are occasionally harvested and it is possible to catch large numbers of cod with hook and line when they move into Kivalina Lagoon. Burbot, a bottom-dwelling species, is caught only occasionally and not in large numbers.

Char. Dolly Varden char are caught year round, but the peak harvests are in June, when the fish are going to sea, and in September after they return to the larger rivers for the winter. People in Kivalina catch spring char primarily in gill nets set in Kivalina Lagoon along the spit south of town. Factors that influence the Kivalina harvest of char in June are principally the run size (abundance) and ice conditions. Occasionally sea ice jams the lagoon outlet and traps char in the lagoon for longer than normal periods. When this happens, large numbers of char can be harvested. Spring char are usually frozen in home freezers or dried in the sun and wind on drying racks erected along the beach.

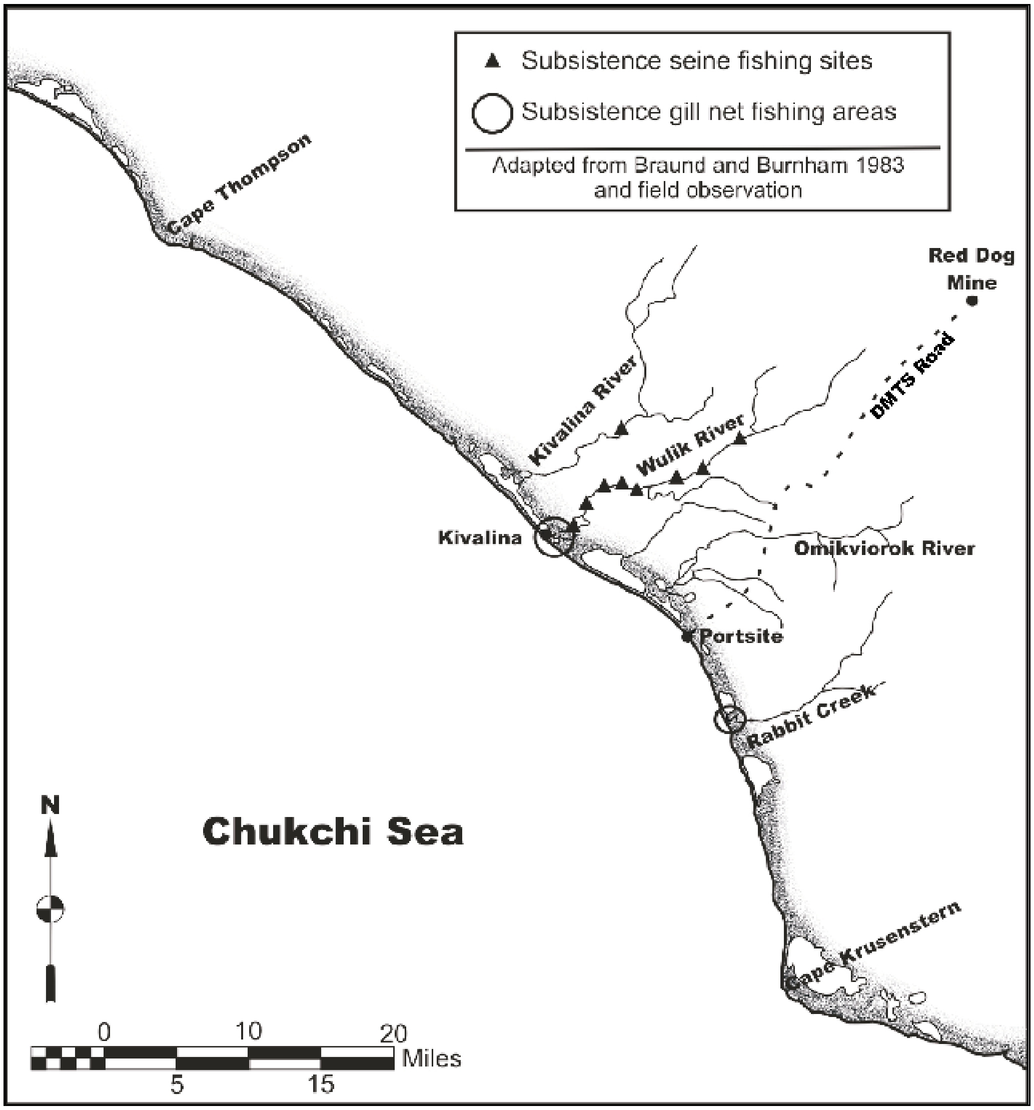


Figure 3-9. Traditional subsistence fishing areas near Portsite (Adapted from Braund and Burnham 1983, and COE field observations).

Factors influencing harvest during the fall run include run size, the timing of freeze-up, and interference by scavenging animals. Most of the fall run is seined at traditional areas in the Wulik River and buried in caches at camps. When freeze-up begins, water levels drop rapidly in the river, and access to traditional areas by boat is limited. Dropping temperatures hamper traditional methods of preservation in the caches along the riverbank. Also, scavenging grizzly bears and wolverines may dig up the caches. Smaller catches and shorter fishing excursions result if the fishing crews have to bring the harvested fish to Kivalina to avoid the scavengers.

Arctic Grayling. This is a freshwater species that also inhabits brackish lagoons. The main area where Kivalina people fish for this species is the Wulik River drainage including Kivalina Lagoon. Fewer pounds of this species are harvested for subsistence (table 3-6c), but considerable effort is spent fishing for them with hook and line through the ice during the winter. Grayling are also caught while netting and seining for char and whitefish. Grayling are preserved or eaten fresh in the same way as char.

Pacific salmon. Salmon are summer-run anadromous fish that enter Kivalina Lagoon and other rivers of the region, starting with Chinook in June and continuing with chum and coho through August and September. Salmon are primarily caught in freshwater and estuaries in gillnets set to harvest char, but are sometimes caught in seines and by hook and line. Kivalina fishermen harvest considerable poundage of combined salmon species (table 3-6c). Salmon are also preserved or eaten fresh in the same way as char.

Whitefish. Several species of whitefish, both anadromous and migratory, are fished in fresh waters of the Portsite area. Whitefish harvest generally peaks in the fall when the fish are running upriver to spawn (table 3-6). At Kivalina, people using seines and gillnets catch the greatest numbers of whitefish in Kivalina Lagoon and the lower Wulik and Kivalina River drainages. Considerable quantities of whitefish are sometimes taken (table 3-6c). Whitefish caught in the fall are preserved in traditional caches, frozen or dried, and dipped in seal oil.

Cod. Saffron cod sometimes enter Kivalina Lagoon in huge numbers and are easily caught by jigging with hook and line through holes cut in the ice near the town (table 3-6c). The traditional method involves two sticks, one with a small jig attached to a short line. One stick is used to hook the fish while the other is used to pull the line up and the fish out of the water. Temperatures are typically low when cod are present in the lagoon, and they are frozen on the ice where they are caught.

Caribou. Caribou, members of the deer family, are hunted in the tundra hills behind Portsite and are the principal terrestrial subsistence animal in Northwest Alaska (table 3-6b). The local caribou are part of the Western Arctic Caribou Herd that annually migrates through northwestern Alaska in large numbers. The range and hunting area for caribou in northwestern Alaska are shown in figure 3-10.

Caribou are shot opportunistically year round, but most are harvested in the fall when the main migration reaches the Portsite and Kivalina area and through the winter as they are available. Caribou are hunted from snow machines when there is enough snow on the tundra for them to operate and sometimes from four wheelers (all-terrain vehicles) along the DMTS road when there is no snow. Local rivers are also used as transportation corridors to reach hunting areas by boat in the fall before freeze-up. Residents of Noatak reported that small planes or boats could startle leaders of a caribou herd and instead of moving south along the coast near Kivalina, they would shift inland and begin moving toward Noatak (Uhl and Uhl, 1977)

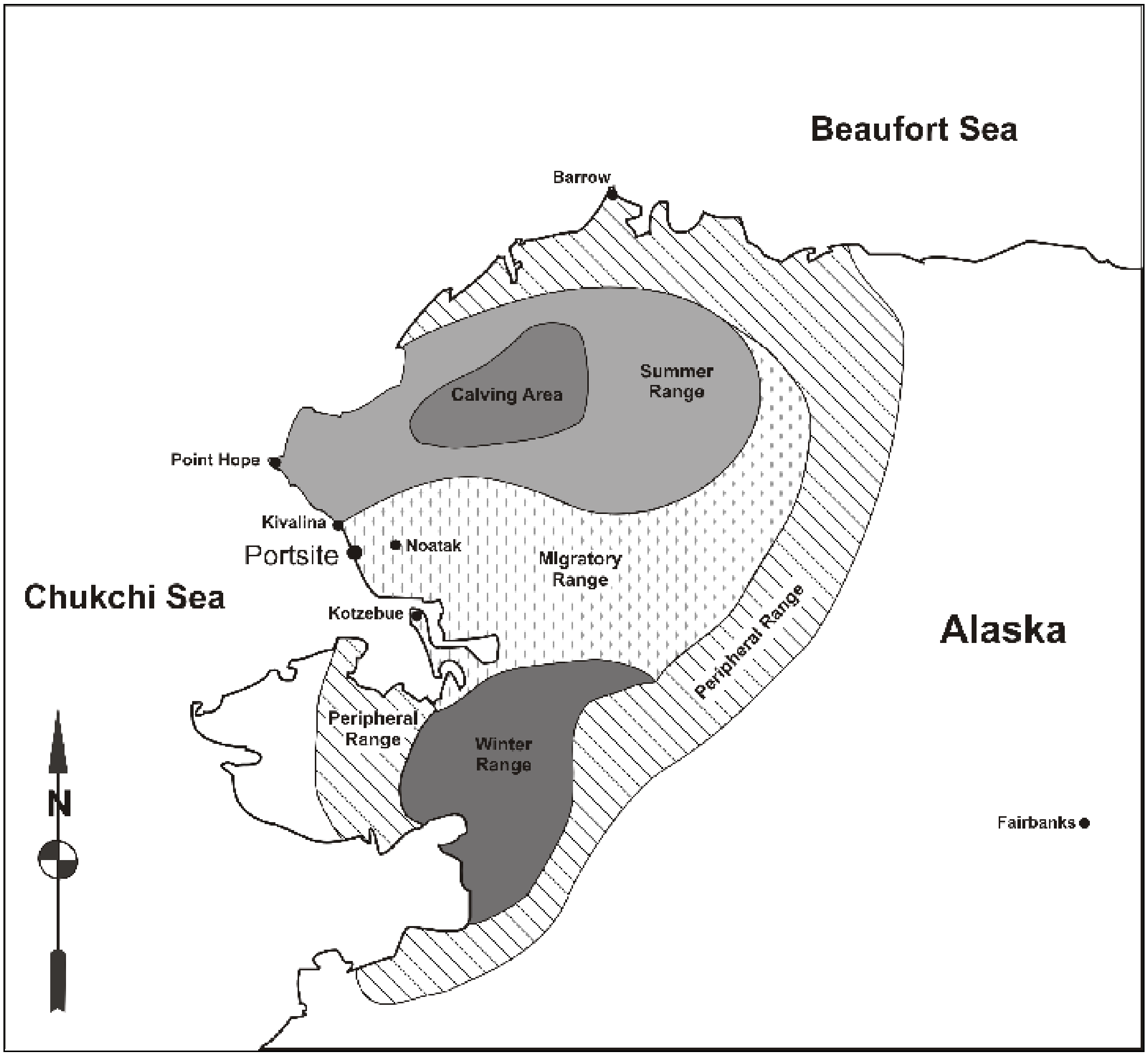


Figure 3-10. Seasonal ranges and calving area of the Western Arctic Caribou Herd (Dau 2001).

Caribou are shot with rifles (table 3-7) and brought home or temporarily cached on the tundra if the weather is cold enough to keep the meat from spoiling. Traditional methods of preservation, such as drying meat into jerky strips, are used along with more modern methods such as canning. The carcasses of caribou shot during the winter are sometimes left frozen whole and butchered frozen with saws as needed.

The number of caribou needed today to support an average family in Kivalina is estimated to be up to 12 animals, but in former days when local families had dog teams, up to 40 caribou per family were needed (R. Adams Sr. personal communication).

Moose. Moose are the largest member of the deer family and are relative newcomers to Northwest Alaska. The first moose harvested near Portsite, at least the first moose in modern times, was taken in the 1950's. Moose are hunted with rifles during the fall and winter when they congregate along the riverbanks and are more accessible to hunters on snow machines.

During other times of the year, moose scatter across the tundra and to higher elevations, where they are not as accessible and are difficult to process in the field because of their large size and weight. Sometimes they are taken opportunistically along the riverbanks from boats. The usual hunting areas for moose are shown in figure 3-11.

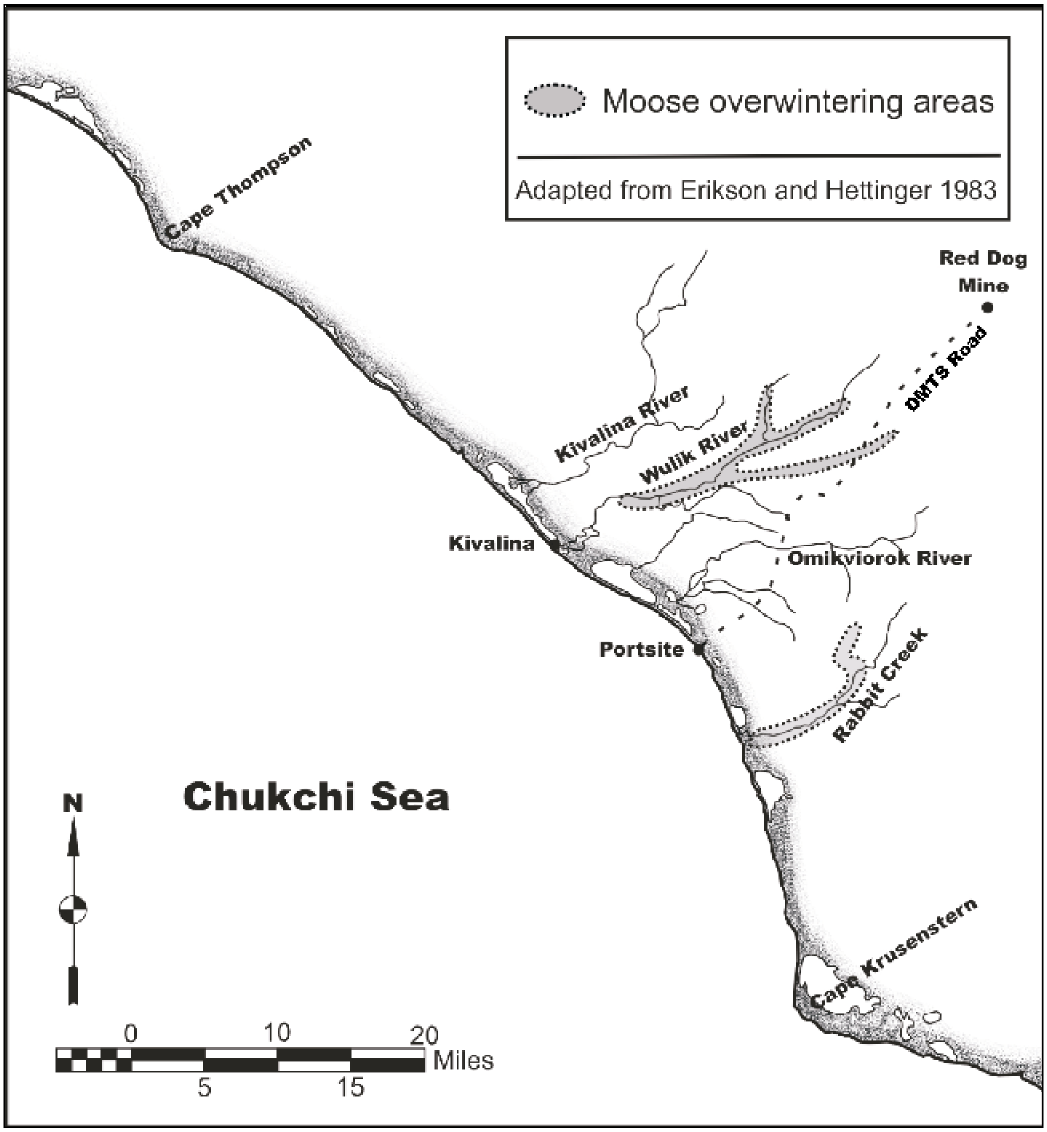


Figure 3-11. The usual moose hunting (overwintering) areas in the vicinity of Portsite (Adapted from Erickson and Hettinger 1983).

Locally, young moose are preferred over mature bulls and cows, although mature bulls are sometimes taken before the fall rut for the mesentery fat. The fat is mixed with berries harvested from the tundra (R. Adams Sr. personal communication).

In general, caribou are preferred over moose as food locally because the flesh of moose is said to be dry and tough compared with caribou. From a hunter's perspective, caribou may be preferred over moose because moose are large and must be butchered in the field where caribou can almost always be brought whole to a central location for processing.

Dall Sheep. Dall sheep inhabit the Delong and Baird mountains to the north and east of Portsite and are harvested for meat, fat, sinew, skins, and horns (Georgette and Loon 1991). Dall sheep traditionally were hunted in the summer, but modern hunts are restricted to the winter for conservation. Hunting areas for Dall sheep include the upper Wulik and Kivalina River drainages, which are accessible to hunters from Kivalina and Noatak (see figure 3-12).

Prior to the common use of powerboats, people traveled by foot or dog team to the upper drainages to seine for char and to hunt sheep in the nearby mountains. The upper drainages are typically too shallow for powerboats and modern hunting is done from a snow machine in the winter (W. Goodwin personal communication). Dall sheep were also occasionally taken in conjunction with egg gathering trips to Cape Thompson (Burch 1985). Current regulations allow one sheep per permit when Federal and State biologists determine a surplus of rams is available.

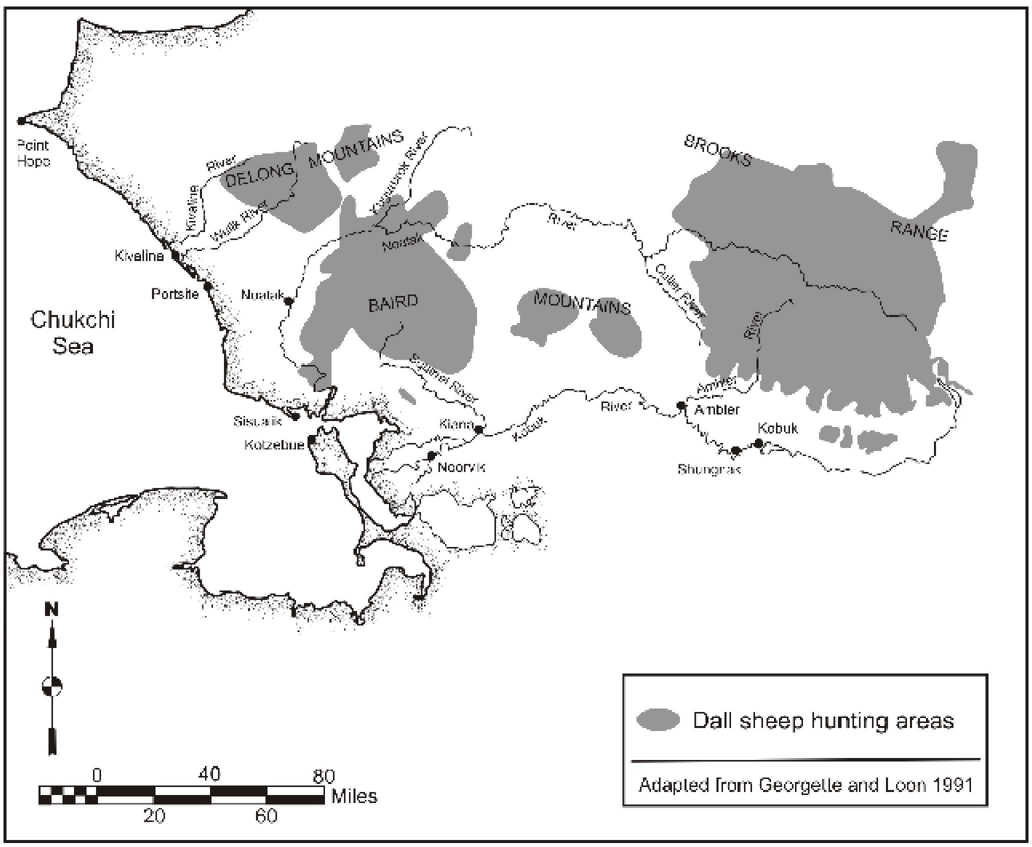


Figure 3-12. Dall sheep hunting areas in northwest Alaska traditionally used by subsistence hunters (Georgette and Loon 1991).

Kivalina hunters are culturally tied to caribou and harvest relatively few Dall sheep when caribou are available (Georgette and Loon 1991). In more recent times, fewer sheep have been taken because there are far more caribou, and sheep are not economically feasible to hunt. Kivalina hunters reported taking about 25 Dall sheep in the 25 years prior to 1991 (Georgette and Loon 1991). Dall sheep are usually harvested with center-fire rifles capable of shooting relatively long distances with accuracy.

3.4 Physical Conditions

The physical environment of Northwest Alaska includes land, water, and air, the structures people have built, and the changes they have made to the land. Energy from the sun and other processes and motion, including sound, waves, and wind also are physical conditions affecting Northwest Alaska and the people and other living things there.

During scoping for this EIS, people of Northwest Alaska were particularly interested in changes to the following physical environmental factors that a project at Portsite might introduce:

- Air quality
- Water quality
- Water movement
- Ice
- Composition of marine bottom material (both chemical attributes and particle size)
- Bathymetry
- Noise

3.4.1 Climate

Weather. Portsite is in a transitional climate zone characterized by long, cold winters and cool summers. The average low temperature during January is -15 °F; the average high during July is 57 °F. Temperature extremes have been measured from -54 °F to 85 °F. Precipitation averages 8.6 inches per year, including 57 inches of snowfall.

Fog is most frequent during May (10 days), June (11 days), July (9 days), August (9 days), September (6 days), and October (6 days). Fog is usually most dense in the morning hours but can last all day and occasionally lasts for several days. In July and August, visibility in the Bering Strait and Chukchi Sea is below 2 miles up to 25 percent of the time.

Effects of Low Temperature. In the Arctic, cold air and ground temperatures limit many biological processes. The effects of low air temperatures are greater in the terrestrial environment than the marine environment because on land the sun has to melt snow and ice before it can start to warm the ground enough to promote biological activity. As a result, many perennial land plants grow more slowly in the Arctic than they would elsewhere.

Because of the low temperatures, most precipitation in the Arctic falls as snow. The snowmelt period is short and ends abruptly. Typically, soil layers for the majority of the Arctic are thin and hold little moisture, and small streams are often dry in the summer. The resulting general lack of fresh water contributes to the limited terrestrial productivity of the region.

The low temperatures also slow the breakdown of organic material, thereby restricting microbial life in soil, water, and the bottom sediments of lakes, rivers, and ocean. This restricted microbial activity limits the rate at which nutrients can become available, leading to deficiencies in many key nutrients in both land and water ecosystems. It has been estimated that it takes more than 300 years to cycle 95 percent of the organic matter present in cold regions such as Northwest Alaska (AMAP 2001). Cold temperatures also limit the supply of mineral nutrients in the soil that come from the chemical weathering of bedrock.

The general scarcity of nutrients in some Arctic areas can be seen in concentrations of plants and animals in areas where food is readily available. Examples include concentrations of whales and sea birds at the ice edge where plankton productivity is high, and the gathering of sea mammals and birds at open patches of water within the polar pack ice. Conversely, areas of Arctic environment such as the shallow marine environment along sand or gravel beaches (such as at Portsite) have considerably less variety and quantity of marine life because of physical stresses imposed by shifting ice, annual freezing, and summer wave action.

The discontinuous and seasonal availability of resources in the Arctic has also made migration a necessary part of the life cycle of many animals. For example, some mammals and fish shift feeding grounds in response to changing ice and snow conditions, while many birds move north to breed only during the most productive season.

Wind. Metrological data including wind speed and direction are collected at the Portsite. Data from the Portsite meteorological station for the year 2000 was plotted to estimate patterns in wind speed and direction. The estimated wind patterns are depicted in figure 3-13.

During the winter and spring months of 2000, winds at Portsite generally blew the strongest and most often from the easterly directions. In June, with open water prevailing, the winds shifted and generally blew from the southerly directions. Southerly wind patterns, with occasional westerly blows, prevailed through September, when the general wind pattern once again shifted to easterly directions.

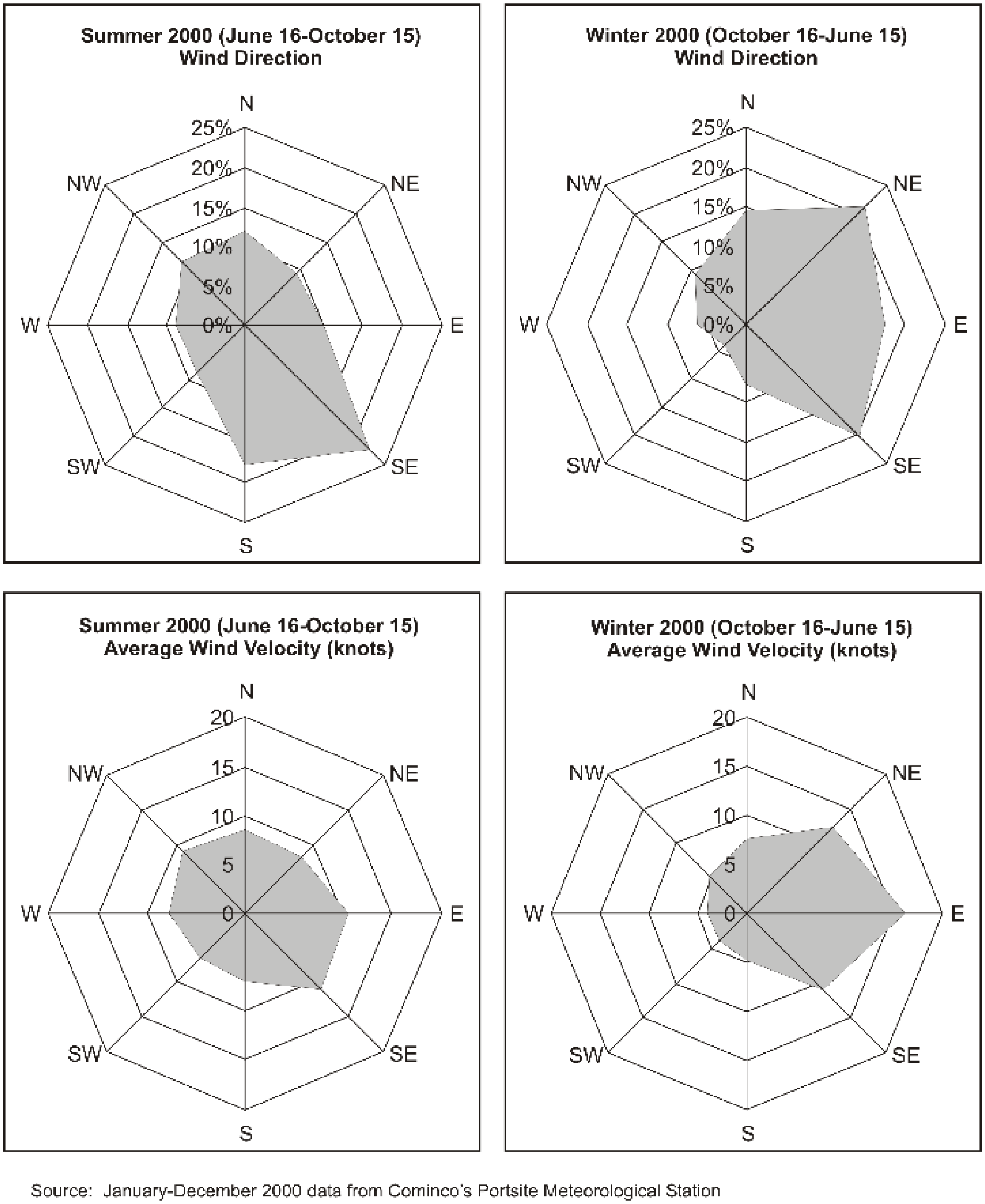


Figure 3-13. Summer and winter wind direction and average velocity (knots) from data taken at the Portsite meteorological station in 2000.

3.4.2 Air Quality

The combination of limited development, and low population density generally results in good to excellent air quality throughout northwestern Alaska. Air quality generally improves with distance from sources of pollution, and the point sources of air pollution at Portsite generally do not significantly degrade air quality in the wider area. Prior to development of the Red Dog

Mine and Portsite facilities in the late 1980's, there were no major man-made sources of air pollutants in the Portsite area. Background concentrations of air pollutants were generally considered negligible, except when particulate levels increased because high winds eroded sparsely vegetated hilltops and ridges, or smoke from rare summer tundra fires was present (EPA-DI 1984).

Continuous operational activities at Portsite and Red Dog Mine generate exhaust, evaporative, and fugitive dust emissions. Exhaust pollutants regulated by the Clean Air Act (CAA) [sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_X), ozone (O_3), and particulate mater (PM_{10} & $PM_{2.5}$)] are generated by electric power and heat generation equipment, and the fleet of diesel-powered light and heavy-duty trucks operating at the mine, DMT, and on the DMTS road. Evaporative emissions are associated with the storage, transfer, and distribution of fuel products. Fugitive dusts, including ore concentrate containing high concentrations of zinc (Zn), cadmium (Cd), and lead (Pb), are also released by mining, production, transportation, and loading operations throughout the year.

During the shipping season, additional operations at the DMT generate exhaust and fugitive dust emissions. Additional exhaust emissions are generated by up to four bulk-carrier ships at a time anchored 3 to 5 miles offshore, four tugboats that tend two lightering barges that are used to lighter concentrate from the terminal to the ships and the tugs that deliver fuel and commodities. Although the lightering barges are non-powered, each is equipped with diesel-powered augers and two front-end loaders to perform offshore transfer operations that also contribute to local exhaust emissions during the shipping season. Loading ore concentrate onto the barges and the offshore transfer to the ships also generates fugitive ore concentrate dust during the shipping season.

Fugitive dust containing high concentrations of lead have generally caused the greatest level of concern for regulators, public health officials, and area residents. To address those concerns, air-monitoring programs have been implemented in the communities of Kivalina and Noatak. The air monitoring results for Kivalina and Noatak are summarized in tables 3-12 and 3-13, respectively. The results for both communities indicate that lead concentrations are approximately 200 times below the National Ambient Air Quality Standard (NAAQS) for lead of 1.5 ug/m^3.

Table 3-12. TSP lead concentrations at Kivalina.

Kivalina TSP-Lead Concentration (Quarterly Average)	
September 2003	0.0052 ug/m^3
October – December 2003	0.0050 ug/m^3
January – March 2004	0.0039 ug/m^3
April – May 2004	0.0062 ug/m^3

TSP: Total Suspended Particulate
Source: Teck Cominco, 2005

Table 3-13. TSP lead concentrations at Noatak.

Noatak TSP-Lead Concentration (Quarterly Average)	
April – June 2003	0.0078 ug/m^3
July - September 2003	0.0072 ug/m^3
October – December 2003	0.0039 ug/m^3
January – May 2004	0.0042 ug/m^3

TSP: Total Suspended Particulate
Source: Teck Cominco, 2005

Studies to investigate and define the potential impacts of fugitive ore concentrate dust emissions from the mine, Portsite, and along the DMTS road have been conducted by the NPS (Ford and Hasselbach, 2001), and TCAK (Teck-Cominco, 2005). The studies identified significantly elevated metals concentrations in samples of dust, in soil collected near the mine, at Portsite, and along the DMTSroad and resulted in additional investigations, cleanup actions, recycling and recovery efforts, and the initiation of a risk assessment. The risk assessment is currently being conducted by TCAK to estimate the potential risks to human and ecological receptors posed by current and future exposures to metals in soil, water, sediment, and biota in areas surrounding the DMTS. The results of the risk assessment are expected to be available for incorporation into the final EIS. The results of the earlier investigations also resulted in extensive modifications to reduce the release of ore-concentrate dust from port and mine facilities and the trucks used to transport the ore-concentrate. In 2003, nearly $4 million was invested in improvements to control fugitive dust at Portsite facilities. A new baghouse was installed and all the seals on the conveyors that carry concentrate to the barges were upgraded. The barge loader conveyor was also enclosed to prevent dust from escaping. The dust control systems on the barges were modified in a similar manner.

Figure 3-14 presents the locations and ranges of lead concentrations reported in moss samples that were collected by the NPS and TCAK to attempt to estimate the extent of the distribution of fugitive dust from operations at the mine, at Portsite, and along the DMTS road. In the figure, concentrations less than 50 mg/Kg approximate background concentrations of about 30 mg/Kg. It is notable that these samples were collected prior to the completion of the fugitive dust control improvements that were completed at Portsite in the spring of 2003 and before many of the improvements at the mine were implemented. Although the data indicates that measurable amounts fugitive dust from operations at the mine appear to have been distributed over a relatively wide area, it also indicates that the distribution of fugitive dust from Portsite operations, and transportation along the DMTS road are limited to areas close to the road and Portsite facilities. Improvements that have been completed as well as future improvements to reduce fugitive dust emissions are expected to significantly reduce fugitive dust related impacts.

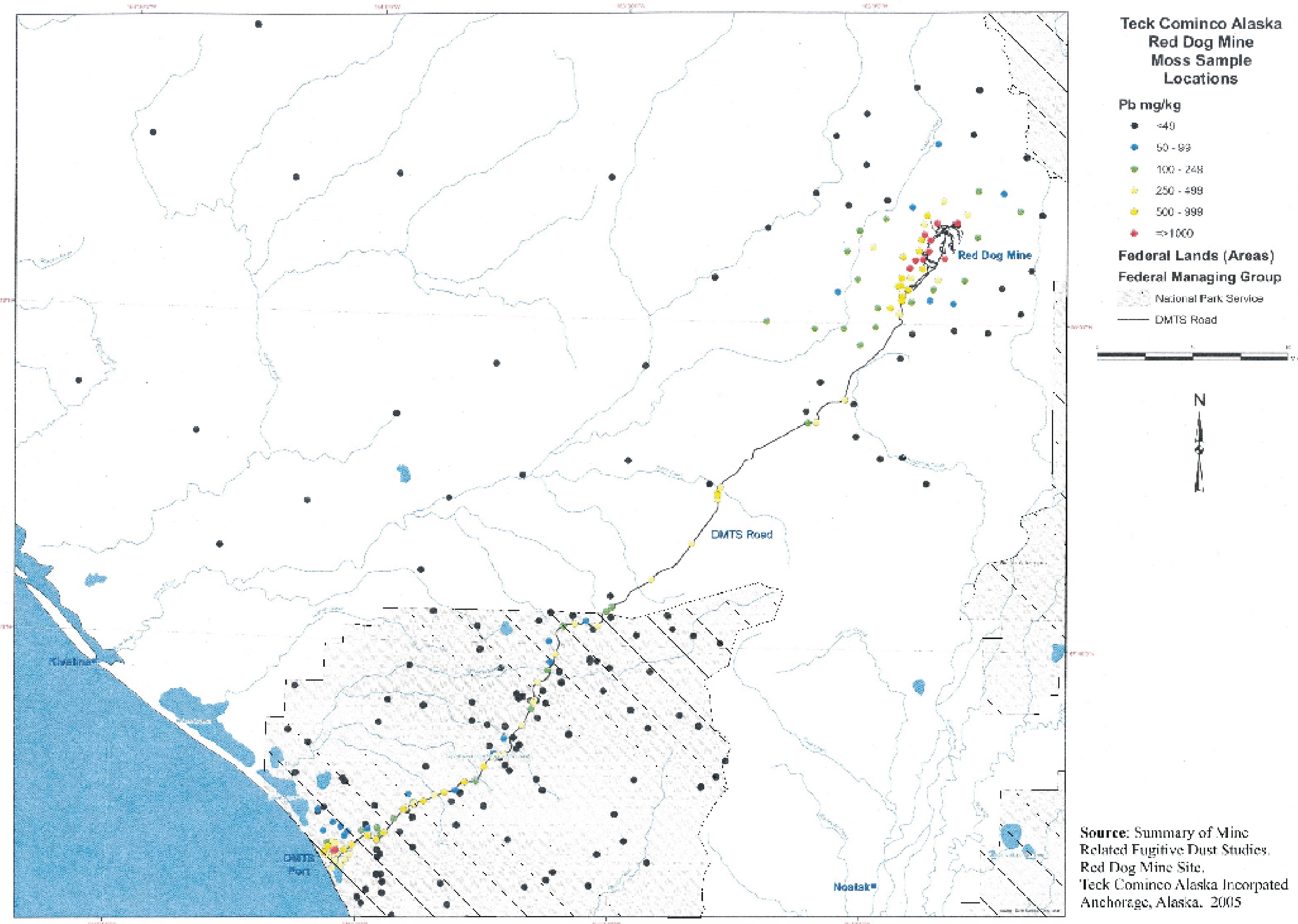


Figure 3-14. Lead concentrations in moss samples collected near Portsite and Red Dog Mine.

Portsite Air Quality Status. The Environmental Protection Agency (EPA) defines Air Quality Control Regions (AQCR's) for all areas of the United States and designates them as attainment or nonattainment areas based on comparison to National Ambient Air Quality Standards (NAAQS). The areas having air quality meeting NAAQS are designated as "attainment areas" and areas not meeting NAAQS are designated as "nonattainment areas." Portsite is within the Northern Alaska Intrastate Air Quality Control Region. The area surrounding Portsite has been classified as attainment or unclassifiable for all regulated pollutants. The closest nonattainment area is the Anchorage/Eagle River PM_{10} nonattainment area, which is approximately 600 miles southeast of Portsite.

The provisions of Alaska's Prevention of Significant Deterioration (PSD) program are applied to attainment and unclassifiable AQCR's with good air quality to limit its degradation from development activities. The areas are classified as PSD Class I, II, or III areas (in decreasing order of relative protection) based on land status/use and the associated protection afforded to the area. The region surrounding Portsite is a PSD Class II area. The nearest PSD Class I area is the Denali National Park, which is approximately 400 miles southeast of Portsite. There are no PSD Class III areas in Alaska. States strive to allow industrial and commercial growth within PSD Class II areas without causing significant degradation of existing air quality or exceeding the NAAQS. The PSD program requires new sources of emission to undergo review and permitting prior to construction or implementation of the emission source. New emissions at Portsite facilities would not be allowed to cause or contribute to a failure to meet any applicable NAAQS or Alaska Ambient Air Quality Standard (AAQS), or applicable Class II PSD increment limit.

The Portsite facilities operate under ADEC-regulated Air Quality Permit 289TVP01. An ambient air boundary has been established around the perimeter of the Portsite facilities and is illustrated in figure 3-15.

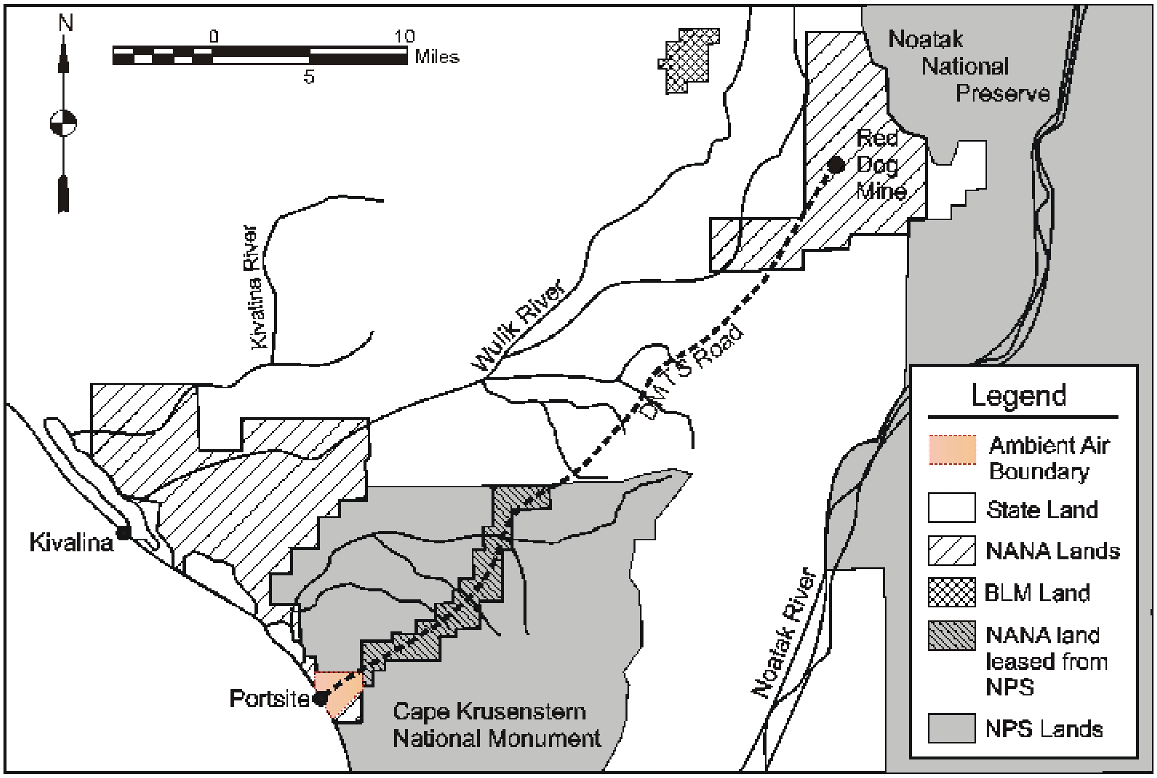


Figure 3-15. Ambient air boundary at Portsite

For compliance with regulatory and permit requirements, air at this boundary is evaluated against NAAQS. Operational areas within the ambient air boundary are protected and regulated by occupational safety and health standards. ADEC completed its latest evaluation of the operation and documentation associated with the Portsite facilities in April 2004. It covered the period from July 2002 through December 2003 and found the facilities to be in full compliance for that period. To demonstrate air quality compliance, NO_2, SO_2, and PM_{10} emissions were modeled (Hoefler Consulting Group, 2004) using the Industrial Source Complex Short-Term model (version 02035). Table 3-14 summarizes the dispersion modeling results for the stationary emission sources operating at Portsite and compares them with background concentrations and Ambient Air Quality Standards. All maximum-modeled impacts are well below their associated AAQS. The results of the model also indicate that the maximum air quality effects would be within 1,000 feet of the stationary emission sources for NO_2 and SO_2 and within 3.1 miles of Portsite for $PM_{10.}$ Lead impacts were not modeled because lead impacts have been demonstrated, through conservative impact analysis, to be no greater than 0.23 ug/m^3 (quarterly average). The AAQS for lead is 1.5 ug/m^3.

Table 3-14. Dispersion modeling results for stationary emission sources at Portsite.

Pollutant	Averaging Period	Maximum Modeled Impact[1] (mg/m^3)	Background Concentration (mg/m^3)	Maximum Total Impact (mg/m^3)	Ambient Air Quality Standard (mg/m^3)
NO_2	Annual	19.1	0	19.1	100
PM_{10}	Annual	7.0	0	7.0	50
	24-Hour	29.5	24	53.5	150
SO_2	Annual	9.8	0	9.8	80
	24-Hour	88.4	0	88.4	365
	3-Hour	244.5	0	244.5	1,300

[1]Highest average for annual averaging period. Highest second-highest average for 24- and 3-hour averaging periods

Existing Pollutant Sources. Current sources of man-made air pollutants at Portsite include: (1) incineration of trash, (2) evaporation of fuels, (3) diesel electrical power and heat generation equipment, (4) other stationary equipment, (5) welding, (6) painting, (7), fugitive dust (8) mobile equipment including forklifts, graders, and light and heavy trucks, (9) tugboat operations, (10) self-loading barge operations, and (11) ships and fuel and cargo tugs/barges. Table 3-15 summarizes the inventory of existing stationary emission sources at Portsite. Non-stationary marine sources of emissions, including the tugboats, self-loading barges, and the ore carriers are not included in the table.

Table 3-15. Existing stationary emission source inventory at Portsite.

Tag Number	Brief Description	Detailed Description and Use
94-02	Caterpillar 3508TA 1	Primary power generation. Located in powerhouse.
94-03	Caterpillar 3508TA 2	Primary power generation. Located in powerhouse.
94-04	Caterpillar 3508TA 3	Primary power generation. Located in powerhouse.
94-32	Caterpillar 3516TA	Primary power generation. Located in powerhouse.
94-10	Caterpillar 3208TA	Standby power generation for fire protection. Located adjacent to fire water tank.
94-35	Cummins-Onan Genset	Portable power generation for contractor support. Located near concentrate storage buildings.
94-09	Caterpillar 3208	Portable concrete batch plant power generation. Located near concentrate storage buildings.
94-30	Caterpillar 3406 1	Construction camp power generation.
94-31	Caterpillar 3406 2	Construction camp power generation.
08-16	Kelly Hoskinson Incinerator	Refuse incinerator. Located north of powerhouse.
08-42	Advanced Combustion Incinerator	Refuse incinerator. Located north of powerhouse.
14-09	Powermatic Used Oil Heater 1	Used oil space heater. Located in storage building near powerhouse.
14-10	Powermatic Used Oil Heater 2	Used oil space heater. Located in storage building near powerhouse.
14-20	Cleaver-Brooks Heater 1	Supplemental hot water heater. Located in powerhouse.
14-30	Cleaver-Brooks Heater 2	Supplemental hot water heater. Located in powerhouse.
None	Black Gold Used Oil Heater	Used oil space heater. Located in construction camp.
14-102	Modine Unit Heater	Heater. Located in transfer tower.
14-103	Modine Unit Heater	Heater. Located in transfer tower.
14-104	Modine Unit Heater	Heater. Located in transfer tower.
14-105	Modine Unit Heater	Heater. Located in transfer tower.
14-106	Industrial Commercial Equipment Heater 1	Heater. Located in transfer tower.
14-107	Industrial Commercial Equipment Heater 2	Heater. Located in transfer tower.
None	5,000 hp Tugboat (hoteling)	Tugboat. Secured at dock when hoteling. Operates only during shipping season.
None	4,000 hp Tugboat (hoteling)	Tugboat. Secured at dock when hoteling. Operates only during shipping season.

Table 3-15. Existing stationary emission source inventory at Portsite.(Continued).

Tag Number	Brief Description	Detailed Description and Use
29-169	Conveyor Surge Bin Baghouse	Baghouse. Located on take-up tower. Operates only during shipping season.
29-175	Concentrate Truck Unloading Station Baghouse	Baghouse. Located between concentrate storage buildings.
29-167	Conveyor P7/P8/P28 Transfer Baghouse	Baghouse. Located near old concentrate storage building. Operates only during shipping season.
29-180	Barge Loader Baghouse	Baghouse. Located at end of wharf. Operates only during shipping season.
29-658	Conveyor P27/P28 Transfer Baghouse	Baghouse. Located near new concentrate storage building. Operates only during shipping season.
29-656, 29-657	Conveyor P22A/P23/P23A Transfer Baghouse	Baghouse. Located between concentrate storage buildings.
29-629	Conveyor P22/P22A Transfer Baghouse	Baghouse. Located between concentrate storage buildings.
29-823	Truck Unloading Building Baghouse	Baghouse. Located in the truck unloading building.
29-170	Conveyor P2/P3 Transfer Baghouse	Baghouse. Located in the old concentrate storage building.
76-02	Concrete Batch Plant	Portable concentrate batch plant. Fugitive emission source.
None	Concentrate Storage Buildings	Completely enclosed. Not an emission source.
None	Conveyor Belts	Completely enclosed. Not an emission source.
76-04	Read Screenall	Operated only in the completely enclosed concentrate storage buildings. Not an emission source.
26-24	Barge Loadout Snorkel	Fugitive emission source. Located at end of wharf. Operates only during shipping season. Equipped with canvas drop chute to minimize emissions.
34-01, 34-02	Portable Rock Crusher	Fugitive emission source.
94-14	Caterpillar 3508TD	Power generation for portable rock crusher.
19-122	Fuel Tank 1	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.
19-123	Fuel Tank 2	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.
19-124	Fuel Tank 3	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.
19-125	Fuel Tank 4	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.
19-74	Fuel Tank 5	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.
19-168	Fuel Tank 6	Fixed roof storage tank for No. 1 and No. 2 fuel oil. Negligible emissions.

Existing Marine Emissions. Marine equipment contributing to baseline pollutants emitted at Portsite includes four diesel-powered tugboats, two self-loading lightering barges that have stationary and mobile diesel equipment onboard and the various tugs and barges that deliver fuel and commodities to the terminal. Ore carriers that anchor between 3 and 5 miles offshore generally would not contribute to Portsite emissions. Diesel engines on tugs and barges produce gaseous and particulate emissions. The gaseous component of diesel fuel includes carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, oxides of sulfur, and hydrocarbons (e.g., ethylene, formaldehyde, methane, benzene, phenol, 1,3-butadiene, acrolein, and polycylic aromatic hydrocarbons). The particulate component of diesel exhaust consists mostly of solid carbon particles known as soot with organic compounds absorbed to its surface. Among these absorbed compounds is a group of compounds known as polynuclear aromatic hydrocarbons (PAH's). Some PAH's have been identified by the U.S. Department of Labor (OSHA 1988) as contributing to cancer in humans.

Baseline estimates of exhaust emission of pollutants per 1,000 gallons of diesel fuel having 0.8 percent sulfur are published in the Non-road Engine and Vehicle Emission Study report (EPA 1991). The four tugboats currently used at Portsite are 2,200, 3,000, 3,000 and 4,000 horsepower (hp), and would be expected to use an average of 115 gallons of diesel per hour during normal working conditions. The shipping season at Portsite averages about 104 days and about 37 days wave and/or weather-days that preclude operations for a total of about 67 tugboat-working days. The tugboats work about a 75 percent duty cycle, 24 hours per day during the 67 days of good weather. The average volume of fuel used at Portsite by each tugboat in working mode can be roughly estimated at 125,000 gallons per season. Working fuel used does not include fuel used off Portsite or while "hoteling" during weather days. The barges used to haul ore concentrate to offshore ore carriers each have two Caterpillar 988 loaders and a diesel-powered augur onboard. This equipment operates only during offloading. The estimated amount of exhaust pollutants emitted by the four tugs and the equipment on the two lightering barges, based on Non-road Engine and Vehicle Emission Study report (EPA 1991) emission factors are provided in table 3-16. The analysis of tug operation duration is presented in Section 3.4.8 of this draft EIS.

Table 3-16. Estimated emissions from four tugboats and two lightering barges at Portsite from July through September).

Equipment	July – September Emissions (tons)[a]					
	Duty Cycle	HC	CO	NO_X	SO_2	PM
Tugs (4), 2,000+ hp	0.75	3.11	14.48	72.44	0.23	3.14
Barges (2), self-loading[b]	0.50	2.84	13.79	24.16	2.04	3.08
Estimated total		5.95	28.27	96.6	2.27	6.22

a. Estimated on 123,280 gallons of 0.8% sulfur diesel fuel used onsite per tug per season.
b. Includes two 475 hp Cat 988G diesel-powered loaders and one auger per barge working 12 hours-day.

Sensitive Receptors. The impact of air quality to sensitive persons is of nationwide concern. Sensitive receptors include children, elderly, and the acutely and chronically ill. The locations where these groups are found include residences, schools, daycare centers, playgrounds, hospitals, and clinics. The closest location of any sensitive receptors to Portsite is Kivalina, 17 miles northwest of Portsite. Air modeling and monitoring data show that air quality impacts at

Kivalina from sources associated with Portsite, DMTS road, and Red Dog Mine operations are negligible.

Region of Influence (ROI). Portsite is on the sparsely populated northwest coast of Alaska, 65 miles northwest of Kotzebue (population 3,130) and 17 miles southeast of Kivalina (population 388). The Chukchi Sea is to the west and Cape Krusenstern National Monument is to the east of the project area. Identifying the Region of Influence (ROI) requires knowledge of the types of pollutants being emitted and the local meteorological conditions. Other than Reactive Organic Gasses (ROG) that can react with ozone (O_3), the ROI for inert pollutants is generally limited to a few miles downwind from the source. Winds at Portsite during winter are generally from the east, while winds during shipping season are typically from the south and east. Winter and summer winds would primarily transport pollutants from Portsite facilities seaward over the Chukchi Sea. However, summer winds are slightly more likely to transport pollutants over land to the north. The ROI for inert pollutants released at Portsite would extend for a few miles over the open Chukchi Sea or across mostly unpopulated tundra. Occasionally, predominant winds would transport pollutants toward Kivalina. However, modeling and air monitoring results at the community support the conclusion that the ROI does not extend more that a few miles from Portsite and does not include Kivalina.

3.4.3 Geology and Soils

Portsite is on the southern edge of the Kivalina Flats portion of the Kivalina-Wulik Lowlands Physiographic Province. A physiographic province is a region in which the landforms are topographically similar to one another, but distinctly different from those of adjacent areas. Silurian and Devonian limestone, dolostone, marble, and shale underlie the Kivalina-Wulik Lowlands. Uplands surrounding the general project vicinity include the DeLong Mountains, Baird Mountains, Iyikrok Mountain, Mulgrave Hills, Kivalina Hills, and the Igichuk Hills.

The Kivalina Flats is a triangle-shaped region between Iyikrok Mountain and the Mulgrave Hills. The widest part of the flats is a few miles north of Portsite between Ipiavik Lagoon and Kivalina Lagoon. The predominantly low relief of the Kivalina Flats is broken up by scattered pingos, depressions, and low ridges, with hundreds of tundra thaw lakes and ponds, and several rivers and sloughs traversing the region, including the Kivalina, Wulik and Omikviorok rivers. Most of the flats are less than 50 feet in elevation, with the highest point being about 135 feet above sea level. Nearer to the coast, the landform is a series of lagoons separated from the Chukchi Sea by beach berms.

3.4.3.1 Geology

The geology underlying the Portsite area is part of what is called the Brooks Range Province. The rock types making up the Brooks Range Province are primarily from sedimentary deposits from 200 to 300 million years ago during a time when ocean and shallow marine basins covered most of northern Alaska. The Brooks Range was formed during the Jurassic and middle Cretaceous periods 144 to 99 million years ago by forces that thrust the sedimentary bedrock up into mountain ranges. The processes that formed these basic geologic structures in Northwest Alaska continue through present day.

The Brooks Range is divided into several smaller upland physiographic provinces. The DeLong Mountains, the Kivalina Hills, the Mulgrave Hills, the Baird Mountains and their southwestern extension, the Igichuk Hills, are upland physiographic provinces in the Portsite vicinity.

The Mulgrave Hills are an extension of the DeLong Mountains and extend almost 40 miles west, terminating immediately east and south of Portsite. The Kivalina Hills are just north of the Portsite, and extend about 50 miles from the middle Wulik River to just northeast of Kivalina. The Igichuk Hills line the southern flank of the Portsite area and extend from the Baird Mountains to near the coast at Cape Krusenstern.

3.4.3.2 Mineral Deposits

The DeLong and Baird Mountains and their foothills (Mulgrave, Kivilina, Igichuk) are highly mineralized. In addition to the Red Dog mine deposits containing zinc, lead, silver, cadmium, and germanium, other deposits in the area contain chromium, gold, tin, barite, copper, platinum and palladium (USGS 2000). They include the Su-Lik deposit, about 12 miles northwest of Red Dog Mine, and the Alvinella deposit about 5 miles north of Red Dog Mine. Other deposits in the area that have the potential for producing lead and zinc concentrate volumes similar to those at Red Dog include Drenchwater, Story Creek, and Kivliktort Mountain. Other mineral discoveries and occurrences extend several hundred miles east and west along the north flank of the Brooks Range, suggesting that still further undiscovered deposits may exist.

The principal known mineral deposits in the DeLong Mountains area are listed in table 3-17. The locations of these deposits are shown in figure 3-16.

Table 3-17. Mineral deposits known to exist in the general area.

Deposit	Mineral Resources					
Su-Lik	Zinc	Lead	Silver	Cadmium		
Ginny Creek	Zinc	Lead	Silver			
Drenchwater	Zinc	Lead	Silver			
Story Creek	Zinc	Lead	Silver	Copper	Gold	
Kivliktort Mountain	Zinc					
Alvinella	Zinc					
Whoopee Creek2	Zinc	Lead	Copper	Silver	Gold	Cadmium
Avan Hills	Chromite					
Misheguk Mountain	Chromite					
Nimiuktuk River	Barite					

Source: USGS, 2000

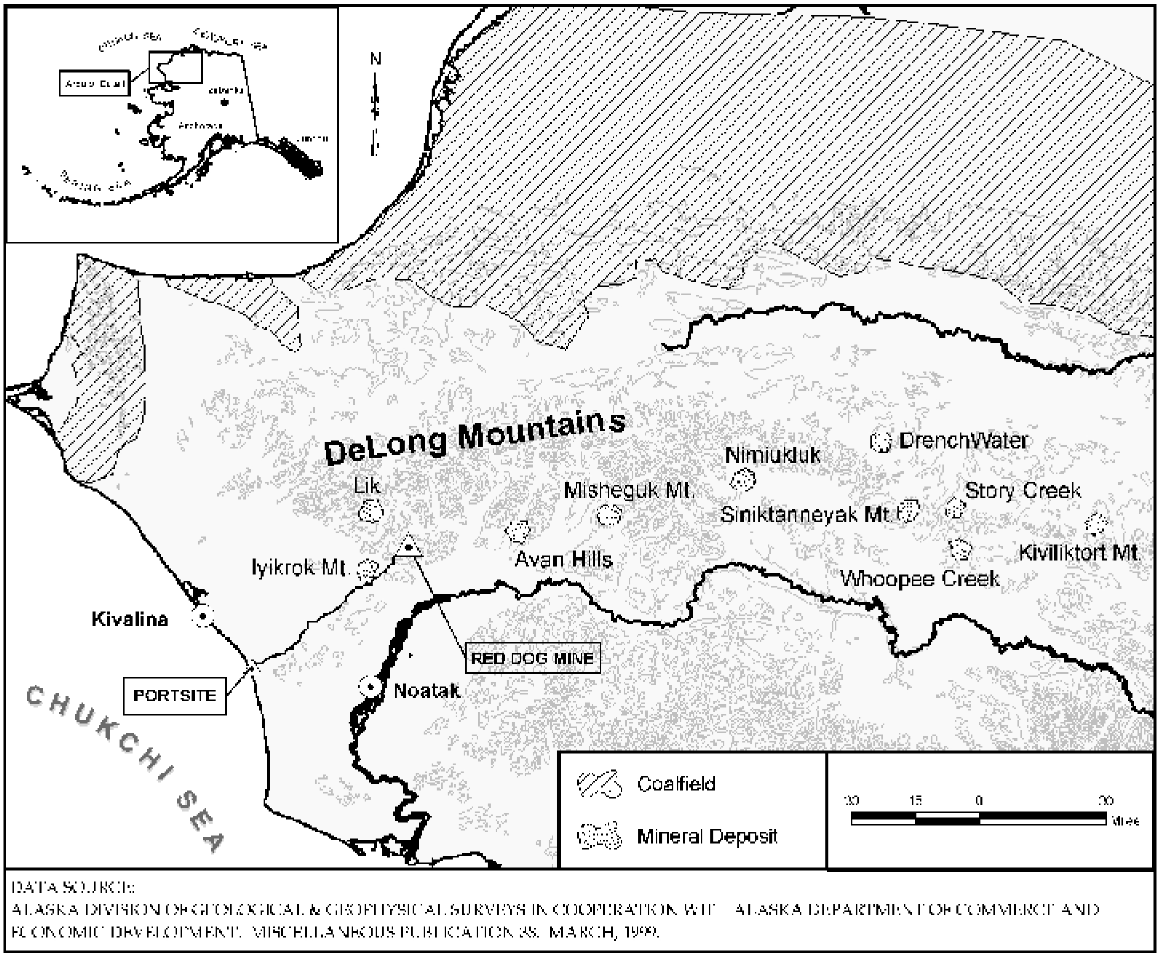


Figure 3-16. The locations of major mineralized districts in northwest Alaska relative to the Red Dog district and to Portsite.

3.4.3.3 Soils

Soils in the Portsite area consist predominantly of mixed gravelly material covered with silty loess sediment. Sources of soil material in the area include (1) glacial drift and glacial outwash plains from successive glaciations; (2) rock material from eroding mountains and hills transported in drainage channels; (3) marine sediments transported by marine currents, and (4) local decomposition of organic matter.

Woodward-Clyde (1983) reported that sandstone bedrock is generally present 50 feet below ground along the DMT beach and at or near the ground surface at a quarry 1 mile inland. The upper several feet of bedrock is weathered, but the material becomes more competent with depth.

Beach Material. Along most of the coastline of Northwest Alaska, where no structures or natural features interrupt the coastline, the beach is in a steady-state condition. The width of the steady-state beaches in Northwest Alaska is related to their exposure to wave action. Sheltered beaches are wide, and exposed beaches tend to be narrow. Beach material can extend to a water depth of approximately 30 feet. The sediment typically grades downward from fine gravel in the surf zone to very fine-grained sand and silt with sporadic gravel in offshore areas.

The ocean beach near Portsite is composed of coarse and fine components that could be generally sorted based on color and type of material (Woodward-Clyde 1983). Coarse material is a mixture of dark and green-gray Triassic chert, limestone and large quartz sand, and light colored sandstone. Fine material was predominantly sandstone, shale, and limestone. The fines indicate contributions from the Wulik River drainage (Woodward-Clyde and Coastline Engineering 1983). Larger beach material may come from Cape Thompson erosion, reworking of old beach deposits, and influx of material from coastal rivers (Moore, 1966 and Hopkins 1986). The composition of near-shore and offshore material and observation of the dynamics of sediment transport indicate that there is not much exchange of material between the beaches and their associated near-shore deposits (in water less than about 25 feet deep and the finer sediment typically farther off shore. Sediments collected off DMT in water deeper than about 25 feet contained little of the material found on the beaches.

3.4.3.4 Permafrost

Northwestern Alaska is in a continuous permafrost zone. Almost all areas of the Kivalina-Wulik Lowland, including the Kivalina Flats and the terrestrial DMT project site, are underlain by permafrost. Permafrost on land can be hundreds of feet deep, but is apparently thin or absent under most of the Chukchi Sea (Burch 1990). Holes bored to bedrock on the beach and seaward (PND 2000) confirmed the absence of permafrost at the Portsite seaward of the beach and under the beach lagoons.

Permafrost is associated with a number of visible landforms including cryoturbation, ground ice, patterned ground, pingos, frost mounds, palsas, thermokarst, thaw ponds, and tussock vegetation.

3.4.4 Seismicity

The three major faults in northern Alaska (Kaltag, Porcupine Lineament, and Tinitina) are not believed to have influence in the Portsite area (Burch 1990). The Kobuk fault, a relatively minor fault, is the closest known fault. It runs along an east-west axis south of Portsite under the Kobuk Valley and may extend east to the Porcupine lineament and west under the Chukchi Sea for approximately 450 miles.

New and existing upland and marine-based structures at Portsite would be periodically subjected to ground shaking and movement from earthquakes. Seismic hazard zones, based on the likelihood of an area to experience horizontal ground acceleration rates above specific rates over a specified time period can be mapped. Regional hazard assessment programs commonly specify a 10 percent chance of exceeding (90 percent chance of not exceeding) ground acceleration rates that are expressed as a percent of the acceleration of gravity ($g = 9.8\ m/s^2$) over a 50-year period.

Portsite is considered to be in a relatively low seismic hazard area of Alaska. Peak ground acceleration in the area is estimated to have a 10 percent probability of exceeding 8%g (about 0.8 m/s^2). Another indicator of seismic risk are Uniform Building Code seismic risk zones based on areas where major structural damage will occur to specific building classifications in the event of an earthquake. The Portsite area is rated in Zone 2 as having a low seismic risk for low structures. Zone 4 is the highest risk category on this scale.

3.4.5 Coal, Oil, and Gas Resources

An estimated 4 trillion tons of high-quality bituminous coal extend along a broad, east-west belt reaching 300 miles inland from the Chukchi Sea. These large deposits are cumulatively estimated to contain 1/9th of the worlds known reserves. Approximately 2 billion tons of those deposits are located on the western Arctic slope north of the Delong Mountains. In addition to the large coal reserves, substantial oil and natural gas reserves might exist north of Portsite. The largely unexplored Western Arctic Oil Province (ADNR 2003) includes a large area of the Arctic slope including potential offshore areas and the western portion of the National Petroleum Reserve-Alaska (NPR-A). The NPR-A is a 23.5-million-acre, Indiana-sized petroleum reserve starting 100 miles northeast of Portsite and 50 miles northeast of the Red Dog mine. The U.S. Geological Survey estimates that there could be between 6 billion and 13 billion barrels of oil reserves on the NPR-A. All three of these resource-rich areas are potentially within transportation range of Portsite.

3.4.6 Oceanography

The Chukchi Sea is a shallow sea with an extensive continental shelf and no significant basin. . Oceanographic conditions that might affect a project at DMT or that might be affected by a project are discussed in considerable detail in the Hydraulic Design Appendix to the DMT Feasibility Report. Material from that appendix forms the basis for most of the summary in the remainder of this oceanography section.

3.4.6.1 Bathymetry

The embayed southeastern Chukchi Sea is predominantly a flat, featureless plain with gradients rarely greater than 4 feet per mile and a maximum depth of 210 feet. Well-defined shoals extend into the southern Chukchi north of Cape Prince of Wales and west of Point Hope, and an ill-defined shoal projects westward from Cape Krusenstern. Hope Submarine Valley, with a relief of only 30 feet, is south and west of Point Hope. Figure 3-17 illustrates the bathymetry of the southern portion of the Chukchi Sea.

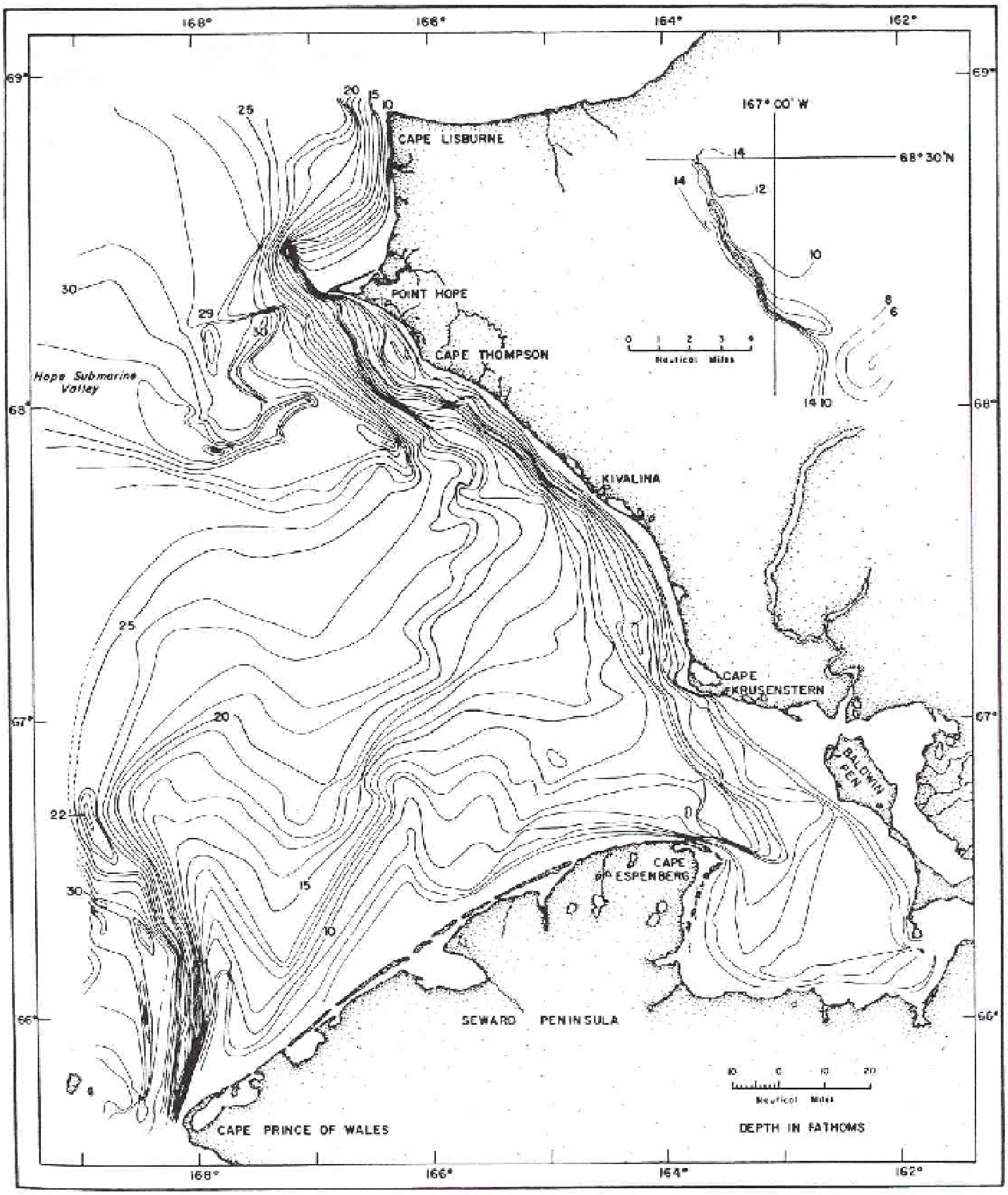


Figure 3-17. Bathymetry of the southeastern Chukchi Sea. *Geology of the Southeastern Chukchi Sea*, Creager and McManus.

Near Portsite, the beach drops steeply to a depth of about 10 feet. There, the sea floor slopes gently southwestward to a depth of about 50 feet at 3 miles and about 60 feet at 5 miles offshore. Beyond this point, the gentle seafloor slopes continue but shift to the west and then to the northwest to the edge of the Hope Basin about 31 miles from shore.

Offshore from some of the rivers in the region, submerged bars form relatively small areas of steeper relief that may shift from season to season. Local and traditional knowledge tells of channels extending offshore from some of the streams and rivers in the general vicinity of DMT. Inflowing fresh water may create temporary channels, but freshwater inflow would be expected to move over the denser marine waters and have relatively little effect offshore from the beach. An exception might occur in the late spring when meltwater in the rivers flows under the ice offshore from the river mouth and scours a temporary channel. No channels offshore from streams near DMT were identified with electronic depth finders during the bottom profiling associated with sampling and other data collection near DMT.

The existing loading facilities at DMT have slightly altered local bathometry. Water is a few feet deeper just off the dock face where tugs tie up and near where the lightering barges are loaded with concentrate. Movement of the barges and turbulence from tugboat props probably displace some of the bottom material at both locations.

3.4.6.2 Waves, Tides and Currents

Waves, tides, and currents influence the DMT area mostly during the open water season, which runs from about July through October. However, currents can also affect ice formation in the fall and ice movement in the spring and fall. Waves, tides and currents that typically occur in the Portsite area are discussed below.

Waves. Waves in the Portsite area are primarily generated by wind. The wave climate near Portsite can be complicated by variable meteorological conditions in seas far from the site, but it is typically characterized by a predominance of waves under 3.3 feet. When waves higher than 6.6 feet occur, it is usually for short durations of 24 to 48 hours. The conditions in the Bering Sea and northern Pacific Ocean, where low frequency energy in the form of swells is radiated from cyclones and large and powerful storms, are particularly important. Wave generation in the Chukchi Sea and the open Arctic Ocean north of Portsite affects wave height and produces the extreme waves recorded at Portsite.

The U.S. Army Corps of Engineers developed a 16-year (hindcast) model of the wave conditions near Portsite between 1985 and 2000 (Hydraulic Design Appendix). The maximum and mean wave heights in the Portsite area for the 16-year period 1985-2000, based on the model, are shown in table 3-18. The 16-year average mean wave heights for July, August, September, and October are 1.4 feet, 1.9 feet, 2.4 feet, and 2.6 feet, respectively. The average maximum wave heights over the 16 years for July, August, September, and October are 6.1 feet, 7.9 feet, 7.7 feet, and 10.1 feet, respectively. As is evident in the table, the wave heights at Portsite tend to get increasingly higher over the 4-month period from July through October.

Table 3-18. Maximum and average wave heights at Portsite from 1985-2000.

Year	Item	July	Aug	Sep	Oct
1985	Mean Ht.	1.3 ft.	1.3 ft.	2.3 ft.	3.6 ft.
	Max Ht.	5.9 ft.	7.2 ft.	9.2 ft.	12.8 ft.
1986	Mean Ht.	1.3 ft.	2.3 ft.	3.0 ft.	2.3 ft.
	Max Ht.	5.9 ft.	6.6 ft.	9.8 ft	6.6 ft.
1987	Mean Ht.	1.0 ft.	1.6 ft.	2.3 ft.	2.3 ft.
	Max Ht.	3.6 ft.	7.5 ft.	7.9 ft.	7.2 ft.
1988	Mean Ht.	2.0 ft.	2.3 ft.	2.0 ft.	1.6 ft.
	Max Ht.	9.8 ft.	10.5 ft.	7.9 ft.	5.9 ft.
1989	Mean Ht.	1.3 ft.	1.6 ft.	2.6 ft.	3.0 ft.
	Max Ht.	6.2 ft.	8.5 ft.	9.8 ft.	10.2 ft.
1990	Mean Ht.	1.6 ft.	1.6 ft.	2.6 ft.	2.6 ft.
	Max Ht.	8.2 ft.	9.8 ft.	6.6 ft.	7.9 ft.
1991	Mean Ht.	1.3 ft.	1.6 ft.	2.0 ft.	3.6 ft.
	Max Ht.	5.6 ft.	5.9 ft.	4.9 ft.	14.8 ft.
1992	Mean Ht.	1.3 ft.	1.6 ft.	2.0 ft.	3.0 ft.
	Max Ht.	4.3 ft.	5.9 ft.	7.5 ft.	14.4 ft.
1993	Mean Ht.	1.3 ft.	1.6 ft.	3.6 ft.	2.6 ft.
	Max Ht.	7.2 ft.	10.5 ft.	9.8 ft.	10.5 ft.
1994	Mean Ht.	0.7 ft.	3.3 ft.	2.6 ft.	2.6 ft.
	Max Ht.	2.6 ft.	11.2 ft.	7.5 ft.	9.8 ft.
1995	Mean Ht.	2.0 ft.	1.0 ft.	2.0 ft.	2.0 ft.
	Max Ht.	7.2 ft.	5.9 ft.	4.9 ft.	8.2 ft.
1996	Mean Ht.	2.3 ft.	2.3 ft.	2.3 ft.	2.6 ft.
	Max Ht.	11.8 ft.	7.5 ft.	7.9 ft.	22.0 ft.
1997	Mean Ht.	1.3 ft.	2.0 ft.	2.0 ft.	2.6 ft.
	Max Ht.	3.3 ft.	8.9 ft.	8.9 ft.	12.5 ft.
1998	Mean Ht.	1.0 ft.	2.3 ft.	2.6 ft.	3.3 ft.
	Max Ht.	4.3 ft.	9.2 ft.	8.5 ft.	7.2 ft.
1999	Mean Ht.	1.0 ft.	1.6 ft.	1.6 ft.	2.0 ft.
	Max Ht.	4.6 ft.	5.6 ft.	3.3 ft.	3.6 ft.
2000	Mean Ht.	1.6 ft.	2.6 ft.	2.6 ft.	2.6 ft.
	Max Ht.	7.2 ft.	5.9 ft.	8.9 ft.	8.5 ft.
16-year avg.	**Mean Ht.**	**1.4 ft.**	**1.9 ft.**	**2.4 ft.**	**2.6 ft.**
	Max Ht.	**6.1 ft.**	**7.9 ft.**	**7.7 ft.**	**10.1 ft.**

Fast moving weather systems of short duration in the Chukchi Sea generate most of the larger waves at Portsite. The largest waves of record occurred in November 1970 during a storm from the south. Waves peaked at 29.5 feet with a 12 to 13-second period. Waves of 19.7 feet from that storm were sustained for over 14 hours, and 13-foot waves were sustained for over 20 hours.

Loading operations at Portsite are frequently interrupted by adverse sea conditions. The termination of loading activities at Portsite is based on sea and weather observations that occasionally shut down loading operations in anticipation of conditions that do not materialize. The actual wave height that causes a shut down of loading activities can not be easily defined because waves arrive as a spectra of heights, and physical wave modifications at the dock face due to reflection can almost double the incoming wave height. The combined effects of reflections and lack of reliable criteria for observation of waves leaves doubt as to the actual wave height that closes the dock operation. However, waves greater than about 3.3 feet are reported to cause too much motion for barge loading operations at the dock. Once the barges are loaded and underway, waves up to 6.6 feet can be tolerated. At the ship, barges are able to conduct their loading operations in the lee of the ship, which provides adequate shelter from the waves. However, all shipping shuts down in waves greater than 6.6 feet. Table 3-19 presents the number of days that the tugs were able to operate compared with the length of each shipping season from 1991 through 2000.

Table 3-19. Comparison of tug operational days and length of shipping season.

Year	Tug Operational Days	Shipping Season (Days)
2000	67	96
1999	106	110
1998	75	102
1997	77	99
1996	62	83
1995	78	85
1994	70	90
1993	68	91
1992	66	81
1991	91	96

It is notable that the period from 1991 through 2000 does not include any historically significant storm events and, based on model results that incorporate data from known historically significant storms since 1954, represents a period of relatively good operating conditions at Portsite.

Tides. Tides in the Portsite area are bi-diurnal with two high tides and two low tides in each lunar day. Tidal characteristics at Portsite are similar to those at NOAA Station 949-1253 at Kivalina Corwin Lagoon Entrance. Table 3-20 presents a summary of NOAA data collected between October 1, 1985 and September 30, 1986.

Table 3-20. Tidal characteristics at Kivalina Lagoon.

Item	Elevation (ft-MLLW)
Highest Observed Water Level (11/10/1985)	4.16
Mean Higher High Water (MHHW)	0.90
Mean High Water (MHW)	0.77
Mean Sea Level (MSL)	0.43
Mean Low Water (MLW)	0.10
Mean Lower Low Water (MLLW)	0.00
Lowest Observed Water Level (12/19/1985)	-3.12

Currents. Marine currents in the Portsite area of the Chukchi Sea are of two general types: offshore and near shore. Offshore currents in the Chukchi Sea can move both vertically and horizontally as temperature and salinity change, whereas near-shore currents generally move horizontally. Near-shore current patterns and velocities are complex and variable because of the influence of coastal configuration, bathymetry, and changing winds. These two types of currents are briefly discussed below. Additional information on waves, tides, and currents can be found in Appendix A of the draft feasibility report.

Offshore. Marine currents offshore of the Portsite are primarily influenced by the Alaskan Coastal mass, originating in the eastern Bering Sea. This water mass and associated current is differentiated from other Chukchi Sea water masses by lower salinity and higher temperatures since it is seasonally fed by freshwater from large rivers flowing into the Bering Sea and Kotzebue Sound (Coachman et al. 1975, Coachman and Shigavev 1988). The Alaskan coastal mass is also characterized by horizontal graduation from a relatively cold and saline fraction far off shore to the west, changing to a warm and less saline fraction closer to the coast of northwestern Alaska (Coachman et al. 1975).

The *Climactic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska Volume III* indicates that the warm current entering the Chukchi Sea via the Bering Strait concentrates near the surface and overlies dense, relic bottom water. According to the atlas, this current has a uniform velocity of 0.87 knots in the summer and 0.20 knots in the winter.

According to Stigebrandt (1984), the (warmer) current generally moves from the Bering Sea to the Chukchi Sea due to a pressure head created by a 1.6-foot-height difference between the Bering Sea and the Arctic Ocean. (The Bering Sea is 1.6 feet higher than the Arctic Ocean). After entering the Chukchi Sea, the current generally circulates counterclockwise and is locally influenced by bathymetry and wind. Flow reversals from north to south in the eastern Chukchi Sea are rare and temporary (Coachman et al. 1975). The flow of Bering Sea water north through the Bering Strait is reported to be declining since the 1940's (Huntington et al. 2000), but the reason has not been determined.

Near Shore. Historical information on the near-shore currents at Portsite is sparse. To obtain near-shore current data, contractors and the Corps of Engineers measured local currents at Portsite between 1998 and 2000. The data were recorded by a series of three Acoustic Doppler Profiler (ADP) current meters. They were placed in shallower water during the open water season and then moved to deeper water before ice began forming. Table 3-21 summarizes the dates and depths that the ADP current meters were deployed at the DMT area.

Table 3-21. Operational periods and placement depths of ADP current meters at Portsite during 1998, 1999, and 2000.

Meter	Depth, ft.	Deployment Period
ADP C47	29	8 April 1998 – 25 July 1998
ADP C47	32	25 July 1998 – 30 September 1998
ADP C47	42	5 October 1998 – 16 April 1999
ADP C47	38	22 September 1999 – 25 June 2000
ADP C55	44	8 April 1998 – 1 July 1998
ADP C43	65	18 September 1998 – 28 May 1999
ADP C43	59	22 September 1999 – 7 June 2000
ADP C43	34	31 July 2000 – 26 September 2000

Data collected from the ADP current meters were compiled into a data base record of current velocities and directions. Based on the data, during the open water season, currents at Portsite predominantly flow generally parallel to the coast, either northward or southward. According to the 1998-2000 data record, northward-flowing currents were recorded as occurring approximately 70 to 75 percent of the time, while southward-flowing currents occurred about 25 to 30 percent of the time.

Currents at Portsite were modeled for a hypothetical year. The seasonal mean northbound current during the hypothetical year was 0.36 miles/hour while the seasonal mean southbound current was 0.25 miles/hour. Peak measured currents flowing north during the open water period were generally higher than peak currents flowing to the south. The highest recorded northbound current in the upper portion of the water column, where velocities tended to be greatest, was 2.5 mph. The highest recorded current flowing to the south, also measured in the upper part of the water column, was approximately 1 mph.

The near-shore currents in the Portsite area appear to be primarily wind generated. Fluctuations in near-shore currents apparently associated with the bi-diurnal tides in the area were evident in the analysis of the database, particularly when currents were weak. The magnitude of these fluctuations was low, amounting to 0.1 to 0.2 mph.

During winter, currents were generally weak, with flows less than 0.2 mph for more than 90 percent of the time. On occasion, the weak flow periods were punctuated by a stronger-current event such as in late March and April 1999 when currents averaged 3.6 mph. It is likely that this increase in current velocity was a localized event associated with the opening of ice leads and water flowing in to fill the void left as ice separated to form the lead.

The 16-year wave hindcast model suggests that the 1998-2000 period was not as energetic in terms of wind and waves as some previous years (e.g., 1996, 1997). Since currents at the project site are primarily forced by wind, it is reasonable to expect that extreme current magnitudes would be larger than those observed during 1998-2000.

Longshore Sediment Transport. Longshore sediment transport is the movement of sediment along the coast by the effects of waves and currents. The longshore sediment transport near the DMT is described in a coastal sedimentation report (Woodward-Clyde and Coastline Engineering 1983) prepared for the 1984 Red Dog Mine EIS (Dames and Moore 1984). According to the report, the wave-generated currents along the beach create a net movement of beach material to the south. This southerly transport of beach material occasionally reverses during intense summer storms from the south.

In an earlier study, Moore and Cole (1960) analyzed longshore sediment transport for the northern Chukchi Sea coastline. The study concluded from analysis of historical deposits of sediment on Sheshalik Spit southeast of Cape Krusenstern that an annual net transport to the south must have occurred over the past 1,000 years to produce the formations on Sheshalik Spit.

In 2001, the U.S. Army Corps of Engineers Research and Development Center, Coastal and Hydraulics Laboratory (CHL) simulated the longshore sediment transport at the DMT for the period 1985-2000 based on the wave hindcast model described previously. Gross and net longshore transport estimates generated by the model are summarized in Section 7.6 of the Hydraulic Design Appendix (Appendix A) to the DMT draft interim feasibility study.

The annual net transport estimated in the model indicated that approximately half of the years simulated had net transport to the north and half had net transport to the south, but the overall net transport was to the south. This agrees with the results of the 1984 and 1960 studies. The model showed that the average annual net transport of sediment to the south over the 16-year period was 11 to 18 percent of the gross transport, indicating an overall directional bias in transport to the south. For individual years, however, the net transport to the south was shown to be as large as 70 percent of the gross transport, depending on the modeled weather and wave conditions. The majority of sediment movement along the shore apparently occurs during large storm events.

Influence of Existing DMT Barge-Loading Facility. Since construction of the DMT shallow-water dock in 1986, sediment has accreted on the north side of the dock. This material accretion supports the CHL model predictions and the findings of the 1984 and 1960 studies that the net longshore transport at the DMT is to the south.

The long-term effect of the loading dock on the beach is evident in an August 2000 aerial photograph of the existing DMT facility shown in figure 3-18. The beach south of the dock appears to have receded while the beach north of the dock appears to have grown. The adjacent conveyor trestle and the three supporting cells, because they do not impede the flow of currents or the wave action, have not noticeably affected longshore sediment transport.

Figure 3-18. Effect of the dock on longshore sediment transport, Aug. 2002.

3.4.6.3 Ice

Ice typically begins accumulating in the south Chukchi Sea in October. It first forms along the northeast coast of Russia and then down the Chukotsk Peninsula to Cape Dezhnev. Usually by the time ice has reached Cape Dezhnev, ice is also forming in the eastern Chukchi Sea along the Alaska's western coast. Ice along the Russian coast tends to grow faster than the ice along the Alaskan coast. Ice on both coasts continues to grow until ice in the Bering Strait cuts off access to the Chukchi Sea. Shortly after the Bering Strait ices up, the Chukchi Sea ices over.

Sea ice in the Portsite area is of two general types: polar pack ice that progresses and recedes from the North Polar area, and more localized shorefast ice that is attached to shore (NCDC 1988). A seasonal ice boundary or "shear zone," typically separates the shorefast ice from the pack ice. The shorefast ice boundary can vary extensively depending on local bathymetry, currents, and wind stresses. Average seasonal shorefast ice boundaries offshore of the Portsite area are charted in the *Climatic Atlas, Volume III Chukchi-Beaufort Sea* (NCDC 1988). The shear zone is generally highly active with a considerable differential movement between the two types of ice. Consequently, substantial grinding, piling, thrust sheeting, and dynamic lead formation characterize the ice in this zone.

Ice in the Portsite area typically forms in late fall as slush and eventually may extend up to several miles seaward from shore as shorefast ice. Pack ice extends south from the polar region where it meets shorefast ice along the shear zone forming rubble ridges and open leads. Shorefast ice in the Eastern Chukchi Sea is more constrained by land than some other Arctic areas, and only very strong east or southeast winds are able to separate it from land.

The thickness of shorefast ice seaward of DMT is variable. In 1998 ice ranged from 2.7 to 4.5 feet thick in water from 5.5 to 44 feet deep (PN&D 1998 cited in RWJ 1999). The seaward edge of shorefast ice generally extends out to about 65 feet of water depth and may be anchored by ice keels from 33 to 65 feet deep (Stringer 1981 cited in RWJ 1999). Ice gouges on the sea bottom in water 70 feet deep were reported throughout the Portsite area in 1998 (NW-GEO sciences 1999 cited in RWJ 1999). These ice gouges mostly ranged from about 10 to 20 inches deep, but were reported as deep as 36 inches (RWJ 1999). The widths of the ice gouges ranged from 16 to 196 feet, but were mostly from 50 to 82 feet wide.

Wind and current are the primary determinants of ice conditions during winter and spring. During prolonged easterly winds, shorefast ice can separate from land forming open leads between shore and ice. These leads, called flaw leads, generally form along the shear zone (NCDC 1988).

During westerly winds shorefast ice can pile onshore in large mounds sometimes called shore ice pile-up. Leads are sometimes closed under westerly and northwesterly wind conditions as pack ice piles against grounded shorefast ice or the shoreline. Pile-ups to heights of 30 feet have been observed in the Chukchi and Beaufort Seas. Similar pile-up heights could occur on offshore structures (EPA-DI 1984). According to Burch (1990) the piling of ice in the Portsite-Kivalina area is more likely to occur during the fall and spring, and is relatively minor compared with some other Arctic areas. During windless periods, the general drift of offshore ice is northerly. During breakup, large masses of ice can move suddenly, as witnessed by Corps biologists during the surveys being conducted June 2000, and as told in local traditional knowledge.

Sea ice patterns in the Bering and Chukchi seas have changed in the past 50 years (Huntington, et al. 2000). Overall, the ice-covered season is shorter with freezeup later in the fall and ice-out earlier in the spring. Multi-year ice is now sometimes blown south after local shorefast ice has already formed, and sea ice is thinner in some areas. Ice cover is also becoming less expansive. These changes are thought to be related to global warming.

Polynyas and Leads. A polynya is an expanse of open water or thin new ice surrounded by sea ice. Environmental combinations of temperature, tide, current, upwelling, and wind form polynyas. Polynyas are critically important to arctic birds and marine mammals for migration, feeding, and reproduction (Sterling 1980). Polynyas vary greatly in size, and the larger polynyas that form at about the same location each year (recurring polynyas) are the most biologically important to marine wildlife. According to Sterling (1980), recurring polynyas can generally be characterized as those that are open throughout the winter and those that are covered with a thin sheet of new ice during the coldest months in some years, but which can be relied on to have open water when the first migrating seabirds and mammals arrive.

A recurring Eastern Chukchi Sea polynya, important to the migration of marine mammals, forms annually south of Point Hope (Dickens 2001). This large polynya, known as the Point Hope polynya, is covered through most of the winter by a sheet of new ice but is generally open during migrations periods. It generally extends from Point Hope south to Cape Thompson. In some years this polynya manifests as a system of open and tapering flaw leads along the coast past Kivalina, Portsite, Sealing Point, and Cape Krusenstern. Figure 3-19 shows the general area where this polynya is likely to develop, although locations vary from year to year. When present, these flaw leads are critical to the northward migration of marine mammals. In some years, this polynya tends to bring migrating marine mammals to within reach of hunters from Kivalina, Noatak, and Kotzebue.

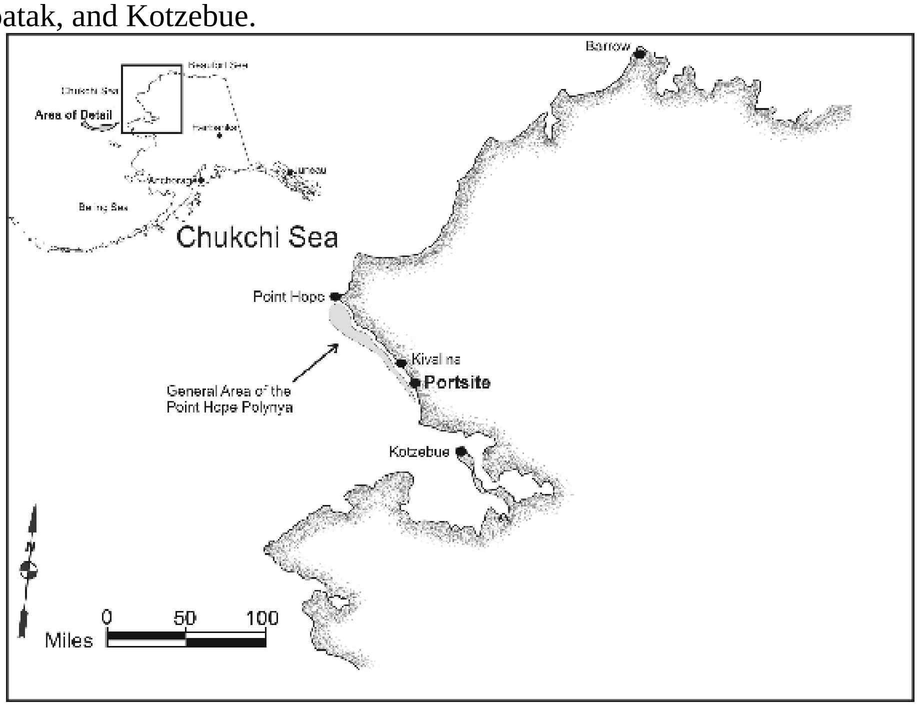


Figure 3-19. General area of the eastern Chukchi Sea where the Point Hope polynya forms during winter.

Carleton (1980) discussed the development of the Point Hope polynya and related the changes in its area to meteorological factors such as cumulative thawing degree-days and the mean vector wind (Dickens 2001). Dickens (2001) recently compiled the available satellite imagery of the polynya for the years 1973 through 2000. The frequency of leads pictured in satellite imagery may be biased by effects of cloud cover on satellite imagery, but is useful to create a general description of the Point Hope polynya.

From the satellite imagery, the width of the Point Hope polynya appears to narrow to the south. In Dickens' compilation of available satellite imagery, the polynya was present offshore of Kivalina during 71 percent of the observations and was an average of 5.2 miles wide. Near Portsite, some 17 miles southeast down the coast, it was present during 55 percent of the observations and an average of 4.7 miles wide. Farther south at Cape Krusenstern, it was present during 50 percent of the observations and was an average of 3.1 miles wide.

Sea Ice and Shipping. The Chukchi Sea shipping season generally opens about mid-June and closes in early November (DECD 2000). Although most shipping lanes in the Chukchi Sea are virtually ice-free until December (NCDC 1988), the shipping season is limited in late autumn by the formation of ice in the Bering Strait about a month before the shipping lanes near Portsite begin to freeze. The threat of ice in the Bering Strait stops ore-concentrate shipping and triggers the movement of the tugs and barges south for the winter. Drifting near-shore and pack ice may also interfere with shipping activities for a short time after breakup in the spring.

At the DMT, the start of the shipping season is determined by the presence of whales or ice in the area. In the fall, equipment needs to be demobilized from the DMT before the Bering Strait ices over. Based on shipping records, ore-concentrate shipping activities typically start in early July and end in mid-October. The start and finish days from 1990 to 2000 shipping seasons are presented in table 3-22.

Table 3-22. Historical DMT shipping start and finish dates.

Year	Start Date	Finish Date	Total Days	Wet Metric Tons Shipped
1990	18 July	3 October	77	319,100
1991	4 July	8 October	96	548,200
1992	11 July	30 September	81	469,900
1993	7 July	6 October	91	464,300
1994	15 July	13 October	90	638,300
1995	7 July	30 September	85	727,400
1996	7 July	28 September	83	862,900
1997	4 July	11 October	99	986,000
1998	8 July	18 October	102	971,629
1999	14 July	1 November	110	1,204,100
2000	12 July	16 October	96	1,143,434

The average shipping season used for planning ore-concentrate shipments from DMT is about 100 days and allows for the presence of about 3 weeks of breakup ice in the spring.

Sea Ice and the Existing DMT Facilities. The DMT dock and loader are typically in shorefast ice through the winter. However, offshore winds and currents can create leads inshore as far as the loader, or occasionally to the dock. Both the dock and the barge loader can influence the ice and its movement. They can cause small areas of ice around them to melt sooner than surrounding ice, and can anchor ice or obstruct its movement. The dock is a solid-fill structure, so ice moving within 200 feet of shore may pile up behind it (up-current) and/or be forced seaward from it. The barge loader is in deeper water and extends about 800 feet off hore. It tends to anchor ice around it. When ice leads open as far inshore as the loader, it can act as an ice anchor and/or an obstruction when the ice moves. As a result, ice can pile up against the sheet-pile cells that support the loading trestle.

The sheet-pile cells can also divide ice moving past them, creating flaws that are carried down current in the moving ice pack. Ice moving near shore is often broken up in similar ways by local currents, winds, near-shore topography, or other natural conditions. If ice is moving, there is a flaw between the offshore ice that is moving and the shore-fast ice. If the wind is blowing seaward, the flaw between the moving and stationary ice tends to open as a lead. If the wind is blowing shoreward, it tends to close any breaks between moving and shore-fast ice. If a flaw between moving and shore-fast ice is offshore from the loader, the loader does not affect ice movement or lead formation. If a flaw between moving and shore-fast ice is shoreward of the loader, the sheet-piles around the loader tend to create one or more additional flaws that mimic natural flaws.

3.4.6.4 Sea Bottom Composition

The sediments of the embayed southeastern Chukchi Sea consist primarily of silt, sand, and gravel in decreasing order of abundance. Clay-sized particles are generally absent because the combination of weathering processes and parent materials common to the region produce primarily silty soils.

The sea bottom near Portsite is gently sloping with large areas of sand/silt interspersed with sand areas and sand/fine gravel areas. Generally, the gravel areas are concentrated near shore in water depths less than 35 feet. The following paragraphs discuss the sources of sea bottom material, material size and distribution, chemistry, longshore transport, and the influences the existing DMT barge loading facilities have on sediments in the in the area.

Material Sources. The primary source of silt deposited on the Chukchi Sea floor near Portsite is from the Yukon and other large rivers that are transported through the Bering Strait on northward flowing currents of the coastal water mass. Most of this sediment settles out before reaching the Portsite area, but is resuspended by Pacific walrus and gray whales near Bering Strait (Nelson 1996), only to settle out again farther north in the Chukchi Sea. The much smaller rivers in the general vicinity of Portsite contribute some silt to the coastal water mass, but it is relatively insignificant compared with the Yukon River. Most of the sediment eroded from the remainder of the adjacent landmass is effectively trapped on the low, rolling, and poorly drained coastal plain adjacent to the southeastern Chukchi Sea.

Occurrences of gravel are associated with headland source areas to the north. The current moving northward through the Bering Strait transports the majority of the finer material that comprises the upper sea bottom strata. The fine-grained sediment is distributed throughout the central and eastern portion of the embayment by re-suspension and transport by the predominant currents. The speed of the current is greatest in the strait and diminishes to the north. The mean diameter of the sediment decreases, and sorting improves in a down-current direction (Creager and McManus, 1966). The primary source of sediments in the Bering Sea is reported by Brabets (2000) to be the Yukon River, which introduces an estimated 60 million tons of suspended sediment annually into the Bering Sea. Much of the larger diameter sediment is deposited quickly. The finer sediments are carried northward by the current and deposited across the floor of the Chukchi Sea (Naidu and Mowatt 1983). According to Burch (1990), walrus and gray whales repeatedly re-suspend that sediment from the Yukon River as they feed. The fine sediment is carried farther north each time it is suspended, and eventually through the Bering Strait and into the Chukchi Sea where it is distributed over a wide area. Burch estimated that gray whales alone re-suspended nearly three times the annual contribution of the Yukon River to the Bering Sea.

Bottom Material Size and Distribution. Surface and subsurface sediment samples have been collected and analyzed for grain size distribution for a variety of construction and planning purposes since the DMT facilities were being considered in the early 1980s. The most relevant and useful data is presented and discussed below. Additional information can be found in the Geotechnical Appendix to the Feasibility Report.

S<u>urface Samples.</u> Surface sediment samples were collected at 15 discrete locations along the potential shipping channel alignment and at six discrete locations in the potential marine dredged material disposal area about 5 miles west of Portsite (PN&D 1999). Sample locations are shown in figure 3-20.

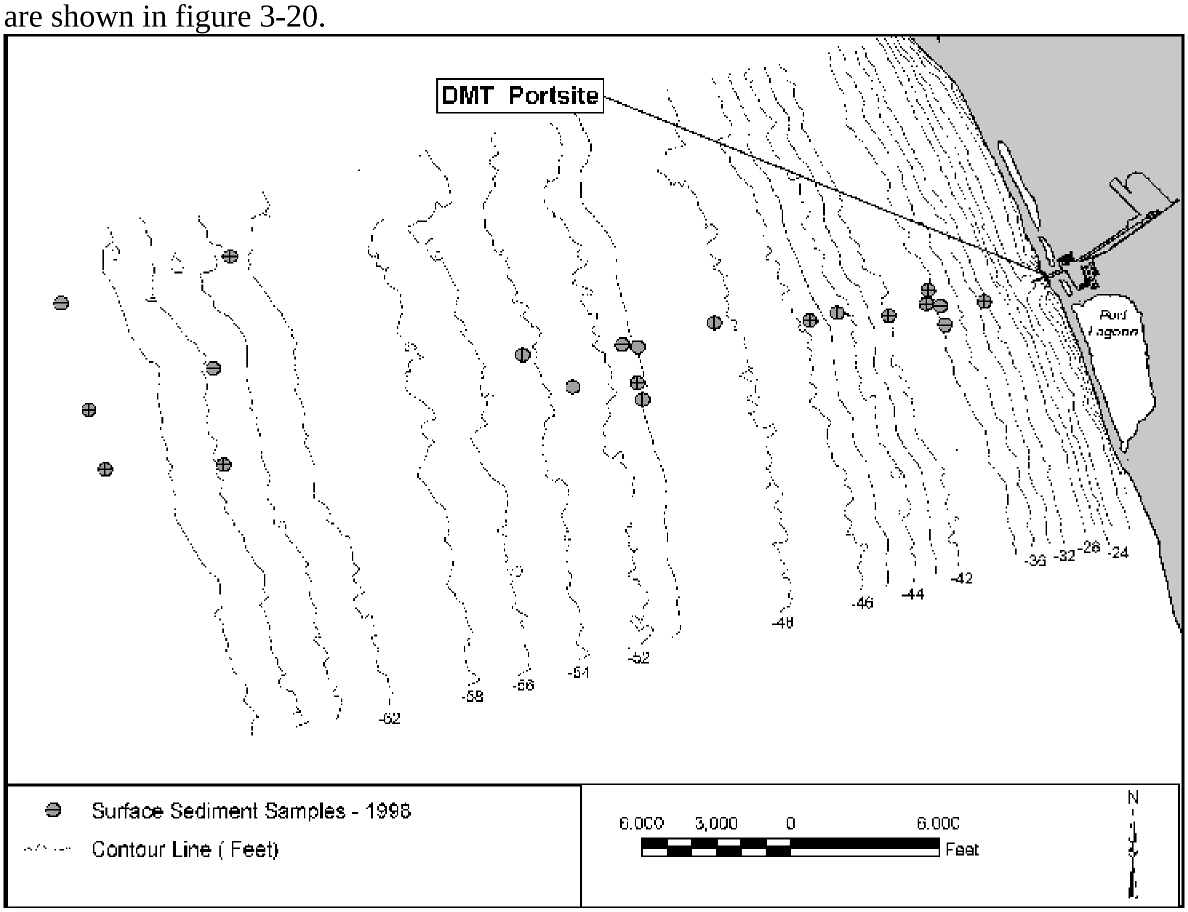


Figure 3-20. Surface sediment samples collected at Portsite by Peratrovich, Nottingham and Drage, Inc. (PN&D) in 1998.

Analysis of the relative percentages of different grain sizes in the samples indicates that progressing offshore in the area of the proposed shipping channel there is a predominance of sandy and gravelly sediments at water depths between 20 and 30 feet. Between 30 feet and 34 feet of water, the samples contained increasing amounts of silts (diameter of 0.2 to 0.06 mm) and fines (diameter less than 0.06 mm). At water depths beyond 34 feet the sediments contained a generally uniform mixture of sand and silt/fines. Analytical results, interpretations, and additional analysis of the physical characteristics of the sediment are provided in the Geotechnical Appendix of the Feasibility Report.

In 2000, the U.S. Army Corps of Engineers collected surface sediment samples at 23 discrete locations in the same general area as the PND 1998 samples (USACE 2001b). Nine of those locations were in or near the proposed shipping channel and turning basin alignment, ten were in the potential marine disposal area, and four were adjacent to the existing barge loading facility. Locations of the surface sediment samples are shown in figure 3-21. A summary of the sediment's physical composition is presented in table 3-23.

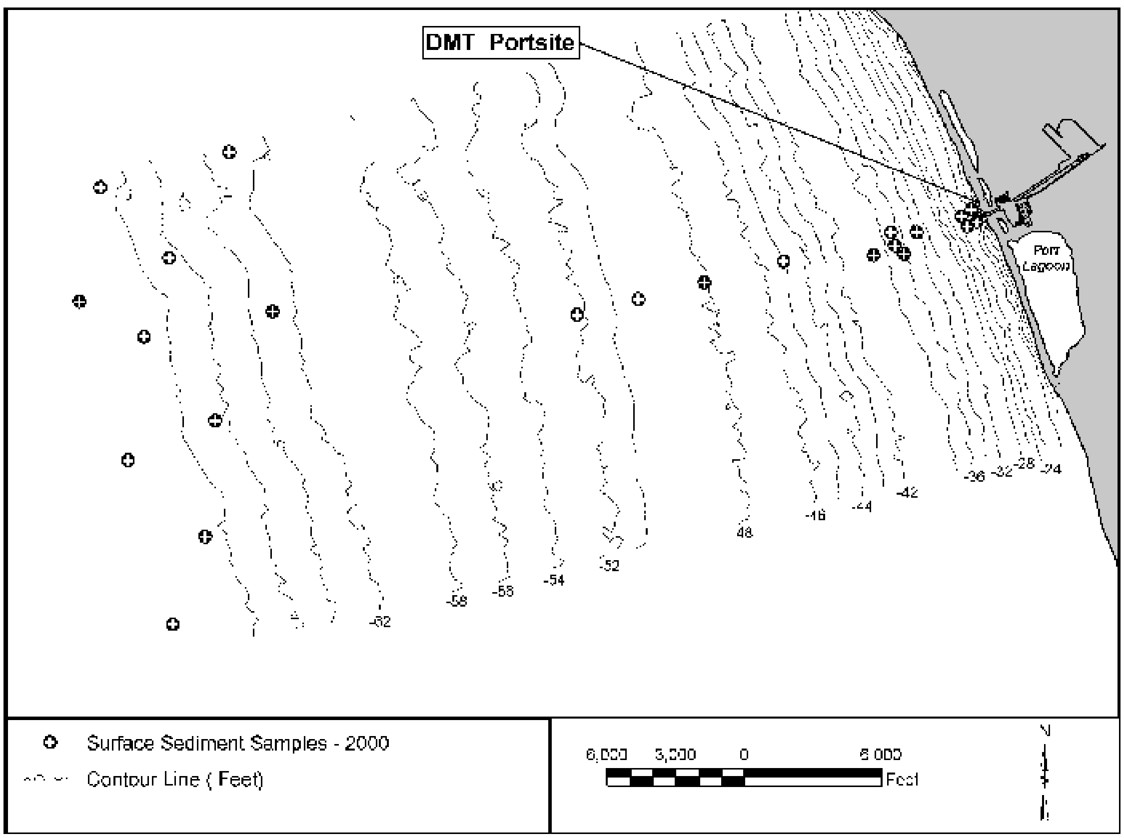


Figure 3-21. Surface sediment samples collected at Portsite by the U.S. Army Corps of Engineers (USACE) Alaska District in 2000.

Table 3-23. Grain size analysis summary.

Sample Location	Percent Silt and fines by Weight	Percent Sand and Gravel by Weight
Marine Disposal Area	43	57
Marine Disposal Area	44	56
Marine Disposal Area	51	49
Marine Disposal Area	53	46
Marine Disposal Area	55	44
Marine Disposal Area	50	46
Marine Disposal Area	49	42
Marine Disposal Area	48	51
Marine Disposal Area	51	49
Marine Disposal Area	53	47
Proposed Channel	48	51
Proposed Channel	48	52
Proposed Channel	41	53
Proposed Channel	43	57
Turning Basin	39	60
Turning Basin	47	53
Turning Basin	43	37
Turning Basin	39	60
Turning Basin	81	19
Loading Cell	31	69
Loading Cell	5	42
Loading Cell	1	49
Loading Cell	1	53

Analysis of the surface sediment sample results from 2000 indicates that the near-shore surface sediment samples (at the barge loader in water depths of approximately 22 feet) contained well-graded sand-and-gravel mixtures with very little silt/fines, while the potential turning basin alignment (water depths of 20 to 24 feet) contained variable mixtures of sand and silt. The potential marine disposal area (water depths ranging from 65 to 70 feet) also generally contained a more uniform mixture of sand and silt.

One surface sediment sample was collected along the beach at Portsite during the 2000 Corps survey. The sample was classified as poorly graded gravel, with 82 percent sand and gravel by weight. Observations of sediment along the beach suggest that the median sediment grain diameter ranges between 0.5 and 20 mm. Generally, the distribution of beach sediments was observed to be variable along the shore with some areas of shoreline composed of gravel that are interspersed between areas composed primarily of coarse sand.

Subsurface Samples. Subsurface samples were collected during the 1998 PN&D (figure 3-22) investigation and in 2000 when divers collected subsurface sediment samples to about 1 foot deep at six locations (figure 3-23).

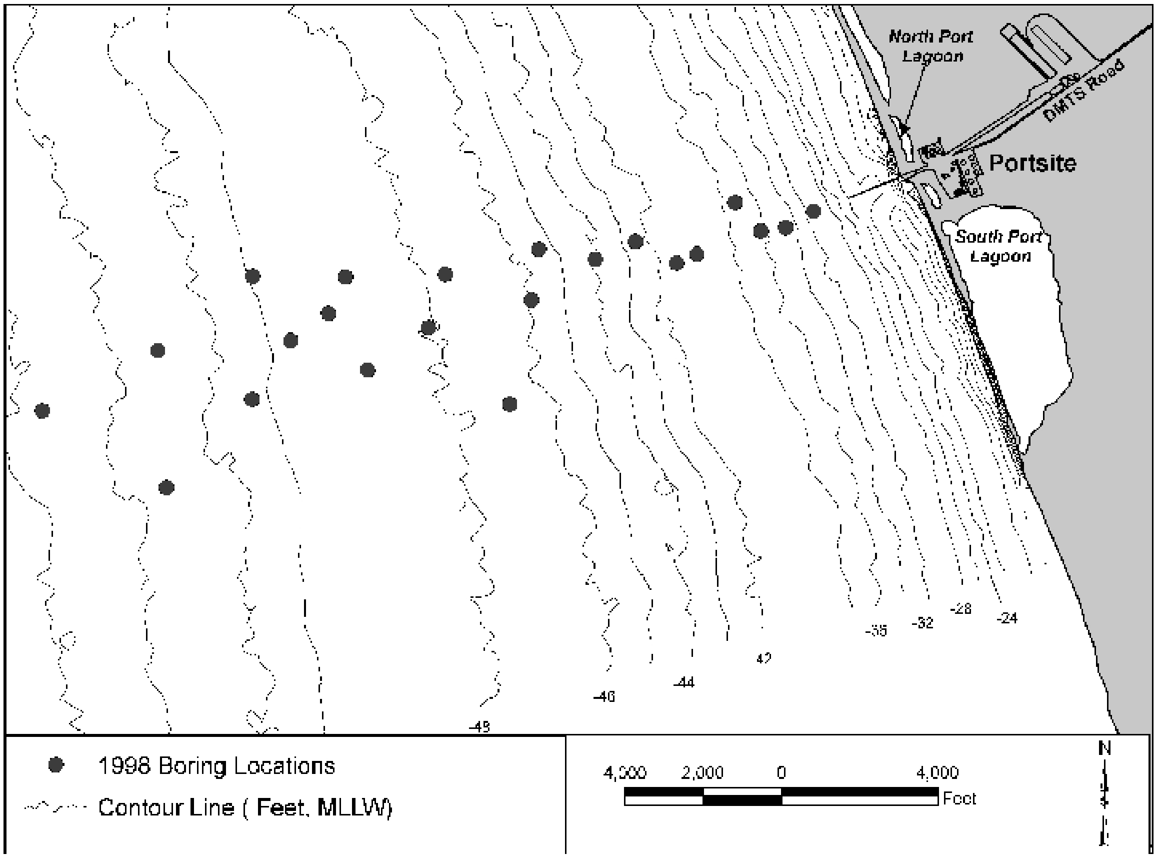


Figure 3-22. Subsurface samples collected from borings in 2000.

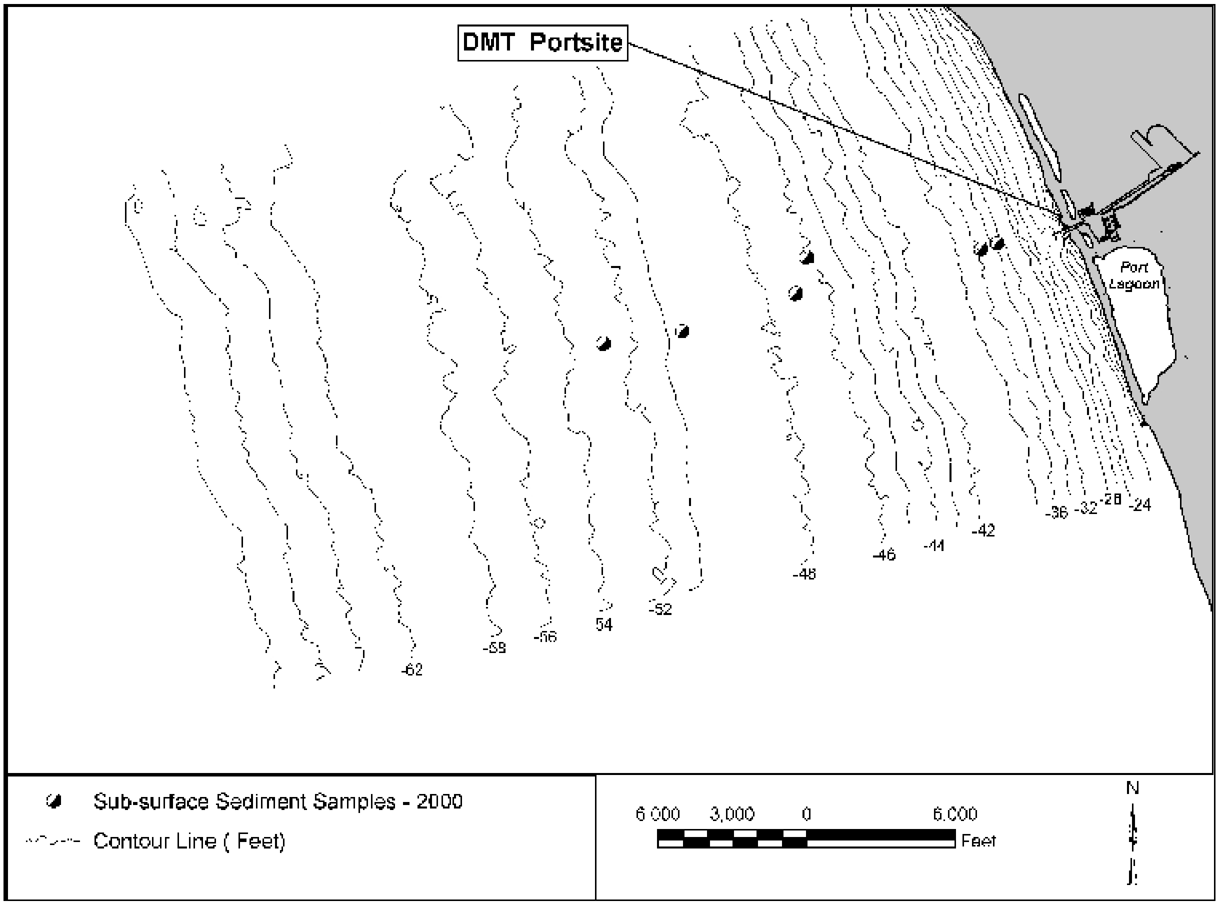


Figure 3-23. Subsurface sediment samples collected by divers at Portsite in 2000.

Results associated with the subsurface samples show that the upper layer of bottom material generally consists of fine-grained material that varies from a firm to very hard consistency and sandy material that is typically of medium density. Occasionally, organic soil layers and lenses of peat were encountered. It was also noted that sand/gravel materials, normally encountered in deeper samples, were exposed the surface of the sea bottom at some locations. Geological evidence suggests that the sand/gravel materials might be alluvial deposits or remnant gravel beaches. Overall, the relative compositions of gravel, sand, and fines that would be dredged for the channel and turning basin is estimated to be about 6 percent, 25 percent, and 69 percent, respectively.

The subsurface sample results support the results of a 1998 side-scan sonar survey of the area (NW GEO Sciences 1999), which indicat that the subsurface profile consists of a layer of sand/silt/gravel/clay materials from 10 to 25 feet thick overlying a denser layer of sand/gravel (from 10 to 100 feet or more thick) with a basement material of sandstone bedrock. The earlier sonar survey and more recent core sample data also showed that the bedrock surface in the Portsite area varies from north to south and east to west. Bedrock was found at about 39 feet below the seabed near the shore, and about 90 feet below the seabed in about 40 to 45 feet of water depth. Beyond this water depth, bedrock was not detected with the equipment used.

Bottom Material Chemistry. The sediment samples collected in 1998 (PN&D 1999) and in 2000 (USACE 2001) were also analyzed for general sediment chemistry and contaminants of concern. The results of the analytical testing associated with each of these surveys are briefly summarized below. Copies of the complete reports are available from the Alaska District.

PN&D 1998 Survey. Sediment samples were collected at 23 locations in or near the proposed shipping channel and at six locations in the proposed marine dredged material disposal area. Surface and subsurface samples were tested for total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc), volatile and semi-volatile organic compounds, pesticides, polychlorinated biphenyls (PCB’s), and total organic carbon. Analysis of the samples was performed using USEPA (1989) recommended methods and the analytical laboratories’ quality assurance programs. In the absence of more appropriate or applicable federal or state standards for the screening of sediment for ocean disposal, the analytical results were compared with screening criteria from the State of Washington Department of Ecology’s Marine Sediment Quality Standards (MSQS), and the Puget Sound Dredged Disposal Analysis (PSDDA) guidance documents. The screening levels used represent concentrations that that will result in no adverse acute or chronic effects on biological resources. A summary of the analytical results associated with the PN&D 1998 Survey are presented below. A thorough analysis is provided in *Delong Mountain Terminal Project Soil/Sediment Analytical Testing Data Report (PN&D 1999)* and the *Delong Mountain Terminal Feasibility Study Dredged Material Evaluation (EVS 1999).*

No volatile organic compounds, semi-volatile organic compounds, pesticides, or polychlorinated biphenyls (PCB’s) were reported in any of the samples at concentrations approaching an associated sediment screening level. Table 3-24 presents the data for metals reported in samples from the disposal site, proposed channel and background samples along with the associated screening criteria.

Table 3-24. Metals reported (mg/Kg) in sediment samples collected in 1998.

Metal	Disposal Site	Back-ground	Proposed Channel	PSDDA Standard	Washington MSQS
Arsenic	5.5-7.4	6.6-10.1	4.9-11.0	57	57
Barium	115-170	101-215	79.5-868	---	---
Cadmium	<0.4-0.05	0.04-0.09	0.05-0.59	5.1	5.1
Chromium	10.8-15.9	10.6-15.2	2.4-24.9	---	260
Copper	5.7-8.5	5.2-8.2	3.7-35.9	390	390
Lead	4.55-6.20	4.81-6.26	3.5-16.8	450	450
Mercury	<0.02-<0.15	<0.02-0.02	<0.02-<0.14	0.41	0.41
Selenium	<1-<8	<1	<1-8	---	---
Silver	<0.8-0.03	<0.05	<0.78-0.04	6.1	6.1
Zinc	32.5-49.0	38.8-50.4	14.6-83.4	410	410

Note: When a number is preceded by “<”, the number is the Method Reporting Limit, and the metal was not detected at this limit

It is notable that two subsurface sediment samples collected in the shallow portion of the potential shipping channel (1 to 13 feet deep into the bottom material) contained the highest concentrations of arsenic, barium, mercury and selenium, and a third subsurface sample contained the highest concentration observed for copper. These samples were collected well outside the present loading area and in material that has been in place for much longer than the existing loading operation has been in operation. Natural process apparently deposited material containing naturally elevated concentrations of metals when the seabed material was laid down.

Corps of Engineers 2000 Survey. The 23 surface samples collected during the survey of the existing barge loading area, proposed shipping channel, and tentatively recommended marine disposal area in 2000 were analyzed for volatile organic compounds (VOC's), polynuclear aromatic hydrocarbons (PAH's), PCB's, pesticides, gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, magnesium, mercury, nickel, selenium, silver, vanadium, zinc), cyanide, and total organic carbon (TOC). The analytical results were compared with screening criteria from the State of Washington, Department of Ecology's MSQS, and PSDDA guidance documents to evaluate ocean disposal options. The results of the chemical analyses are summarized below. A thorough analysis is provided in the *Delong Mountain Terminal Project Pre-Dredge Sediment Characterization Report (USACE 2001b).*

Of the 63 VOC analytes, only methylene chloride was detected. Laboratory contamination is suspected because methylene chloride is a common laboratory contaminant, it is not a likely contaminant at this site, and it was only found in the quality control sample. Only two PAH's were detected. Chrysene and pyrene were reported in one sample collected near the proposed turnaround basin at 0.0092 and 0.0073 mg/Kg, respectively. The PSDDA screening criteria for chrysene and pyrene are 1.4 and 1.5 mg/Kg, respectively, and the TOC-normalized MSQS are 71 and 650 mg/Kg, respectively. No PCB's or pesticides were detected in any samples. GRO was detected in one sample near the proposed channel alignment, and DRO was detected in one sample in the potential marine dredged material disposal area. Both concentrations are well below levels of concern. RRO was detected in most of the samples but at concentrations well below levels of concern.

Eight metals (arsenic, antimony, barium, beryllium, cadmium, chromium, copper, lead, vanadium, and zinc) were detected in all sediment samples, and mercury was detected in 13 samples. Metals data and associated screening criteria are summarized in table 3-25.

Table 3-25. Metals reported (mg/Kg) in sediment samples collected in 2000.

Metal	Disposal Site	Proposed Channel	Loading Cell	PSDDA Standard	Washington MSQS
As	3.5-10.0	6.6-10.0	5.5-9.8	57	57
Ba	150-270	220-390	140-390	---	---
Cd	<1-2.4	1.9-2.5	<1-2.3	5.1	5.1
Cr	20-28	18-28	7.2-12	---	260
Cu	5.9-11.0	5.6-7.8	4.3-12	390	390
Pb	4.7-7.6	5.3-15	8.8-32	450	450
Hg	<0.04-0.05	<0.04-0.1	<0.2	0.41	0.41
Se	<14	<14	<10	---	---
Ag	<2.9	<2.8	<2.1	6.1	6.1
Zn	41-78	48-64	29-240	410	410

Note: When a number is preceded by "<", the number is the Method Reporting Limit, and the metal was not detected at this limit.

All reported metal concentrations were well below PSDDA and MSQS screening criteria. However, it is notable that the concentrations of arsenic, cadmium, lead, mercury, silver, and zinc show a trend of increased concentrations in surface sediment near the loading cell. This trend could be interpreted as an indication that operations at the existing loading facilities may be measurably impacting the metals concentrations of the sediment near the existing facilities. However, naturally high background concentrations and the fact that some of the highest metal concentrations were found in subsurface samples prevent any definitive conclusions about the impact of existing operational activities on the sediment proposed to be dredged.

In 2004, surface sediment samples were collected from 26 locations near existing loading operations in June (prior to loading operations) and September (during loading operations). Sample locations are shown in figure 3-24. The samples were collected to attempt to determine if gradients in metal concentrations exist in surface sediments near the DMT or if a temporal relationship with the seasonal variability of loading operations could be identified.

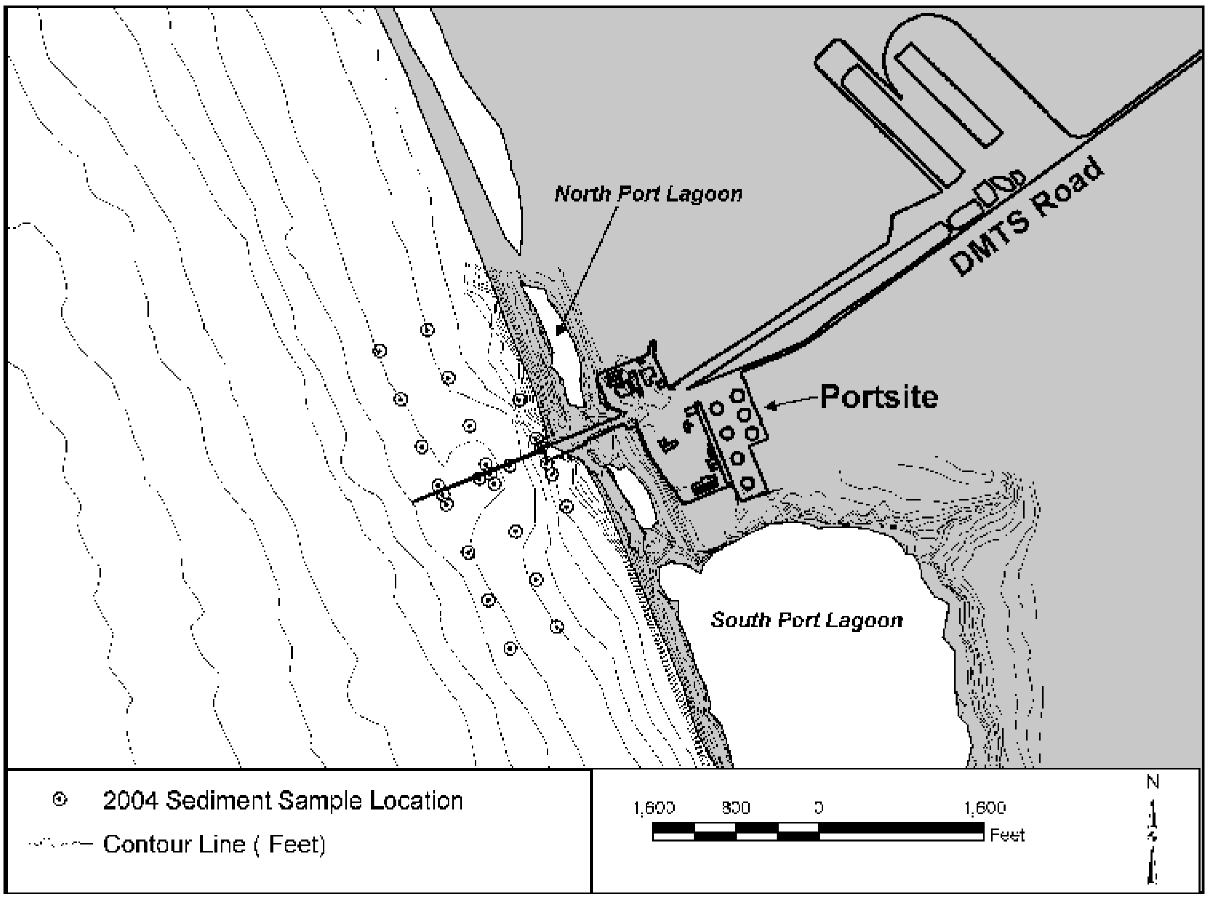


Figure 3-24. Surface sediment samples collected at Portsite in 2004 (TCAK 2005).

All the 2004 results were below PSDDA and MSQS screening criteria but also show a general increase in ore concentrate-related metal concentrations near the barge loader. Although some metal concentrations indicated variations that could be related to loading operations, no clear and consistent relationships could be identified.

Based on test results generated between 1998 and 2004, and the comparison of the chemical and physical nature of the proposed dredged material with the material at the proposed disposal site, the material that would be dredged is not significantly contaminated or substantially different from the sediment at nearby coastal or offshore locations and is suitable for marine disposal.

3.4.6.5 Marine Water Quality

Alaska Water Quality Standards (AWQS, 18 AAC 70), regulate human activities that could result in alterations to waters within the state's jurisdiction, including marine waters to 3 miles offshore. The quality of water offshore of Portsite is subject to State of Alaska standards for marine waters. In 2003 and 2004, water quality samples were collected near Portsite and at reference sites not impacted by Portsite activities. The samples were tested for 22 metals to determine if fugitive dusts from ore concentrate loading operations were impacting water quality (TCAK 2005). Arsenic concentrations in several samples exceeded AWQS. However, similar concentrations were also reported in the reference samples. No other metal concentrations exceeded AWQS and the fugitive dust from loading operations does not appear to be significantly impacting metals concentrations in marine waters near Portsite.

The primary water quality parameter that would be impacted by navigation improvements is turbidity. Construction and maintenance of the channel and turning basin would be expected to temporarily increase turbidity in the vicinity of the work. Existing turbidity in the water near Portsite is caused by the presence of suspended sediment, organic matter, plankton, and other microscopic organisms. It is primarily the result of natural processes and is generally seasonal in nature.

In the marine waters off Portsite, the annual turbidity cycle begins in early winter when newly ice-covered waters begin to clear as wave action and light penetration are gradually reduced. Relatively clear water prevails during winter, with occasional increases from near-shore ice gouging and feeding by bearded seals. By late April, as more light penetrates the ice, the water becomes increasingly turbid from massive blooms of diatoms and other microscopic single cell algae that mostly cling to the undersurface of the ice where light penetration is greatest. These large algal blooms attract equally large numbers of zooplankton such as microscopic copepods, as well as larger shrimp-like euphausiids or krill.

The turbidity levels at Portsite increase during spring breakup when turbid coastal streams swollen with melting snow fill the coastal lagoons in the area, break through their beach berms, and run into the southeastern Chukchi Sea. After the melting marine ice leaves the Portsite area in early summer, the shallow areas and beaches are subjected to wave action, further increasing the turbidity in coastal waters.

The marine water near Portsite is generally more turbid during the open water season and the turbidity levels tend to fluctuate with the frequency and intensity of storms that stir the coastal waters. The generally higher turbidity conditions near Portsite prevail through the summer months until fresh and marine waters begin to freeze, locking freshwater runoff in ice and calming the marine waters.

The Corps of Engineers measured turbidity and other water quality parameters (pH, temperature, TDS/salinity, specific conductance, and oxidation/reduction potential), on September 11 and 12, 2001. Additionally, 13 water samples were submitted to a laboratory for total suspended solids

(TSS) analysis. The parameters were measured in-place (in-situ) at 15 locations in the proposed dredged material disposal area and at eight offshore locations near the potential shipping channel alignment (figure 3-25). The water quality parameters were measured at the surface and subsequent 10-foot depth increments in the proposed disposal area, and at the surface and subsequent 5-foot depth increments near the potential shipping channel alignment.

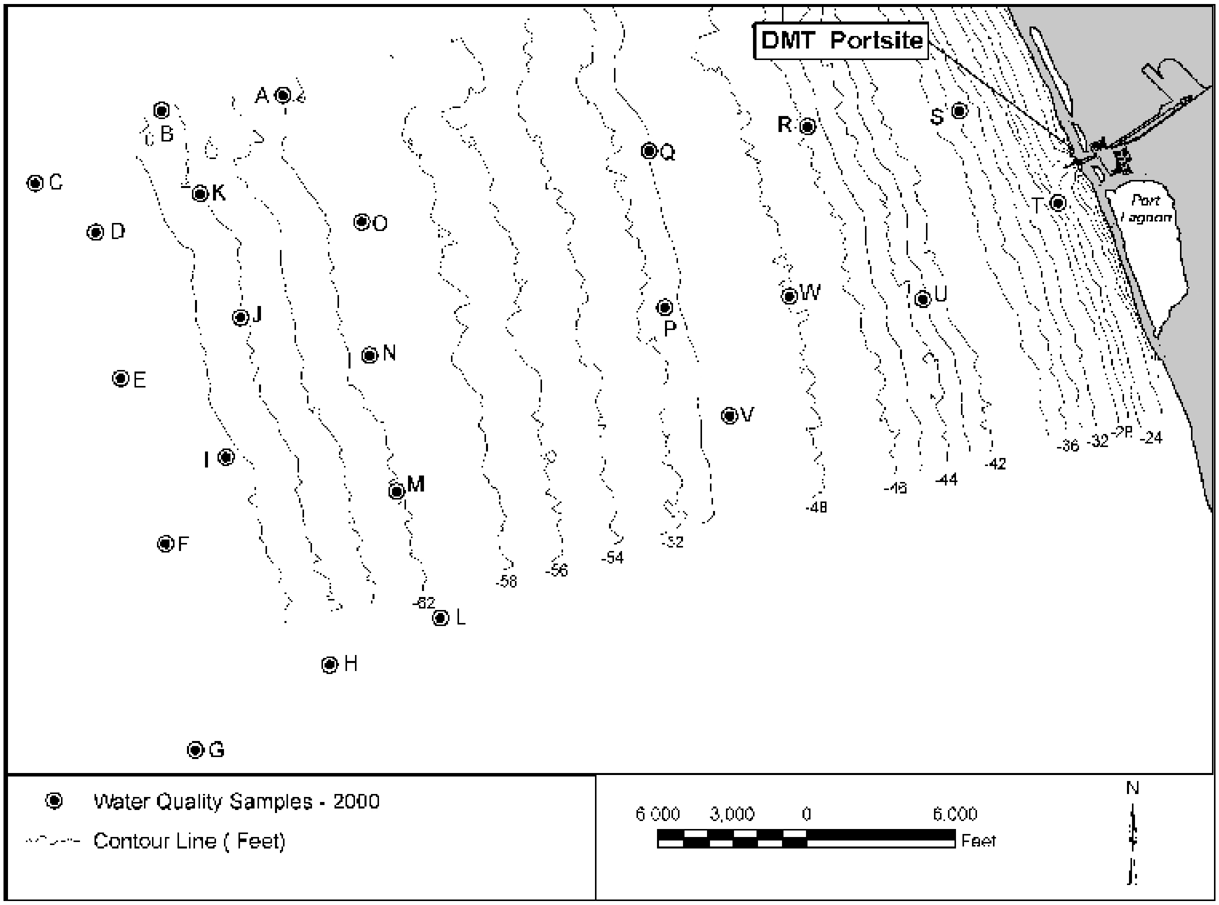


Figure 3-25. Water quality sample locations, September 2001.

A summary of the maximum, minimum, and average values for the in-situ water quality data collected at each station near the potential dredged material disposal site and shipping channel areas are presented in tables 3-26a and 3-26b, respectively.

Table 3-26a. Summary of in-situ water quality measurements at Portsite in 2001.

Station	Value	Turbidity (NTU)	TDS[1] (g/L)	Temp (C)	SpCond[2] (mS/cm)	PH	ORP[3] (mV)	Salinity (ppt)
A	**Max**	6.8	31.4	9.2	48.3	7.9	227	31.2
	Avg	*5.1*	*25.7*	*8.7*	*46.8*	*7.8*	*217*	*30.2*
	Min	3.4	28.6	8.5	44.0	7.5	209	28.2
B	**Max**	5.9	31.6	9.2	48.7	8.0	215	31.5
	Avg	*3.4*	*31.1*	*8.5*	*47.8*	*8.0*	*212*	*30.9*
	Min	2.0	29.0	8.3	44.6	8.0	209	28.6
C	**Max**	2.0	31.8	8.4	48.9	8.1	224	31.6
	Avg	*1.2*	*31.8*	*8.3*	*48.9*	*8.1*	*218*	*31.6*
	Min	0.7	31.7	8.2	48.7	8.1	213	31.6
D	**Max**	10.4	31.8	8.4	49.0	8.1	195	31.7
	Avg	*4.5*	*31.8*	*8.3*	*49.0*	*8.1*	*191*	*31.6*
	Min	1.8	31.8	8.2	49.0	8.1	188	31.6
E	**Max**	3.3	31.9	8.2	49.0	8.1	184	31.7
	Avg	*1.4*	*31.8*	*8.2*	*49.0*	*8.1*	*181*	*31.7*
	Min	1.0	31.8	8.2	49.0	8.1	179	31.6
F	**Max**	1.4	31.9	8.2	49.1	8.1	173	31.8
	Avg	*0.8*	*31.9*	*8.2*	*49.1*	*8.1*	*170*	*31.7*
	Min	0.4	31.9	8.2	49.0	8.1	168	31.7
G	**Max**	1.5	31.9	8.2	49.1	8.1	163	31.8
	Avg	*1.1*	*31.9*	*8.2*	*49.1*	*8.1*	*161*	*31.8*
	Min	0.4	31.9	8.2	49.0	8.1	159	31.7
H	**Max**	3.7	31.9	8.4	49.0	8.1	165	31.8
	Avg	*1.9*	*31.9*	*8.3*	*49.0*	*8.1*	*163*	*31.7*
	Min	1.3	31.8	8.3	49.0	8.1	162	31.6
I	**Max**	1.4	31.9	8.3	49.1	8.1	169	31.8
	Avg	*1.0*	*31.9*	*8.2*	*49.1*	*8.1*	*167*	*31.7*
	Min	0.8	31.9	8.2	49.0	8.1	164	31.7
J	**Max**	12.6	31.9	8.5	49.0	8.1	179	31.7
	Avg	*3.2*	*31.8*	*8.3*	*48.9*	*8.1*	*177*	*31.6*
	Min	1.4	31.7	8.3	48.7	8.1	174	31.5
K	**Max**	2.5	31.8	8.5	48.9	8.1	162	31.6
	Avg	*2.0*	*31.7*	*8.4*	*48.7*	*8.1*	*160*	*31.5*
	Min	1.7	31.4	8.3	48.4	8.1	159	31.2
L	**Max**	1.8	31.9	8.2	49.1	8.0	205	31.8
	Avg	*1.4*	*31.9*	*8.2*	*49.0*	*7.9*	*198*	*31.7*
	Min	0.7	31.8	8.2	48.9	7.8	194	31.6
M	**Max**	3.1	31.9	8.4	49.1	8.1	192	31.8
	Avg	*1.8*	*31.8*	*8.3*	*48.9*	*8.1*	*189*	*31.6*
	Min	1.2	31.3	8.2	48.1	8.1	187	31.0
N	**Max**	3.5	31.8	8.5	49.0	8.1	172	31.7
	Avg	*3.3*	*31.4*	*8.4*	*48.4*	*8.1*	*169*	*31.3*
	Min	3.0	30.9	8.3	47.5	8.1	167	30.7
O	**Max**	5.0	31.8	8.8	49.0	8.1	162	31.6
	Avg	*4.1*	*31.1*	*8.5*	*47.8*	*8.1*	*161*	*30.1*
	Min	3.0	30.0	8.3	46.1	8.1	159	29.7
OVERALL	**Max**	**12.6**	**31.9**	**9.2**	**49.1**	**8.1**	**227**	**31.8**
	Avg	***2.4***	***31.3***	***8.3***	***48.6***	***8.1***	***183***	***31.4***
	Min	**0.4**	**28.6**	**8.2**	**44.0**	**7.5**	**159**	**28.2**

[1] Total dissolved solids. [2] Specific conductivity. [3] Oxidation/reduction potential.

Table 3-26b. Summary of in-situ water quality data near *Proposed Shipping Channel* at Portsite in September 2001 (See figure 3-22 for Locations)

Station	Value	Turbidity (NTU)	TDS[1] (g/L)	Temp (C)	SpCond[2] (mS/cm)	PH	ORP[3] (mV)	Salinity (ppt)
P	**Max**	14.9	31.3	9.7	48.2	8.1	173	31.1
	Avg	*7.7*	*29.0*	*9.0*	*44.6*	*8.1*	*171*	*28.6*
	Min	3.4	25.6	8.4	39.4	8.1	169	25.0
Q	**Max**	14.5	30.6	9.8	47.1	8.1	161	30.4
	Avg	*8.9*	*28.4*	*9.2*	*43.7*	*8.1*	*160*	*28.0*
	Min	5.4	25.8	8.6	39.6	8.0	158	25.1
R	**Max**	11.9	29.8	9.8	45.8	8.1	154	29.5
	Avg	*9.9*	*27.2*	*9.5*	*41.8*	*8.1*	*153*	*26.7*
	Min	7.8	25.7	8.9	39.5	8.1	152	25.1
S	**Max**	19.2	28.1	9.7	43.2	8.1	153	27.6
	Avg	*16.9*	*26.2*	*9.6*	*40.2*	*8.1*	*152*	*25.6*
	Min	14.8	25.2	9.4	38.8	8.0	151	24.6
T	**Max**	19.8	26.0	9.7	40.0	8.1	161	25.4
	Avg	*16.3*	*25.7*	*9.6*	*39.5*	*8.1*	*160*	*25.1*
	Min	13.5	25.3	9.5	38.8	8.1	158	24.6
U	**Max**	11.7	29.6	9.8	45.5	8.1	153	29.2
	Avg	*9.7*	*27.3*	*9.4*	*42.0*	*8.1*	*152*	*26.8*
	Min	6.8	25.6	8.9	39.5	8.1	151	25.1
V	**Max**	13.3	31.4	9.7	48.3	8.1	148	31.2
	Avg	*7.2*	*29.1*	*9.0*	*44.8*	*8.1*	*147*	*28.8*
	Min	3.4	25.2	8.4	38.7	8.1	146	24.5
W	**Max**	12.3	30.8	9.9	47.3	8.2	153	30.5
	Avg	*8.7*	*28.2*	*9.3*	*43.5*	*8.1*	*152*	*27.8*
	Min	4.6	25.4	8.6	39.0	8.1	151	24.7
OVERALL	**Max**	**19.8**	**31.4**	**9.9**	**48.3**	**8.2**	**173**	**31.2**
	Avg	***10.7***	***27.6***	***9.3***	***42.5***	***8.1***	***156***	***27.2***
	Min	**3.4**	**25.2**	**8.4**	**39.0**	**8.1**	**146**	**24.6**

[1] Total dissolved solids. [2] Specific conductivity. [3] Oxidation/reduction potential.

Average turbidity in the disposal area ranged from 1.0 to 5.1 NTU while the average turbidity in the shipping channel ranged from 7.2-16.9 NTU. Average turbidity decreased with depth and distance from shore. The pH of water samples within the disposal area ranged from 7.8 to 8.1 and averaged 8.1, while water samples in the channel were more consistent with a steady pH averaging 8.1. The average water temperature measured at Portsite ranges from near zero most of the winter to as high as 8.3 degrees C offshore in the tentatively recommended disposal area to 9.3 degrees C inshore in the channel area at the time of measurement in September.

As shown in the tables, turbidity levels near the tentatively recommended shipping channel were on average four times higher than in the tentatively recommended disposal area. Conversely, the measurements of oxidation-reduction potential (ORP), TDS, specific conductance, and salinity were somewhat higher in the tentatively recommended disposal area than in the tentatively recommended shipping channel.

Seawater worldwide normally has an average salinity of about 35 ppt. The waters at the tentatively recommended disposal area are probably typical for the more pelagic areas of the southeastern Chukchi Sea, with an overall average of 31.4 ppt salinity. Waters nearer shore were fresher, with an overall average salinity of 27.2 ppt. The results of the laboratory TSS analyses of the water samples are presented in table 3-27.

Table 3-27. Results of total suspended solids in water samples collected 2001.

Station	Location	Depth (ft)	**TSS (mg/L)**
A	Disposal Area	60	13.4
C	Disposal Area	70	5.8
E	Disposal Area	70	10.0
G	Disposal Area	70	7.0
I	Disposal Area	60	5.8
K	Disposal Area	65	9.8
L	Disposal Area	58	8.8
N	Disposal Area	55	10.0
N	Disposal Area	55	12.2
Maximum **Average** **Minimum**	Disposal Area		**13.4** ***9.2*** **5.8**
P	Shipping Channel	20	12.6
P	Shipping Channel	45	8.8
R	Shipping Channel	42	74.8*
T	Shipping Channel	15	11.0
T	Shipping Channel	15	10.8
V	Shipping Channel	45	9.4
W	Shipping Channel	45	10.4
Maximum **Average** **Minimum**	Shipping Channel		**12.6** **10.5** **8.8**
OVERALL **Maximum** **Average** **Minimum**	Portsite		**13.4** **9.8** **5.8**

*This reading is likely an anomaly, and is not included in selection of maximum or calculation of average.

As shown in the table, TSS levels ranged from 5.8 to 13.4 mg/L, and averaged 9.2 mg/L in the tentatively recommended disposal area, compared with a range of 8.8 to 74.8 mg/L and an average of 19.7 mg/L near the tentatively recommended shipping channel. The 74.8 mg/L reading at station R is likely an anomaly. If it is ignored, the range of TSS levels and the average TSS in both areas are comparable.

3.4.7 Freshwater Resources

Freshwater resources are the fresh waters on and under the land. They include groundwater, lakes, rivers, and other water bodies.

3.4.7.1 Groundwater

Most of the groundwater in the Portsite area is incorporated as permafrost and is not available for human use. A thaw bulb of unfrozen ground typically extends a short distance inland from the shores of the Chukchi Sea and probably is beneath the coastal Portsite facilities. No ground water is extracted from the thaw bulb, and extraction of potable water would not be feasible.

3.4.7.2 Surface Water

Surface freshwater in the Portsite area is present in the form of tundra ponds (thaw lakes), freshwater lagoons, streams, and snow. Several small, perched, un-named tundra ponds and shallow lagoons are on the north and south sides of Portsite. Two larger lagoons are in the general area: Ipiavik Lagoon, about 2 miles north of the Portsite, and the Imik Lagoon about 6 miles to the south. All the lagoons in the Portsite area are separated from the sea by gravel beach barrier berms that are sometimes vegetated. All are normally closed to the sea unless the barrier berm is overtopped during infrequent summer storm surges.

The nearest drainages are the Omikviorok River and New Heart Creek flowing into and from Ipiavik Lagoon. Agarak Creek drains into the Chukchi Sea about 4 miles south, as does the Rabbit Creek about 5 miles farther south. The Wulik River, the largest river in the Portsite vicinity, drains a 903-square-mile area and enters Kivalina Lagoon and the Chukchi Sea about 15 miles northwest of Portsite.

3.4.7.3 Floodplains and Flood Hazard Areas

The 100-year floodplain and flood hazard areas have not been delineated in the Portsite area. The DMT facilities are not within the floodplain of any substantial drainage and the risk of flood damage from upland sources is extremely low. Approximate distances from drainages that could overflow their banks during major flood events and the Portsite are:

Drainage	Direction from DMT	Distance from DMT
New Heart Creek	North	2
Omikviorok River	North	5
Imikruk Creek	North	10
Wulik River	North	15
Umagatsiak	South	3
Agarak Creek	South	4
Rabbit Creek	South	9

The DMT facilities are more likely to be affected by a 100-year storm surge from the Chukchi Sea. Typical annual surge amplitudes at Kivalina are reported as 3-foot wind driven and 0.5-foot tidal (Triton Consultants Ltd. 1999), while recent estimates put the 100-year surge event at 12 feet excluding waves (S. Hunt personal communication). The main Portsite facilities and fuel tanks are around 18 to 20 feet elevation, but the dock and lower portions of gravel pads that support DMT facilities at Portsite would be flooded during a 12-foot storm surge.

3.4.7.4 Wetlands

Wetlands of the United States are identified and classified using Corps of Engineers and U.S Fish and Wildlife Service definitions and guidelines based on vegetation, soils, and hydrology data. These guidelines are somewhat more complex in arctic environments with the inclusion of permafrost.

Except for the beaches, berms, and the alpine highlands in the Portsite area that are well drained, the tundra areas surrounding the Portsite are considered wetlands. These areas are characterized by poor drainage, areas of standing water, and saturated soils that support a variety of water plants. The wetland areas in the Portsite area are shown in figure 3-26.

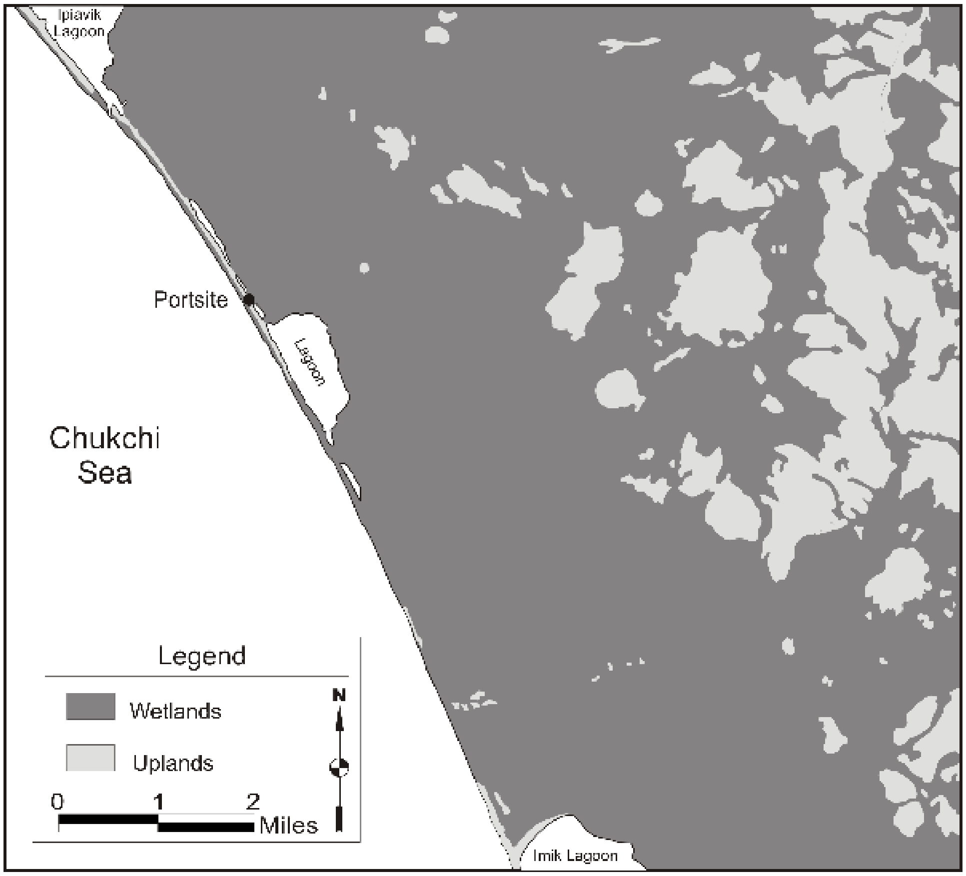


Figure 3-26. Wetland and upland areas surrounding Portsite.

3.4.8 Noise

This discussion describes the sounds in the environment at and near Portsite, including the sounds made by the on-going loading, shipping, and other industrial noises associated with the operations at Portsite. It focuses on sounds heard seaward from Portsite and particularly on that environment in the spring, when marine mammals are most abundant and in the summer when the port is busiest and is generating the most sound.

3.4.8.1 Sounds in the Environment

Sound is vibration. The vibration may be weak or strong, and may be rapid or slow. It also may be carried, again as vibration, through the ground, air, water, steel, rock, or any other medium. The vibration may be steady or it may change in strength, rapidity, or both. The combination of vibration frequency (pitch), strength, modulation (changes in pitch, volume, and combinations of frequencies), duration, and other physical variations produce the sounds that we identify as the sounds of birds, waves, familiar voices, and other sounds we associate with specific activities and events. The strength of these sounds is perceived as loudness to humans and animals. Since the perception of "loudness" varies greatly between different animals, sound will be discussed in terms of strength in this section. Noise is another term for sound, but it generally refers to sounds that are not wanted or are undesirable. Sound, in the discussion that follows does not include electromagnetic energy such as light, heat, radio waves, or other communication signals.

The science of measuring and describing sounds and how they behave in the environment uses terms and units of measurements that are very different from those that most people are accustomed to seeing. In some cases those measurements and descriptive terms cannot be reduced to plain language. Readers who want to know more about terms used to describe sounds, how sound measurements are expressed, factors affecting how sound travels through air, water, and other material, or the methods used to measure sounds at Portsite may find information about these topics in Appendix 6.

In 2000, the Corps collected sound data in the area surrounding Portsite. In addition to Corps personnel, a professional acoustician participated to record sounds and analyze the results. Recordings were made at three times of the year: when ice was present in May, during breakup in June, and during the open water period in August. Results of these surveys are discussed in the following sections.

Background Sounds The existing noise environment at Portsite consists of a mixture of natural background sounds and man-made sounds generated by DMT facilities and other human activities in the area. Examples of natural background noise in the area include intermittent and occasional sounds from wind, rain and hail, waves breaking on the beach, currents, calls of birds and other animals, seismic disturbances, and sea ice melting, cracking, and moving. Man-made noises in the Portsite area include intermittent, continuous, and seasonal sounds from vehicle traffic, generators, conveyors, vessel traffic and associated industrial noises, aircraft, small watercraft with outboards, snow machines, ATV’s, and firearms. There is no single “source” of background noise; instead several or many sources are continually changing in their contribution to background. Background sounds often are referred to as “ambient sounds” or “ambient noise.”

Ambient sound is important in discussions of sounds and their effects because ambient sound is the reference point for measuring sounds and because sounds are considered to have diminished to the point that they can no longer be heard or detected when they are reduced to background or ambient levels. There is a large variation in natural background sounds from season to season, day to day, and sometimes minute to minute. For example, we observed a variation in background airborne noise due to varying wind condition on 2 days to be approximately 25 dB. Under the ice the effect of the wind conditions was less dramatic, resulting in difference of approximately 3 dB between the 2 days.

Sounds in the Air It is quiet along the Arctic coast on calm days in the winter and spring, before the ice begins to melt and move. Background (ambient) sounds are about the same as in a quiet residential neighborhood at nighttime (Blackwell and Greene citing Kinsler *et al.* 1982), about 40 dB. When the wind blows or the ice moves or melts, ambient sounds can be much stronger and may change from moment to moment. Ambient sounds were measured offshore during 2 days in May. On a day when winds were 18 mph gusting to 30 mph, ambient sound levels were 10 to 25 dB greater than another day when calm winds prevailed. Sound levels on the windy day were approximately 50 to 70 dB, whereas the sound levels on the calm day were approximately 40 dB. Stronger wind, moving ice, or other natural events could produce louder sounds for at least short periods.

The sounds of Portsite operations are faint on the ice offshore from Portsite on a calm day, but almost continuous. Generators run constantly to power the facilities and trucks are being operated. Sensitive sound-measuring instruments placed about 1,300 feet offshore from Portsite could detect the steady operating sounds, but when they were moved to about 2,000 feet offshore, they could not detect the same steady operating sounds. Regardless of wind conditions experienced during our survey, airborne noise from Portsite could not be detected beyond the nearest recording location at W1, approximately 700 feet from the barge loader (about, 1,300 feet from shore).

Operations during the winter and spring may produce occasional sounds that are louder than the continuous operating sounds we recorded. We did not record any substantially louder operations sounds during May measurements, so we generated our own sounds from the seaward end of the barge loader with full swings of an 10-pound sledgehammer striking a davit welded to the sheet pile on cell 3, the barge loader cell farthest from shore. We also recorded sounds produced from running a snow machine on the nearby sea ice. The snow machine sounds were measured both at idle and moving at various distances from the sound measuring instruments.

The wind was strong and the sounds it produced were loud when we measured sledgehammer and snow machine sounds. Even with the disrupting effect of the strong wind, the snowmachine sounds were detectable in the air for approximately 650 feet from where it was traveling at moderate speed. People who live and work in the Arctic know that the wind and other background sounds tend to reduce the distance a snow machine can be heard and that in the right conditions, a powerful snow machine traveling across the ice at full throttle can be heard for more than a mile even when there is some wind, and sometimes for several miles on a calm, clear, cold day.

Sledgehammer blows were audible in the air at all recording locations, but poorly at the farthest ones (W4, W5 and N3) from the loader (figure 3-27). Those hammering sounds were audible even though the wind interfered with sound transmission through the air and increased background sounds. People who live in the Arctic know that a sharp, loud noise produced by metal striking metal, hammering on a wood plank, or a gunshot may be heard for several miles across the ice on a calm day.

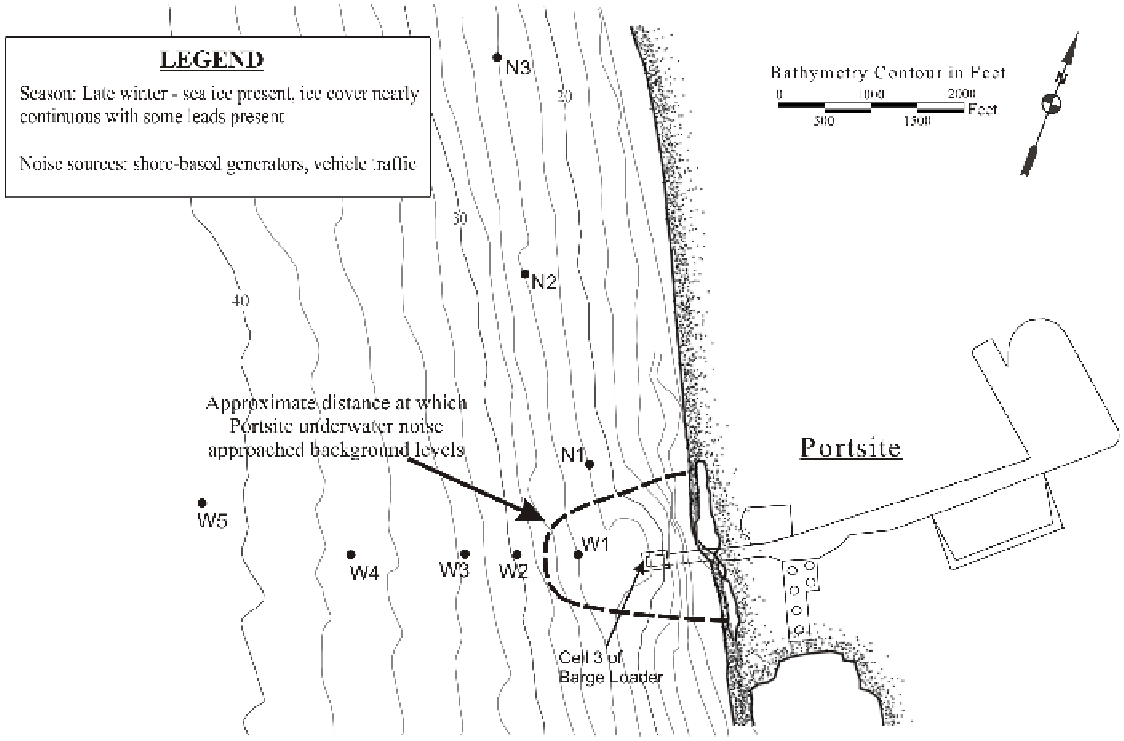


Figure 3-27. Noise sample locations, shorefast ice present.

Sounds Under the Ice. At location W-1 (figure 3-26), the station nearest the existing barge-loader, background sound levels under the ice were 84 to 92 dB, approximately the same as would be expected in open water and calm seas. At all other stations (W2 through W5 and N1 through N3) ambient noise levels were detected below ice of 75 to 84 dB, which are lower than ambient levels typical for open water. Blackwell and Greene (citing Wenz, 1962) reported that this is in the range of expected ambient underwater sound levels during calm winds and under frozen seas.

Almost all (97 percent) of the ambient sound energy measured was at frequencies (tones) higher than 200 Hz. The lower tones, which made up only about 3 percent of the recorded sound energy, may be disproportionately important because low frequency tones tend to carry farther through water than higher tones of the same strength. Tones of 30 and 20 Hz made were most of the low-frequency ambient sound energy recorded at station W1. Tones in the 20-30 Hz range were the prominent frequencies recorded at station N2, about 2,700 feet north of the loader. The 20 Hz tone probably was produced by a generator or some other type of engine or other manmade source on shore (Blackwell and Greene, 2000).

To help assess how rapidly sound diminishes under water at Portsite when ice is present, the same two sounds events recorded in the air also were recorded under the ice. They were: (a) snow machine operation on the ice and (b) sledgehammer blows on a davit on the barge-loader.

Sound levels of about 115 dB were recorded in the water 6.5 feet directly below an idling snow machine. Sounds of 107dB were recorded about 50 feet from the same snow machine driving over the ice. This sound attenuated rapidly and broadband levels were indistinguishable at station W2, about 700 feet seaward of the snow machine, although sounds from the snow machine were still detectable at four frequency tones. The underwater noise from the moving snow machine diminished at the rate of about 38 dB per tenfold increase in distance. Snow machine sounds were not detected in measurements recorded about 1,300 feet seaward of the snow machine. Based on the data collected, the sound from the snow machine driving on the ice would be expected to reach ambient levels (about 85-90 dB) about 1,200 feet seaward from the snow machine.

The results were about as might be expected. Sound from the snow machine diminished rapidly, as is typical of sound energy composed primarily of higher-frequency tones transmitted through ice and water. Sounds tend to reflect off ice, so only part of the sound energy generated above the ice actually goes into the water. Transmission of sounds generated on the ice surface to the underwater environment is influenced by snow depth and ice thickness. Higher frequency tones that make up most of the sounds produced by snow machines do not transmit well through water. They drop to ambient levels in a shorter distance than lower tones of the same magnitude.

The average sound levels generated by sledgehammer blows on the barge loader davit were measured at 103 dB about 700 feet seaward. At about 3,500 feet seaward of the barge loader, the average sound levels diminished to approximately 85 dB, a level that is close to ambient. The underwater noise level from the sledgehammer was calculated to diminish at the rate of about 23 dB per tenfold increase in distance. Peak sound levels (i.e. those not averaged over a short time period) were higher and could still be detected at the farthest recording location at about 1 mile seaward of the barge loader. Based on the 23 dB rate of decrease, the peak sound level would approach ambient levels at about 3.7 miles seaward of the barge loader. Our noise survey crew generated these peak sounds primarily to detect the transmission loss rate since no other loud industrial sounds were available. Typically, industrial noise of this type is uncommon during the period when ice is present.

The same sledgehammer sounds measured underwater north of the barge loader did not travel as far. The noise generated by the sledgehammer blows on the davit was received by one station to the north of the barge loader (N1, about 1,100 feet north). They were not detected at all at the next station, 1,600 feet farther north. Sounds traveling through shallow water over soft bottom close to shore typically diminish faster and travel shorter distances than the same sounds traveling into deeper water off shore.

The duration of human-produced underwater sound when ice is present depends on the source generating the sounds. Generators run constantly, but the sounds they generated dropped to ambient a short distance off shore. Truck and other vehicle traffic on shore is sporadic when ice is present, but was never specifically detected in any offshore noise measurements. Snow machines traveling on ice produce powerful sounds. Some of the snow machine sounds are reflected off the ice, so only part of the sounds reach the water. Sounds that do travel through the ice and into the water rapidly decrease to background levels because most of the snow machine sounds are high frequency tones that do not transmit well through the water. Sounds from snow machines differ from other sounds measured in that they are a mobile sound source. The snow machine’s zone of influence is not static since it moves as the vehicle travels, potentially affecting a large area.

In summary, the near-shore marine environment under the ice near Portsite beyond a few hundred yards from shore usually is very quiet. Sounds produced by industrial activity on shore rapidly approach background levels and cannot be detected very far off shore. The relatively shallow water and soft bottom cause sounds to diminish comparatively quickly.

Underwater Sounds in the Open Water. As the ice is going out at Portsite in June, and before shipping and loading activities begin, the marine environment off Portsite is quiet on calm days. Ambient sound levels measured at the seaward end of the existing barge loader on a calm day in broken ice and open water averaged between 85 and 89 dB. These levels are roughly equivalent to the average levels measured through the ice in May and are levels that might be expected in calm open water conditions at sea.

When shipping begins at Portsite, sound is generated from a number of sources associated with ship and barge operation and movement and from loading material into barges for shipping. When several activities are happening at the same time, it may be difficult to identify and separate sources of sound, but most of the loudest sources can be isolated and measured with relatively good confidence in results. The information that follows identifies the major sound-producing activities associated with loading and shipping ore concentrate from Portsite and the sounds associated with them.

The ore loading operation at the Portsite is almost continuous, weather allowing, from the beginning of the shipping season until the concentrate storage buildings at Portsite are emptied. Thereafter, concentrate is loaded and shipped intermittently as enough concentrate to load a ship is accumulated in the storage buildings. Shipping, and the noises associated with it, ends when the threat of ice closes shipping for the year. During the ship loading cycle, one ship is loaded at a time. During a typical cycle, one barge is loaded at the barge loader while a second barge is discharging ore to the ore carrier ship. The ore loading operations employ seven vessels at Portsite, two lightering barges and five tugs to transfer ore concentrate to the ships. Two tugs are dedicated to each barge, one to pull it and another to assist with positioning. The fifth tug pulls on the stern of the ore carrier being loaded to maintain proper orientation with the wind and to keep it stationary during loading. When weather conditions are favorable and there are few maintenance problems, an ore carrier can be loaded in 3 days.

The ore loading process involves the following noise-producing activities:

- Ore is transported via a conveyor belt from one of two concentrate storage buildings over land a short distance to the barge loader, where it is discharged to a tended lightering barge. The ore concentrate enters the barge via a movable chute from the barge loader and is spread evenly in the barge by an onboard front-end loader.

- The loaded barge is towed and tended by two tugs to the waiting ore carrier approximately 3.5 miles offshore.

- As the full barge is being towed to the ore carrier, an empty barge that has completed unloading at the ore carrier is towed to the barge loader.

- When the tug and full barge reach the waiting ore carrier, two tugs hold the barge in position for offloading and a third tug assists in holding the ore carrier in position.

- A conveyor system onboard the lightering barges then transfers ore the ore carrier. After the transfer is complete, the empty barge returns to the barge loader for another load.

The results of the August 2000 open water survey are summarized in table 3-28 for each of the main sources of underwater noise (ore carriers, tugs, barge loader, and the ore transfer equipment on the lightering barges). A discussion of the survey methods and results follows for each of these main sound sources.

Table 3-28. Sources of noise, their operational duration and sound pressure levels at Portsite.

Event	Occurrence	Duration Per Event or Season	Sound Pressure Level (dB re 1 μPA)
Ore carrier arrives on site empty.	About 27 times/season	N/A	Not recorded. No ore carriers arrived during survey period.
Ore carrier generators running while waiting and loading.	Constant during season (mid July to mid October)	3500 (total season hours)	Not recorded. Sound could not be isolated from other activity in the area.
Lightering barge trips and cycle time.	323 round trips/season (total for both barges)	13.5 hours to load, unload, and arrive at the barge loader empty again.	Noise considered with tugs, see below.
Estimated cycle time when tug engine is under load.	323 round trips/season	6 hours per round trip	
• Tug towing loaded barge from pier to ore carrier.		• 1.25 hours	144 at ~100 m 123 at ~700 m
• Tug towing empty barge from ore carrier to pier.		• 1.25 hours	143 at ~200 m 126 at ~300 m
• Tugs positioning and holding barge against ship.		• 3.5 hours	Not recorded. Sound could not be isolated from tug pulling on ship's stern.
• Tugs positioning empty barge against pier.		• 0.25 hours of the 1.0 ore carrier to pier transit time.	133 at ~150 m 120 at ~650 m
Estimated time when tug engine is idle.	Variable portion of 323 round trips /season	7.5 hours/ round trip (2,422 hours/season)	Not recorded. Could not be isolated from sound of moving tugs.

Barge loading at pier (totals for both barges)	323 loads/season	4 hours (2000 season data combination of no delays, weather and various delays)	120 to 137 at ~100 m
Barge discharging at ore carrier. (totals for both barges)	323 loads/season	4 hours each load	130 at ~100 m 120 at ~1000 m
Roving tugs (2) assisting with barge placement.	323 loads/season	2200 hours (usable hours/season)	Not recorded. Noise depends upon activity, see other tug data.
Tug holding ore carrier in place.	27 loads/season	2200 hours (usable hours/season)	143 at 100 m 133 at 300 m
Ore carrier departs full.	27 times/season	0.5 hour per departure	148 at 100 m and 123 at 2000 m

Ore Carriers. An average of 27 ore carriers arrive at the Portsite during the open water season. Sounds associated with their arrival were not recorded and would depend upon the way they were operated. If an ore carrier was allowed to slow gradually as it came to its mooring position, then arrival sounds would be relatively quiet. If the propeller was strongly reversed to stop the ship, then arrival sounds levels generated would likely be much greater than those caused by gradually slowing the ship. Typically, up to four ore carriers are positioned offshore waiting their turn to take on ore. Their engines generally are shut down shortly after arrival, but generators run constantly to supply power to the vessel. They typically run the generators until they are loaded and depart to deliver the ore concentrate to the global market.

Sounds produced by the ore carrier *Lucky Marine* getting underway were recorded. They were the strongest sound levels (186 dB at 1m and 148 dB at 100m) recorded during the survey. Of the frequency tones analyzed, 98 percent were above 200 Hz and 92 percent were above 1,000 Hz. When the 10 strongest frequency tones were analyzed, all but one were below 1,000 Hz and 93 percent were below 500 Hz. The most common frequency tones were 52 and 72 Hz, followed by 35, 43, 45, 83, 109, and 127 Hz.

Sound levels and frequency tone data measured during departure of the *Lucky Marine* are consistent with published data about ships of similar size. Large ships typically produce loud underwater sounds at low frequencies. Propeller cavitation produces most of the broadband noise during departure, although engine and other sources contribute. Dominant frequency tones typically coincide with propeller blade rate (Richardson *et al.* 1995). Richardson *et al.* (1995) reports that the dominant frequency tone for large vessels underway is the following: a 440-foot ore carrier produced 41 Hz at 172 dB measured at 3.2 feet and a 1,100-foot supertanker produced a dominant frequency tone of 6.8 Hz at a sound pressure level of 190 db at 3.2 feet. The distance at which a given sound will approach background levels is site-specific, and therefore data obtained at Portsite cannot be accurately compared with data from other locations.

Based on measurements during August 2000, the sound produced by the departing ore carrier *Lucky Marine,* an ore carrier typical of those commonly servicing Portsite, would approach background levels at approximately16.8 miles from the departing ship. Since large ore carriers often take a long distance to get up to cruising speed, it was not possible to determine the sound level and degree to which noise from operation diminished when the *Lucky Marine* was underway at cruising speed. Sound levels generated underway for any given vessel depend on several factors such as cruising speed, whether it is laden or unladen, condition of propellers and whether they are operating synchronously or asynchronously, and the degree to which auxiliary equipment is operating. Generally, large ships produce more noise than smaller ones, laden vessels produce more noise than unladen vessels, and the faster the vessel travels the more noise it produces (Richardson *et al.* 1995). It would be reasonable to assume noises of similar strength and duration may be produced during at least some ship arrivals.

Tugs. An average of 323 round trips are made from the barge loader to the ore carriers each season by the lightering barges and attending tugs. Each of the two tugs associated with a barge are under load for approximately 6 hours for each round trip of a lightering barge. During the 4-hour unload time for the barge at the ore carrier, an additional tug pulls on the stern of the ore carrier. Therefore, a total of approximately 16 hours of tug engine time under load is associated with each round trip of a barge. The tug pulling on the stern of the ore carrier pulls constantly during loading operations, including the time when no barges are unloading to the ore carrier, so the actual total hours under load is about the same as the usable season hours (2,200).

The tug pulling on the stern of the ore carrier produced consistently higher sound levels than the tugs holding the barge in position (table 3-28). The tug on the stern was continuously pulling, while the pushing and pulling of tugs tending the unloading barges is generally for short periods as needed during the loading operations. The dominant frequency tone of the tug pulling on the stern of the ore carrier was 742 Hz. Other common frequency tones associated with tugboats were 1002-1005, 168, 564, and 924 Hz. The frequency tone at 53 Hz was common and was one of the strongest frequency tones recorded when a tug was pulling an empty barge. This frequency tone probably corresponds to the propeller blade rate (Blackwell and Greene, 2001).

Barge loader. The survey results showed a high variability in the sounds produced during barge loading due to the range of activities involved in loading, including: ore pouring into the barge at different rates, dozer operation, and the movement of the arm on the barge loader.

It takes approximately 4 hours to load each barge at the barge loader. At 323 loads per season, loading operations at the barge loader take approximately 1,300 hours per season. At 328 feet, the sound produced by loading varies from 120 to approximately 137 dB.

Ore Loaders on the Barges. The sounds associated with the barge unloading operations at an ore carrier were also measured. At 328 feet, the sound produced by the unloading barge was approximately 130 dB. The stronger sounds generated by the tugs generally masked the sounds produced by machinery loading ore concentrates from the barges into the ore carrier ships.

3.4.8.2 Distance Portsite Sounds Travel

Sounds in the Atmosphere.

Winter. Noise created by onshore activities at Portsite and traveling though the air could be measured 1,300 feet directly offshore by sensitive equipment on a calm day in late winter (figure 3-26). Generators likely produced those sounds. Other onshore noises included truck movement, people talking, and other daily activities, but these noises could not be specifically singled out from the generator noise. Louder noises from occasional maintenance, operating, and construction activities would be heard farther offshore. A Corps of Engineers biologist counting seals reported that blasting at the quarry about 2 miles inland from Portsite was heard and produced short-term response in ringed seals as far as 1 mile offshore. Loud noises from maintenance on the barge loader and construction noises on shore also might carry a mile or more offshore in calm weather and might be comparable to the distance that noise produced by gunshots and snow machine operation might be heard.

<u>Open-water Shipping Season.</u> Maintenance, barge loading and unloading activities, tugs, and ships all contribute to noise heard through the atmosphere during the July through October shipping season. The sounds heard the greatest distance seaward from Portsite would be noise produced by ships and the tug operations associated with loading ore concentrate onto the bulk ore carriers. The tug operations associated with loading are comparatively noisy, but the biggest factor in the seaward range of sound is that the ships moor several miles offshore. That means the loading noises originate several miles offshore and then may be heard a similar distance farther offshore (figure 3-28).

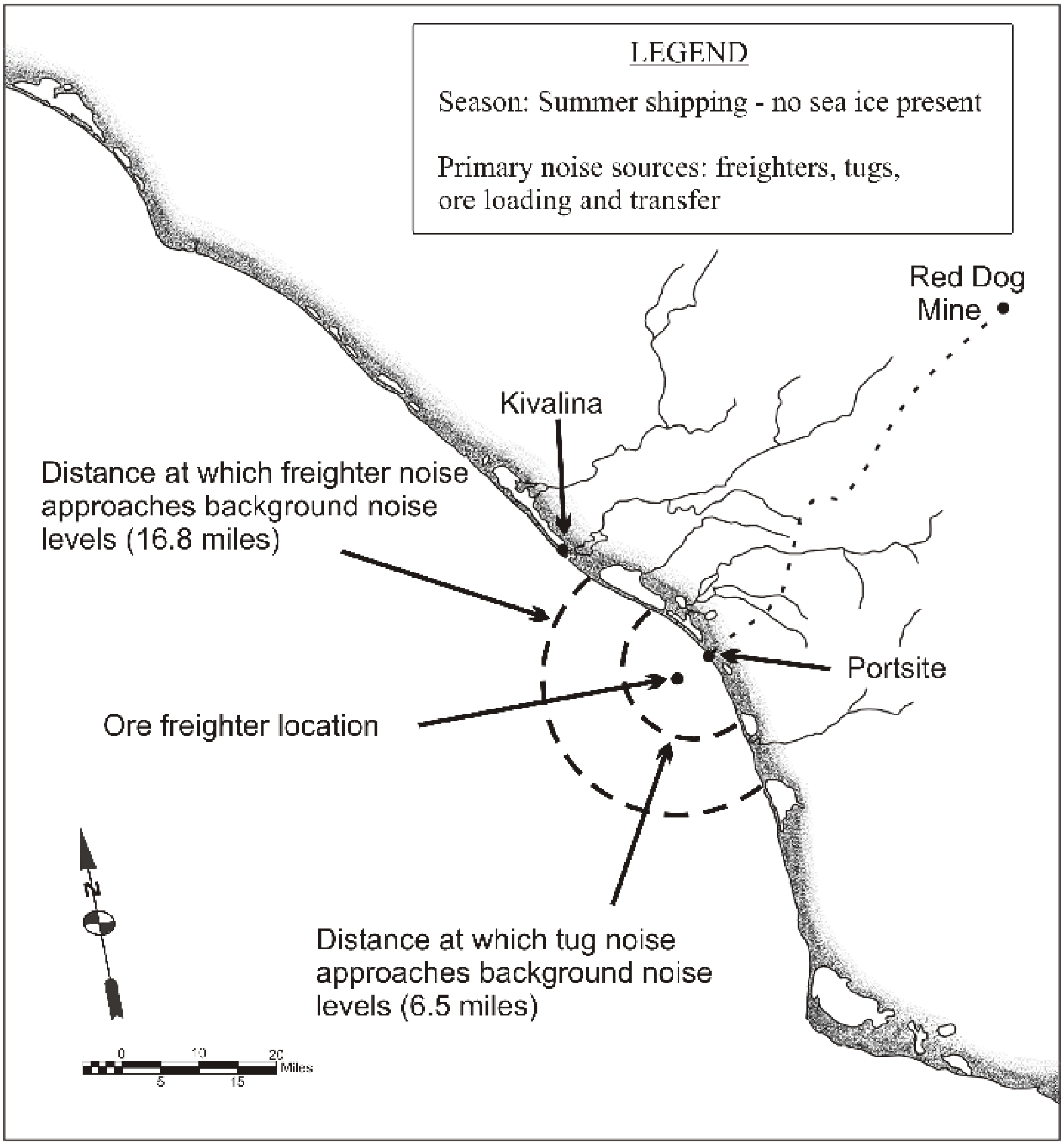


Figure 3-28. Approximate distances that noises from ore loading operations travel through the water before decreasing to ambient levels.

Sounds in the Water Under Ice. Not much sound from operations goes into the waters of the Chukchi Sea before the ice goes out. There generally is no activity in the water or on the ice related to Portsite. Sound traveling through the air tends to be reflected up from the ice surface rather than traveling through it into the water below. This is especially true of sounds that reach the ice surface at a relatively shallow angle, as would be the case for noises generated on land.

Maintenance work on the existing loader could generate sound that would be transmitted into the ice and water. Heavy maintenance work that required hammering or other heavy metal-to-metal contact might produce noises about like the sounds we generated with a sledgehammer and measured under the ice at Portsite and might be detectable up to about 3.7 miles directly offshore. The sound would not travel as far to the north or south in the shallower water along the coast. Sledgehammer blows were only detected 1,100 feet to the north of the barge loader.

Sounds in Open Marine Waters. Operations at Portsite generate sounds from a variety of sources and many of those sounds are transmitted into the water. The loudest regularly occurring sounds transmitted into the water at Portsite are generated by the tugs. These sounds are almost continuous, at varying intensity, during good weather and sea conditions throughout the shipping season. Our measurements indicate that peak noise generated by tugs at Portsite might be expected to be detectable up to about 6.5 miles from the source. Tugs involved in assisting the lightering barge at the ore carrier operate 3.5 or more miles off shore and might be heard in the water approximately 10 miles off shore. Other sounds generated at Portsite were much less powerful than tug noises and would not appreciably affect how far seaward the Portsite operations might be heard (see Appendix 6 for an explanation of how several sounds of different intensity affect the total distance that noises can be detected).

Transferring ore concentrate to ships moored several miles offshore from Portsite requires almost continuous operation of two or more tugs, which generate powerful sounds from propeller cavitation and other sources. Those sounds, which were measured at 133 dB within 10 feet of the source, could be expected to travel as far as 6.5 miles seaward on a calm day before they attenuated to background levels. Other sounds associated with loading were much less powerful and would have had little influence on the distance sound could be heard from the ship loading operations.

Ship departure is the loudest regularly occurring underwater event in the entire shipping program. The bulk carrier we recorded produced about 148 dB at about 350 feet and would have been detectable to sensitive instruments as much as 16.8 miles seaward, or about 20 miles off shore from Portsite. The literature indicates that this is typical for heavily loaded ships of this type. Ships may produce less propeller cavitation after they reach standard speed and produce less sound. The bulk carrier we recorded produced 186 dB at 3 feet. Similar ships operating underway produced sounds of about 172 dB at the same distance. In ambient conditions like those measured in the Chukchi Sea, that level of sound (172 dB) from a ship traveling at cruising speed through the open sea would likely approach background levels at a distance less than 16.5 miles. Several factors induce variability such as differences in cruising speed, operating status of auxiliary equipment and whether the vessel is laden or unladen.

3.5 Biological Conditions

3.5.1 Vegetation and Algae

The types of vegetation and algae in the Portsite area can be separated into three groups: (1) vegetation and algae associated with the marine environment (2) plants associated with the near-shore lagoons (transitional vegetation); and (3) plants associated with land habitat (land vegetation).

3.5.1.1 Marine Vegetation and Algae

In the oceans and seas of the world, algae ranging in size from single-cell microscopic plants to giant kelps more than a hundred feet long use sunlight in the same process (photosynthesis) as land plants to store food, grow, and produce the chemicals they need for life. The algae through photosynthesis break carbon dioxide down into carbon and oxygen and then use the carbon and plant material. Unused oxygen is released into the water (and air). The production of plant material in the oceans and seas by microscopic algae contributes to the "primary productivity" that begins the marine "food chain" of many marine invertebrates, and many of the small crustaceans (shrimp, krill, crabs, copepods and amphipods) that are food for bigger invertebrates, as well as for herring, juvenile salmon, juvenile char, baleen whales, birds, and many other animals of the Chukchi Sea.

The Chukchi Sea does not have the large assemblages of kelps and other large, multicellular attached algae that are plentiful in many oceans and seas of the world, but it does have an abundance of microscopic algae throughout the year. These microscopic algae can be floating or suspended in the water (phytoplankton), or attached to either the bottom sediments (benthic) or the underside of ice. Kelp and other large multicellular algae may be absent because the growing season is short, the water is comparatively turbid, and /or the bottom is generally too soft for larger algae to attach. Near-shore freezing and ice gouging also may keep attached algae from colonizing in waters less than about 20 feet deep. These all may be factors, but kelps are attached in considerable aggregations on hard-bottomed surfaces (called "boulder patches" in recent literature) farther north in the Arctic Ocean (Moore et al. 1957, Dunton et al. 1982). This indicates that the general lack of kelp and other attached large algae in the Chukchi Sea is probably due to the absence of hard attachment surfaces in water shallow and clear enough to allow photosynthesis, but deep enough to avoid destruction by ice gouging.

A variety of microscopic algae accounts for primary productivity in the Chukchi Sea, but two groups, diatoms and dinoflagellates, are reported to be the major producers. Figure 3-29 shows two forms of microscopic diatoms in the Chukchi Sea.

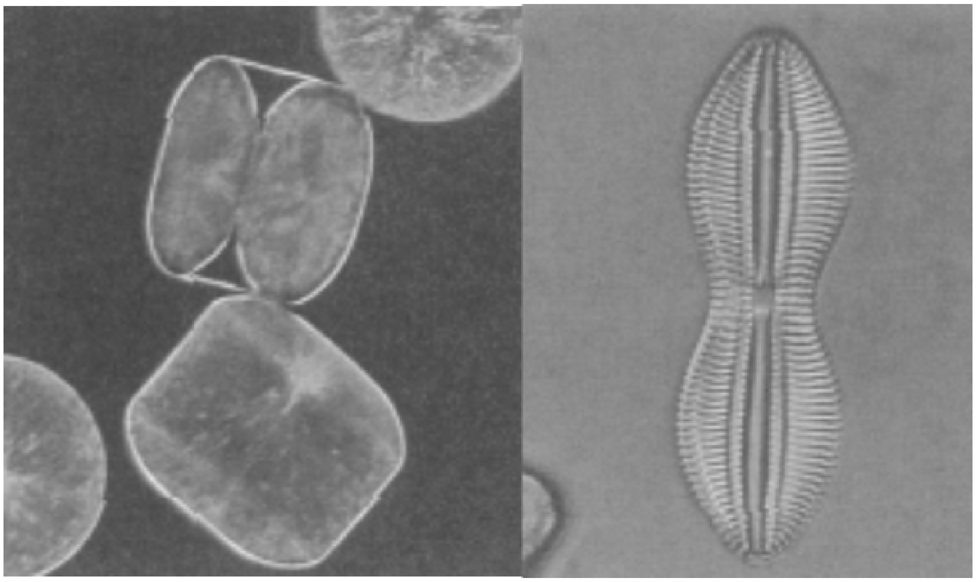


Figure 3-29. Microscopic diatoms (Chrysophyta).

Diatoms are major components of plankton, an important source of food for many marine animals. There are about 10,000 species of diatoms. The above photos are at different scales. The diatoms in the left photo are about 350 microns long, and the diatom in the right photo is about 180 microns long. There are about 25,000 microns in an inch.

The amount of plant material produced by the algae through photosynthesis varies from one place to another in the Chukchi Sea. For example, the primary productivity of microscopic algae in the 26,000-square-mile southeastern Chukchi Sea (including Kotzebue Sound) in one year was estimated at 75 to 100 grams of carbon per square meter (Schell et al. 1988). This amount of carbon would be used by the algae to produce between 5 and 8 ounces of plant material for each square yard of sea surface. This may not seem like much, but since there are about 3 million square yards in 1 square mile, this would mean that about 900,000 to 1,500,000 pounds of plant material are produced each year in each square mile of the southeastern Chukchi Sea and Kotzebue Sound. By comparison, in the Bering Strait, an area influenced by a nutrient-rich ocean current, Sambrotto et al. (1984) measured primary productivity at about 324 grams of carbon per square meter, which is about 3 to 4 times higher than the productivity in southeastern Chukchi Sea and Kotzebue Sound reported by Schell et al.

Coachman and Shigaev (1988) and Hansell et al. (1989) charted the major transport routes of nutrients and the major areas of algae (primary) productivity in the Bering and Chukchi seas, which are shown in figure 3-30. As this figure indicates, the greatest primary productivity from Chukchi Sea microscopic algae is in the Bering Straits and in the central Chukchi Sea north of the Bering Straits. In contrast, as reported by Schell (1988) above, the southeastern Chukchi Sea and the eastern Chukchi Sea north of Kotzebue (including Portsite) is an area of much lower primary productivity.

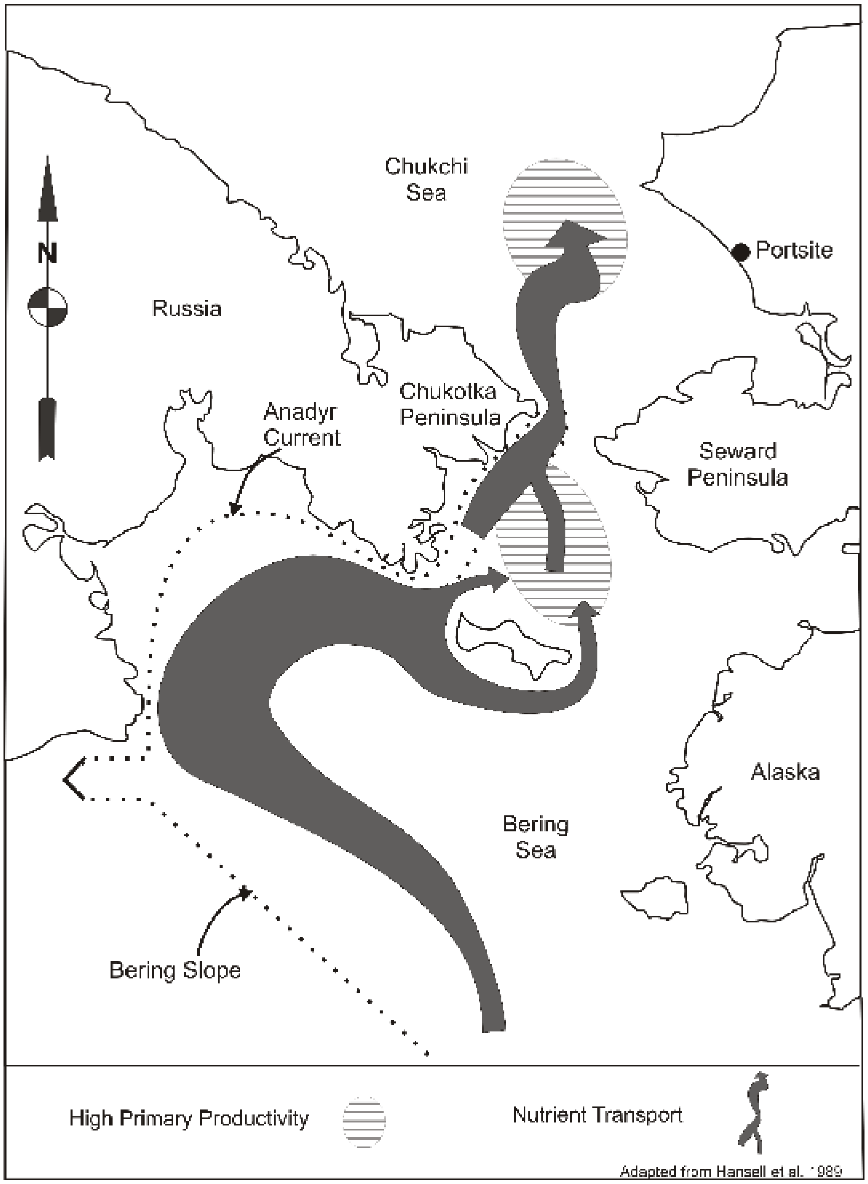


Figure 3-30. Areas of high primary productivity in the Bering and Chukchi seas, and the path of nutrient transport from the Bering Sea to the Chukchi Sea (Adapted from Hansell et al. 1989).

The abundance of microscopic algae, and the corresponding primary productivity levels in the Chukchi Sea, varies with the season. Primary productivity levels are lowest during the winter and spring when ice covers most of the Chukchi Sea, and there is less sunlight (Horner and Schrader 1982). The Chukchi is ice-covered from about November through June and thin dense mats of microscopic algae typically form on the bottom surface of the ice. These algal cells may be visible on the bottom of the ice as a brown layer during the spring (Horner 1985). This algae community is composed primarily of pinnate diatoms (*Nitzschia, Amphiprora, Fragilariopsis*) and dinoflagellates (largely *Peridinium*) (Horner and Alexander 1972, Horner 1985). The abundance of ice microscopic algae typically peaks in late May and diminishes quickly with melting ice in early June (Horner 1985).

Floating (phytoplankton) and bottom-dwelling (benthic) microscopic algae increase in abundance as the ice melts and sunlight increases (Horner and Schrader 1982, Matheke and Horner 1974). Matheke and Horner (1974) reported that beneath the near-shore Chukchi Sea ice in the spring, motile, unattached diatoms were the main microscopic algae found on or near the bottom. After the ice melted, the filamentous diatoms, especially *A. ratilans*, formed a thin living mat of microscopic algae over the bottom sediment. *Gyrosigma*, *Licmophora*, and *Navicula* are other common microscopic algae on the Chukchi Sea bottom during late spring and summer.

Microscopic algae are most abundant and primary productivity levels are at their highest in the Chukchi Sea during the summer (Hillman 1984), when there is abundant light and the marine waters are warmer. During this time, benthic microscopic algae that live on and among grains of sediment on the sea floor make up the greatest percentage of the microscopic algae population where sunlight can reach the bottom. In deeper or more turbid water, planktonic algae would be more important.

3.5.1.2 Transitional Vegetation (Lagoons)

Several shallow lagoons are separated from the Chukchi Sea by gravel and sand berms in the immediate vicinity of the DMT. These lagoons are either open or closed to the sea. Closed lagoons have no hydraulic connection to the sea other than during storm surges. Of the three largest lagoons in the project area, Kivalina and Ipiavik lagoons are open to the sea and are often brackish (figure 3-31). A third large lagoon, the Imikruk Lagoon, is normally closed to the sea and is a freshwater system unless the barrier berm is overtopped during summer storm surges. The small lagoons adjacent to Portsite are closed.

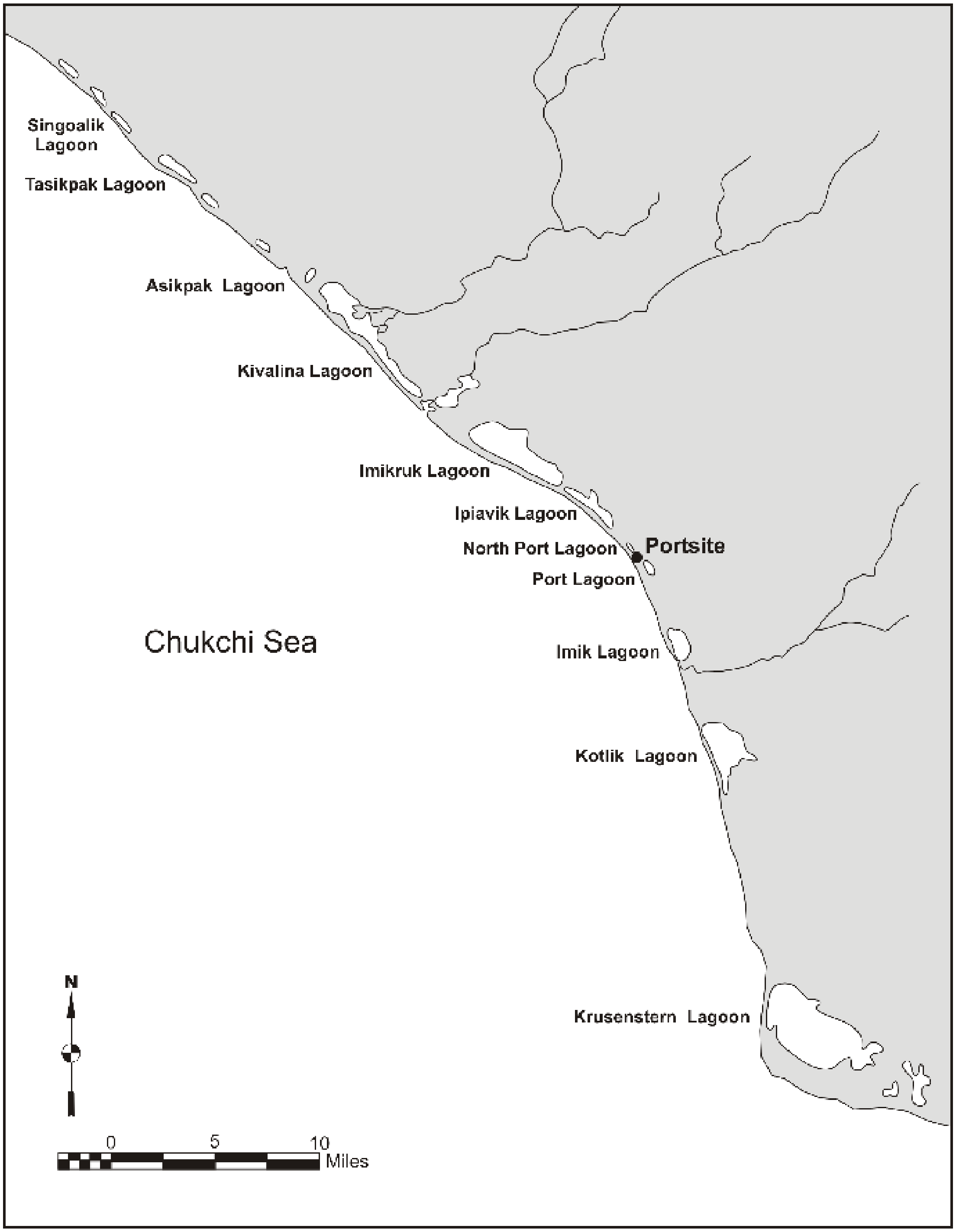


Figure 3-31. Major lagoons in the vicinity of Portsite.

The berms separating the lagoons from the sea are often vegetated with tall grass *(Elymus sp.)*, beach pea, and other salt tolerant species. Most lagoons in the project area, both open and closed, have emergent vegetation along the shorelines. Lagoon emergent vegetation commonly includes sedges, Puccinellid alkali grass, and Arctophilid pendant grass. The types, diversity, and abundance of emergent vegetation in the lagoons at Portsite are influenced by influxes of seawater, lagoon depth, and the amount of freshwater input, wind action, and changes in ambient air temperature.

Baseline environmental studies conducted in 1983 for the Red Dog Mine (Dames and Moore 1983) noted unidentified green algae (Chlorophyta) in Port Lagoon on the south side of the DMT loading facility. There is physical evidence that salt-water overtops the berm of this lagoon, indicating that environment fluctuations likely affect the composition of emergent vegetation.

During the spring and summer 2000 surveys, the lagoon on the north side of the loading facility showed no visible evidence of overtopping in recent years, and it has likely remained relatively fresh for some time. Waterfowl flocks of varying size congregated in this lagoon during spring, and by late June, the lagoon had developed a rich algal bloom, as well as a dense growth of grasses along the shoreline.

3.5.1.3 Land Vegetation

Land vegetation communities in the Portsite area include tall-grass herbaceous growth on beach berms, transitioning inland to a mosaic of low shrub tussock tundra, sedge-grass tundra, wet meadow, marsh, and wetland herbaceous zones. As land elevations increase inland, mat and cushion alpine tundra communities are predominant, culminating with sparse or vegetation free zones at the highest elevated inland areas. Figure 3-32 presents these general vegetation zones in the project area, as depicted in a map of the Cape Krusenstern National Monument prepared by McClenahan in1993.

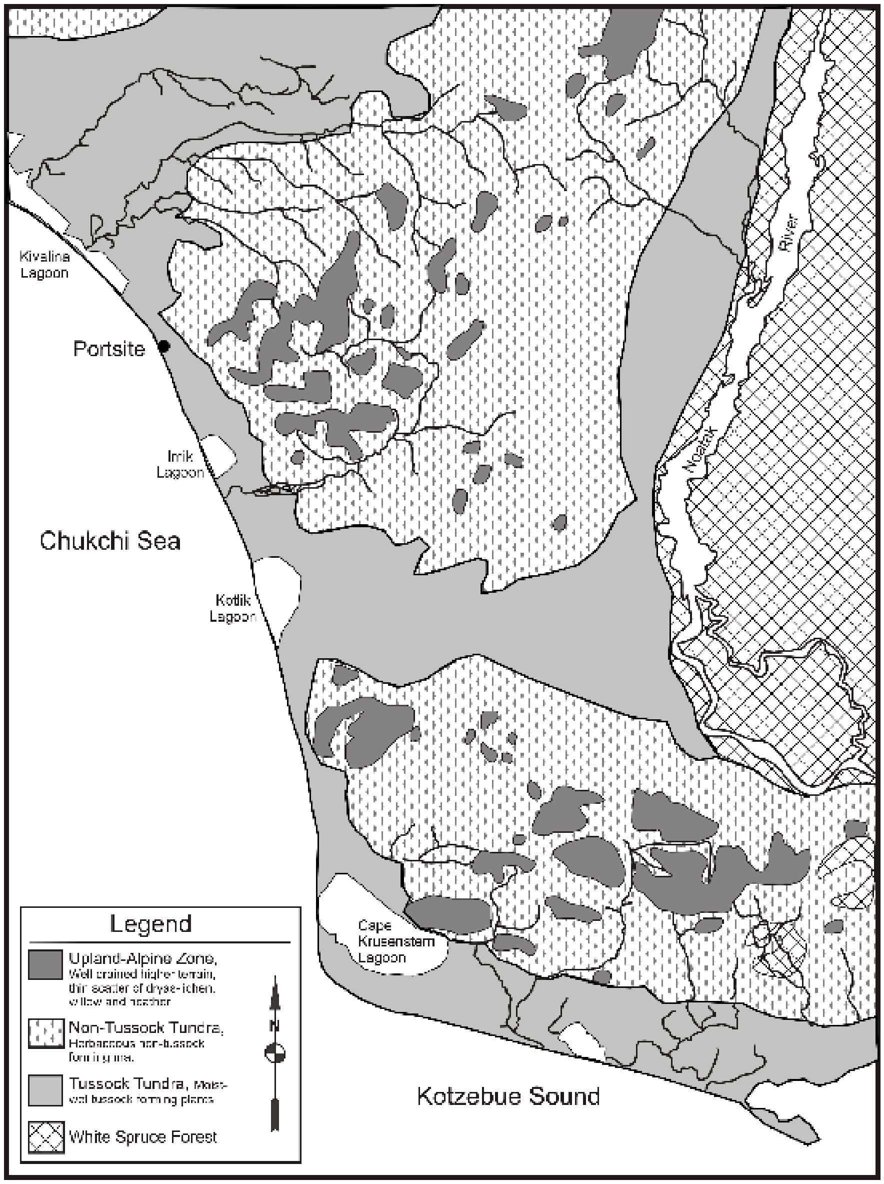


Figure 3-32. Zones of vegetation near Portsite and in Cape Krusenstern National Monument (Adapted from McClenahan 1993).

The classification and nomenclature of vegetation in the Portsite area are presented in Table 3-29 based on the environmental baseline studies done for the Red Dog Mine Portsite in 1984 (Dames and Moore 1983). Plant species and coverage in the area have not changed appreciably since the time of these studies. *Elymus* grasses dominate vegetation on the beach berm, and sedges dominate the inland tundra. Areas of low and tall shrub also exist in riparian and upland areas. Higher elevations are dominated by dwarf shrub, mat, and cushion tundra where vegetation is present.

Table 3-29. Classification of vegetation in the DMT area.

II-Shrubland	**III – Herbaceous**
A-Tall Shrub (> 1.5 m tall) 1 - Closed (= 75% foliar cover) 2 – Open (25 % – 75%) tall shrubs	A – Tall Grass (> 1 m tall) 4 – *Elymus*
B – Low Shrub (= 20 cm to 1.5 m tall) 1 – shrub tundra 2 – Closed (= 75% low shrub) 3 – Open (25 % – 75%) low shrubs	C – Sedge-Cottongrass 1 – Sedge-Cottongrass tundra 2 – Tussock tundra 3 – Sedge-Cottongrass marsh 4 – Sedge-Cottongrass wet meadow 5 – Sedge-Cottongrass bog
C – Dwarf Shrub (< 20 cm tall) 1 – mat and cushion tundra	D – Herbs 3 – Wetland herbaceous
Tall Shrub communities: *Salix planifolia, Calamagrostis canadensis, Epilobium augustifolium*.	
Low Shrub communities: *Betula nana, Empetrum nigrum, Vaccinium uliginosum, Salix planifolia*.	
Dwarf Shrub communities: *Betula nana, Dryas octopetala, Salix phebophylla, Salix spp.*	
Tall Grass communities: Cassiope tetragona, *Dryas octopetala. Elymus arenarius.*	
Sedge-Cottongrass communities: Carex spp., Eriophorum spp., Kobresia spp., Trichophorum caespitosum, *Betula nana, Dryas intergifolium.*	
Herb communities: Puccinellia spp., Triglochin spp., Carex spp.	

Source: After Viereck et al. (1981), and compiled by Hettinger (1983) for the original Red Dog Mine Portsite baseline studies (Dames and Moore 1983).

Wetlands. The Corps of Engineers and U.S Fish and Wildlife Service have developed definitions and classifications for wetlands in the arctic environment based on vegetation, soils, and hydrology data that includes permafrost (COE 1987, FWS 1979). All the tundra areas surrounding Portsite are classified as wetland because they are poorly drained and have areas of standing water or saturated soils that support plants that grow in very wet environments.

3.5.2 Marine Invertebrates

Marine invertebrates in the Portsite vicinity and the Chukchi Sea are of four main types:

- Those floating or weakly swimming in the water column such as copepods (zooplankton);
- Those swimming in the water column such as amphipods, shrimp, and krill (holoplanktonic invertebrates);
- Those living on the bottom sediment and other substrates, such as sea stars, crabs, sponges, barnacles, snails and whelks, (epibenthic invertebrates) and;
- Those living in the bottom sediments, such as clams, and worms (infaunal invertebrates).

Marine invertebrates inhabiting the Chukchi Sea and the Portsite vicinity (and other oceans and seas in the world) make up the second step in the marine "food chain." Many of those animals feed on floating and attached marine vegetation, while others feed on a variety of organic matter in the water column or deposited on or mixed in with the bottom substrate. As part of the marine food chain, many of these marine invertebrates are food for a variety of fish, marine mammals, and other larger vertebrate species that are farther "up" the food chain.

3.5.2.1 Marine Invertebrates in the Portsite Area

The types, diversity, and abundance of the marine invertebrates living in the eastern Chukchi Sea (and Portsite area) have been defined by a number of marine invertebrate surveys completed over the past 35 years. The surveys most appropriate to describing the existing biological environment near Portsite are briefly discussed below. Three major surveys (Sparks and Pereyra 1966; Wolotira et al. 1977; and Fair and Nelson, 1999) were conducted as part of regional efforts to characterize marine resources for potential commercial fisheries and/or industrial development. The areas they sampled near Portsite are illustrated in figure 3-33. The principal species they collected in trawl collections are compiled in table 3-30, which is keyed to the survey sites in figure 3-33.

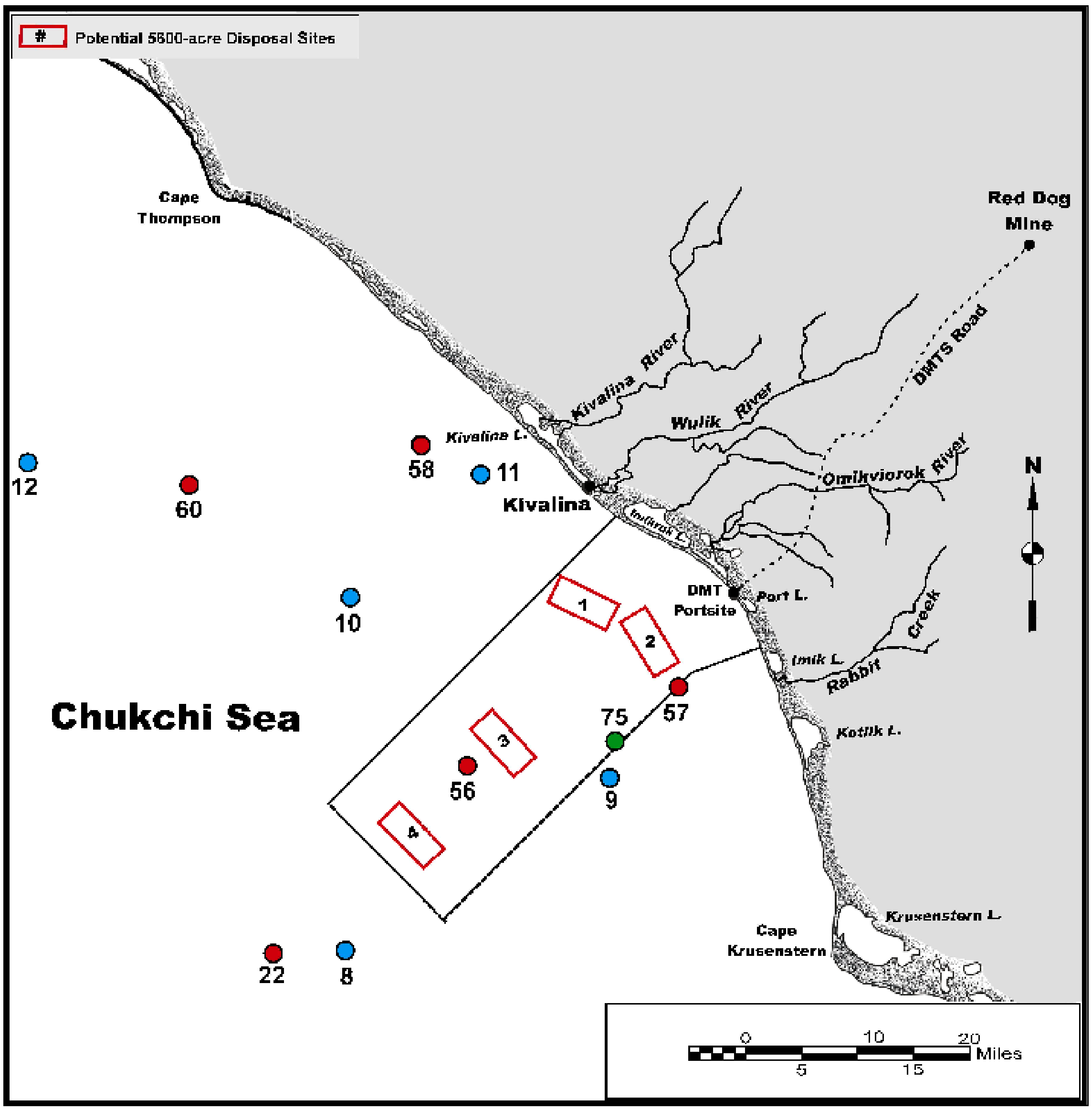


Figure 3-33. Survey stations trawled during three major fisheries surveys (Sparks and Pereyra 1966; Wolotira et al. 1977; and Fair and Nelson, 1999) and their proximity to potential offshore disposal sites (1-4).

Table 3-30. Estimated catch of principal species in kilograms per kilometer at stations surveyed in the vicinity of Portsite between 1959 and 1998.

Station Number [a]	**11**	**58**	**57**	**9**	**22**	**8**	**10**	**56**	**60**	**12**
Depth (feet)	**60**	**60**	**60**	**84**	**96**	**96**	**114**	**108**	**120**	**138**
Distance Offshore (miles)	**4**	**5**	**7**	**13**	**38**	**34**	**17**	**18**	**30**	**45**
Sea stars	**0.1-0.4**	**9-26**	**9-26**	**0.1-0.4**	**26-43**			**67-110**	**43-67**	**0.5-2.0**
Basket stars	**26-50**			**0.3-14**			**26-50**			**50+**
Clams					**0.02-0.04**		**0.2-0.7**	**0.12-0.47**	**0.04-0.12**	**0.2-0.7**
Snails					**0.02-0.24**		**0.01-0.05**			**0.06-0.25**
Amphipods							**0.1-0.5**			
Crabs	**5.05-10.0**	**3.02-18.22**	**2.05-3.02**	**1.3-5.0**	**0.03-0.04**	**0.05-0.25**	**10.0+**	**0.01-9.0**	**28-75**	**1.3-5.0**
Green urchin		**9.5-20.7**	**0.01-2.8**		**0.01-2.8**			**0.01-2.8**	**0.01-2.8**	
Barnacles	**0.3-0.5**			**0.07-0.27**			**0.27-0.54**			
Tunicates	**8.2-16.2**	**14-30**	**0.1-2**	**8.2-16.2**	**0.01-2**	**0.1-0.4**	**16.2+**	**7-14**	**14-30**	**0.1-0.4**
Shrimp		**1.66-3.37**	**1.66-3.37**		**0.03-0.31**	**0.003-0.014**		**0.31-0.78**	**0.78-1.66**	
Cod		**2.7-8.0**	**2.7-8.0**					**0.1-1.2**	**0**	
Sculpin		**3.4-9.4**	**0.5-1.7**					**0.5-1.7**	**0.5-1.7**	
Flatfish			**1.5-3.8**					**0.01-1.5**	**0.01-1.5**	
Forage fish		**0.38-0.68**	**0.01-0.18**			**12**	**1.3**	**0.4-0.75**	**0.01-0.18**	**0.4**
Total Catch [b]		**73-115**	**9-43**		**9-43**			**116-185**	**116-185**	
Total Fish catch [b]		**6-11**	**6-11**		**1-5**			**1-5**	**1-5**	
Total invertebrate catch [b]		**65-112**	**9-35**		**36-64**			**113-163**	**113-163**	

a. Station locations are shown in Figure 3-35.
b. Total catches reported by Fair and Nelson (1998).
+. No upper limit was reported. Catch was greater than accompanying value.

Sparks and Pereyra 1966. This survey utilized a trawl and biological dredge and covered part of the eastern Chukchi Sea, approximately 2 miles offshore. Conducted in 1959 as part of Project Chariot, the survey found the same invertebrates that later surveys collected near Portsite and elsewhere in the region. Some of the more common invertebrate groups found in the survey are shown in table 3-31. Collectively, the groups shown in this table accounted for about 95 percent of the samples.

Table 3-31. Common marine invertebrates found in the Eastern Chukchi Sea in 1959.

Invertebrate Group	Where Found
Worms	Silty substrate
Mysid shrimp	Near shore brackish areas
Clams	Muddy areas
Sea stars	Areas with higher densities of bivalve mollusks
Isopods	Cosmopolitan
Sea cucumbers	Silty substrate
Brittle stars	Silty substrate
Sand fleas (Amphipods)	Cosmopolitan
Snails and whelks	Wide spread, particularly in areas of high bivalve density
Bryozoans (colony organisms)	Cosmopolitan
Sponges	Near shore areas less than 20 fathoms
Shrimp	Cosmopolitan
Crabs	Cosmopolitan

Source: Sparks and Pereyra 1959.

The conclusions reached by Sparks and Pereyra from their survey included: (1) There are probably no commercial quantities of economically important invertebrate species in the area they surveyed; (2) the type and consistency of the bottom substrate greatly influences the distribution and abundance of benthic (bottom-dwelling) invertebrates in the area; and (3) ice scouring of near-shore areas greatly reduces the possibility of invertebrates becoming permanently established at water depths of less than 20 to 30 feet.

Wolotira et al. (1977). This trawl survey was conducted in 1976 as part of the National Marine Fisheries Service's Outer Continental Shelf Environmental Assessment Program (OCEAP) surveys in the Bering and Chukchi seas. The survey sampled 242 bottom stations in the eastern Bering Sea north of Saint Lawrence Island, and in the eastern Chukchi Sea north to Point Hope and west to the boundary established by the 1958 International Convention of the Continental Shelf. It included stations offshore of the Portsite. The survey focused on fish and invertebrates with potential economic importance and on sea stars and their relatives (echinoderms) because of their extremely high abundance relative to other invertebrates in the survey area.
Sea stars were the major invertebrate in the eastern Chukchi and eastern Bering Sea areas surveyed, and accounted for 65 percent of the catch. Among the more common marine invertebrates of economic importance found in the study area were Crangonid shrimp that live in the substrate, cockles and clams, whelks (marine snails), and crabs including small numbers of king crab. None of these invertebrates were found in commercial quantities.

Fair and Nelson (1999). Fair and Nelson (1999) conducted the most-recent comprehensive fish and invertebrate trawl survey of the southeast Chukchi Sea and accounted for 52 species of fish in 12 families. The stations surveyed were mostly the same as those surveyed during previous surveys, and included several near Portsite. They found relatively little diversity of fish species with cod (mostly saffron cod), pleuronectid flatfish (mostly Alaska plaice and yellowfin sole), and sculpin (mostly shorthorn sculpin), which collectively accounted for over 88 percent of the species caught. Smelt, herring, poachers, sandlance, eelpouts, snailfish, pricklebacks, and greenlings made up the remaining 12 percent of species caught. The highest catch in kilograms per kilometer trawled (CPUE) of saffron cod and flatfish was in the strait of

Kotzebue Sound and near Cape Prince of Wales. Catches of sculpin were highest in deeper water between Cape Prince of Wales and Point Hope. Rainbow smelt, a near-shore anadromous species of little importance, dominated the remaining 12 percent of species.

Fair and Nelson identified 71 invertebrate taxa representing nine phyla. Mollusca (clams and snails) had the greatest diversity followed by Arthropoda (crabs), Echinodermata (sea stars, basket stars, and urchins), Cnidaria (hydras and jellyfish), Annelida (worms), Bryozoa (bryozoans), Chordata (sea squirts), Phoronida (horseshoe worms), and Porifera (sponges). The highest catches of invertebrates were in deeper waters. In order of abundance (CPUE), sea stars or starfish was the most abundant, followed by the spider crab (sub-legal size *Chionoecetes opilio*), tunicates, green urchin, and sponges. Clams were more abundant in deeper water offshore, but no calms were found along shore north and south of the proposed disposal site.

Shrimp, and especially bottom dwelling Crangonid shrimp, are widely distributed in southeast Chukchi Sea and were caught at all but one station trawled by Fair and Nelson. Higher shrimp CPUE was generally found in near-shore waters between Cape Krusenstern and Point Hope.

Fair and Nelson (1999) surveyed the same general locations as Sparks and Pereyra (1966) and Wolotira et al. (1977) that included three stations near Portsite: one (station 58) north offshore of Kivalina, one (station 57) south offshore of Rabbit Creek, and one (station 56) about 18 miles directly offshore of Portsite. With exception of saffron cod, helmet crab, and shrimp, the relative abundance (CPUE in kg/km trawled) of fish and invertebrate species present increased with distance from shore. None of the near-shore species were particularly abundant (CPUE range 0-9.22 kg/km), but they are expected to be present near shore in varying abundance year round.

Blaylock and Erickson (1983 Red Dog Port Baseline Survey). This survey was part of baseline research for the Red Dog Mine EIS, which included the Portsite area. The survey area included approximately a 50-mile length of the coastline between Tasikpak Lagoon, which is north of Kivalina, to Kotlik Lagoon, south of Portsite, and extended from shore out to waters about 50 feet deep. Five transects were sampled and sampling methods included diving, bottom coring, trawling, and dragging a sled on the bottom to collect invertebrates. The five transects sampled ranged from about 32 miles northwest of Portsite to about 12 miles southeast of Portsite. Three of the survey transects are of special interest because they were close to Portsite. One transect was surveyed about 2 miles northwest of Portsite, a second one was directly at Portsite, and a third about 4 miles south of Portsite.

The most common marine invertebrates reported at the three transects are in table 3-32.

Table 3-32. Marine Invertebrates found in the Portsite area in 1983.

Location of Transect Relative to Portsite	Common Invertebrates (Listed in descending order found)
Two Miles North	Amphipods, Brittle Stars, Sea Stars, Mysid Shrimp, Cumaceans (crustacean), Worms, Crabs, Bryozoans (colony organism), Shrimp.
At Portsite	Worms, Amphipods, Shrimp, Mysid Shrimp, Crangon Shrimp, Brittle Stars, Sea Stars, Tunicates (colony organism), Clams, Crabs.
Four Miles South of Portsite	Worms, Amphipods, Sea Stars, Brittle Stars, Shrimp, Crangon Shrimp, Mysid Shrimp, Isopods, Cumaceans (crustacean), Crabs.

Source: Blaylock and Erikson 1983.

Worms and amphipods were frequently the most numerous invertebrate collected. Brittle stars and sea stars were abundant and three varieties of shrimp were common. Helmet crab (Telemessus) was the only crab species caught by trawling. Apparently no crab pots were placed during this survey. Red king crab, although possibly present in the area, were not caught.

RWJ (2000 Portsite EIS Survey). Surveys for marine invertebrates were conducted off Portsite during the spring and summer of 2000 as part of the environmental studies conducted in preparation for this draft EIS. These surveys, which included collecting invertebrates and plankton living in the water column, on the surface of the bottom and in the bottom sediments, are briefly described below. Collecting methods used baited pots for crabs and shrimp, a trawl for collecting fish and invertebrates living on or near the bottom (benthic fish and invertebrates), plankton net for sampling zooplankton, and a dredge for collecting worms and other invertebrates living in the mud and sand on the bottom. The locations of surveys reported in the RWJ report are illustrated in figure 3-34. Principal organisms collected in trawl samples, which represent the broadest and most effective open-water collection technique for marine organisms of particular interest, are presented in table 3-33.

Pot Surveys. The pot surveys during spring used baited shrimp and crab pots fished through holes cut in the ice. Crab and shrimp pots were set at 11 stations: six north, four south, and one about 1.1 miles straight offshore from the DMT. Distances from Portsite ranged from about 2.1 miles for pots set north of Portsite to about 1.9 miles for pots set south of Portsite. Most pots were set in water 34 feet deep from 0.53 mile to 0.75 mile off shore, but the pots set 1.1 miles straight out from the Portsite were set in water 41 feet deep.

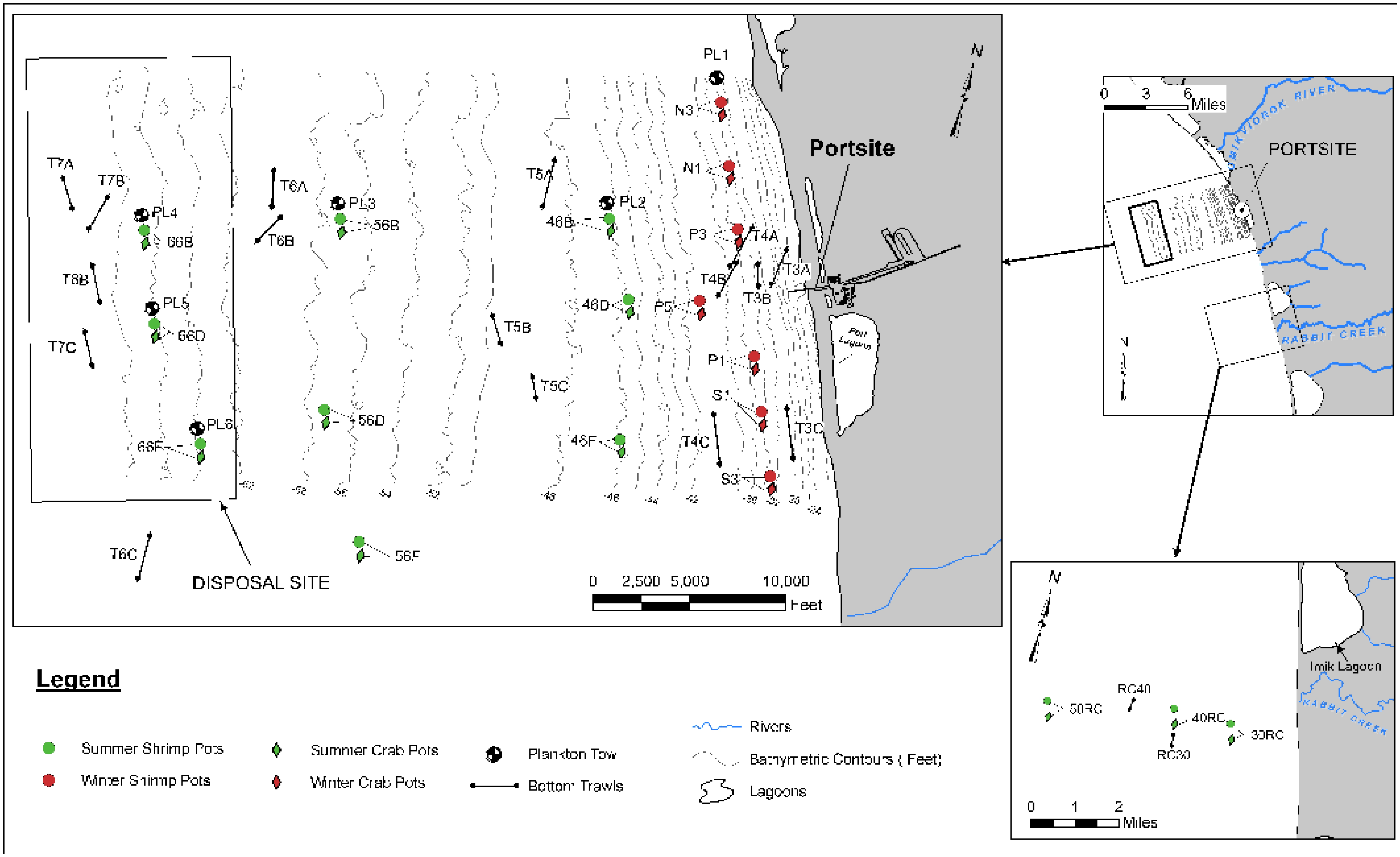


Figure 3-34. Invertebrate and plankton surveys location at Portsite as reported by RWJ Consultants, Inc. (RWJ 1999, 2001).

Table 3-33. Ranking by wet weight (in g/m^2) of the top 15 taxa (by overall weight) for trawl samples collected offshore of the DeLong Mountain Terminal in summer 2000 (RWJ 2001).

Common Name or Taxa	Scientific Name	RC30	RC40	T3A	T3B	T4A	T4B	T5A	T5B	
Seastar	*Evasterias echinosoma*		0.203		0.682		0.641	0.000	1.249	
Helmet crab	*Telmessus cheiragonus*	0.797	0.129	0.247		0.163	0.199	0.105	0.156	
Blacktip seastar	*Lethasterias nanimensis*	0.315	0.370		0.510	0.258	0.207		0.356	
Shrimp	Crangonidae		0.190	0.098	0.063	0.183	0.244	0.000	0.475	
Shrimp	Caridea	0.555	1.212					0.000		
Saffron cod	*Eleginus gracilis*	0.543	0.167	0.689		0.011	0.023	0.036		
Yellowfin sole	*Pleuronectes asper*	0.093	0.256	0.046	0.104	0.033	0.050	0.014	0.131	
Basket star	*Gorgonocephalus caryi*						0.003		0.012	
Seastar	*Leptasterias polaris acervata*	0.165	0.033		0.057	0.027	0.304	0.000	0.069	
Sculpured shrimp	*Sclerocrangon boreas*	0.455			0.042					
Northern sculpin	*Icelinus borealis*	0.028	0.037	0.018	0.031		0.053	0.008	0.032	
Snake prickleback	*Lumpenus sagitta*	0.061	0.211	0.039	0.016	0.038	0.055	0.053	0.008	
Alaska plaice	*Pleuronectes quadrituberculatus*					0.035			0.061	
Starry flounder	*Platichthys stellatus*			0.022	0.076					
		T5C	T6A	T6B	T6C	T7A	T7B	T7C	T8B	Average
Seastar	*Asterias amurensis*	3.044	2.912	2.659	1.833	1.393	2.163	2.729	2.194	2.048
Seastar	*Evasterias echinosoma*	0.861		1.038	0.670	0.147	0.970	0.132	0.334	0.433
Helmet crab	*Telmessus cheiragonus*	0.427	0.219	0.194	0.041	0.294	0.038	0.205	0.053	0.204
Blacktip seastar	*Lethasterias nanimensis*	0.769	0.055	0.163	0.027	0.081		0.089		0.200
Shrimp	Crangonidae	0.484	0.153	0.106	0.127	0.168	0.210	0.191	0.206	0.181
Shrimp	Caridea		0.213		0.175	0.222		0.260	0.216	0.178
Saffron cod	*Eleginus gracilis*	0.028	0.011	0.002	0.008	0.002	0.050	0.007	0.010	0.099
Yellowfin sole	*Pleuronectes asper*	0.090	0.075	0.082	0.061	0.036	0.170	0.114	0.118	0.092
Basket star	*Gorgonocephalus caryi*			0.048	0.004	0.349	0.296	0.359	0.344	0.088
Seastar	*Leptasterias polaris acervata*	0.094					0.016		0.076	0.053
Sculptured shrimp	*Sclerocrangon boreas*			0.149			0.113			0.047
Northern sculpin	*Icelinus borealis*	0.002	0.030	0.004	0.047	0.093	0.079	0.063	0.134	0.041
Snake prickleback	*Lumpenus sagitta*	0.050	0.014		0.014	0.010	0.007	0.007	0.016	0.037
Alaska plaice	*Pleuronectes quadrituberculatus*		0.022		0.055	0.066	0.056	0.025	0.068	0.024
Starry flounder	*Platichthys stellatus*				0.036	0.031	0.090	0.098		0.022

The pots fished during summer were set in water from 44 to 66 feet deep between 1.7 and 6.6 miles off shore from Portsite. Nine stations were sampled during the summer. Another three stations from 1.5 to 5.7 miles offshore from Rabbit Creek, about 10 miles south of Portsite, were also sampled with baited pots during the summer. Marine invertebrates caught during the spring and summer pot surveys are listed below, in descending order of abundance:

1. Sea Star
2. Helmet Crab
3. King Crab
4. Lyre Crab
5. Shrimp
6. Jellyfish
7. Brittle Star

Trawl Survey. Eighteen stations were surveyed by dragging a 16-foot-wide trawl on the bottom for approximately 10 minutes at each station. The trawl stations ranged from about 24 feet deep at 0.3 mile offshore, to 70 feet deep 7.3 miles offshore. Two additional stations were trawled about 2.8 and 3.8 miles offshore from Rabbit Creek, about 10 miles south of Portsite. The marine invertebrates caught in the trawl survey were predominantly shrimp (3 varieties), followed by sea star (2 varieties), and helmet crab.

Plankton Survey. During the spring and summer survey periods, plankton samples were also collected through the ice in the spring and from a vessel during the summer. Very few planktonic invertebrates were collected through the ice during the spring, but in the summer the larvae and pre-settle juveniles from many invertebrates were collected. Larvae included jellyfish, amphipods, copepods, and arrow worms. The most prevalent zooplankton larvae collected were copepods, followed by larvae of sand dollars, sea urchins, and jellyfish. No king crab larvae were collected during the spring or summer sampling period.

Bottom Sediment Survey. Samples of sediment-dwelling invertebrates (infauna) were taken from a 5,600-acre offshore area that could be used for disposal if a navigation channel was dredged at Portsite. Sampling stations were stratified at 2-foot-depth increments between 63 to 71-foot depth contours, and randomly distributed within the potential disposal area. Marine worms of four families were the dominant (in numbers) invertebrate in the samples, and amphipods were second in order of abundance. A high degree of similarity was exhibited in the density of organisms between the stations sampled.

3.5.2.2 Marine Invertebrates of Special Interest

During scoping for the draft EIS, some marine invertebrates in the vicinity of Portsite were of particular interest because they: (1) have potential commercial and subsistence value to local people; (2) are food resources for larger invertebrates, fish, and marine mammals; and (3) are likely to be in areas that might be directly affected by construction of marine transportation improvements at Portsite. Those invertebrates include king crab, lyre crab, helmet crab, and shrimp. Information about the distribution, life history, and environmental factors influencing populations are summarized in this section.

King Crab.

Distribution. The three most important species of king crabs in Alaskan waters are red king crab *Paralithodes camtschatica*, blue king crab, *P. platypus*, and golden king crab, *Lithodes aequispina* (Kessler 1985). Based on size, abundance, and distribution, red king crab is the principal species south and north of the Alaska Peninsula, where they range from the Queen Charlotte Islands, west to Japan and north through the Chukchi Sea to Barrow, Alaska. Their center of abundance in Alaskan waters is the Unimak Pass area of the Aleutian archipelago and southeastern Bering Sea. The Chukchi Sea, including the Portsite area, is on the outer margins of their natural range.

The slightly smaller blue king crab is locally abundant in Olga Bay, Kodiak Island, and near the Pribilof Islands and Saint Matthew Island in the Bering Sea, but has also been reported in the Chukchi Sea (Sparks and Pereyra 1966). Golden king crab can be found north and south of the Alaska Peninsula along the continental slope in waters deeper than 100 fathoms, and would not likely be found in the shallow Chukchi Sea.

Adult red and blue king crabs migrate between deeper offshore and shallower inshore waters. The inshore migration is generally a more rapid mating migration, while the offshore migration is generally a slower feeding migration. Adult male red king crabs have been known to migrate up to 100 miles round-trip annually, moving at times as fast as 1 mile per day (Blau 1997). Less is known of the migration of golden king crabs, but it is believed they migrate more in a vertical fashion since they generally inhabit steep-sided ocean bottoms (Blau 1997).

The Bering Sea Fishermen's Association (BSFA) conducted pot surveys for red king crabs to the north and south of Portsite during the summer of 1999 (BSFA 2001). The largest catch of legal subsistence-size (≥4-inch carapace width) in the BSFA survey was off Rabbit Creek about 9 miles south of Portsite. In the Rabbit Creek area, the pots were set in water 25 to 100 feet deep and from ¼ mile to more than 3 miles offshore (J. Schaeffer Jr. personal communication). The substrate off Rabbit Creek is primarily gravel or sand with gravel (J. Schaeffer jr. personal communication, RWJ 2001). Smaller catches of legal-sized king crab were recorded north of the Portsite, off Kivalina, and along the shoreline north to Cape Thompson.

Red king crabs were also captured in pots set under the ice during the spring and summer 2000 Portsite surveys (RWJ 2001). A total of 95 crabs were caught during March, April, and May under the ice in approximately 34 feet of water, while one crab was caught by trawl during August in 60 feet of water. The mean carapace width of 47 male red crabs that were measured was 5 inches, (SE. 0.09). Thirty-three of these crabs were of legal size (≥4 inches) and 14 were sub-legal. Catches through the ice off Portsite suggested that at least on some occasions during the late winter/early spring, there are subsistence quantities of red king crab in the Rabbit Creek-Portsite area.

Chukchi Sea populations of king crab probably inhabit the outer geographical limits of the species range. Abundance of red king crab in the southeastern Chukchi Sea in general has historically been low, and the findings of the Portsite surveys are similar to those of other eastern Chukchi Sea surveys (RWJ 2001). Sparks and Pereyra (1966) hypothesized that the king crab population in the southeastern Chukchi Sea may be generally low because replenishment may be dependent upon larvae drifting north on currents from the Bering Sea. RWJ (2001) hypothesizes that low king crab abundance in the vicinity of Portsite could be due to an absence of suitable hard substrate. Additionally, the BSFA (2001) hypothesized that local abundance of king crab may be influenced by seasonal influxes of unfavorable water temperature and salinity concentrations from coastal rivers, implying that red king crab may migrate away from places where rivers flow into the sea.

Biology. Adult red king crabs are reddish brown to purple in color and are covered with spines. They can be quite large, with males reaching in excess of 3 feet across. Their diet is variable depending on their age and location, but as adults it generally consists of sea stars, urchins, clams, barnacles, marine worms, and other benthic invertebrates (invertebrates that live on or near the bottom).

Larval red and blue king crabs settle in waters less than 90 and 200 feet deep, respectively, while larval golden king crabs appear to settle in waters 300 feet or deeper. In nature, the young red king crabs are found almost exclusively on live substrates such as hydroids, bryozoans, sea stars, mussels, and worm colonies, and prefer gravel and mixed substrates to sand (Armstrong, et al. 1998, Stevens and Kittaka 1998).

Red king crab adults seem to prefer sand or mud bottoms ranging in depth from 10 to 1,200 feet . King crabs are agile underwater and can scale rock walls and pilings (T. Loher personal communication). Near-shore molting and mating areas often contain seaweeds or cobble and boulders. Areas with structure such as kelp, rocks, or even pilings appear to be more successful as larvae settling or juvenile rearing areas than sandy or muddy substrates without much relief.

Adult females and some adult males molt and mate before they start their offshore feeding migration to deeper waters. Adult females must molt in order to mate but males do not. Mating will be unsuccessful for females that mate more than 5 days after molting. Adult males often skip a molt and keep the same shell for 1 or 2 years.

Red and blue king crab come to shallow water in late winter and by spring the female’s embryos hatch. Adult female king crabs can brood thousands of embryos underneath their tail flap for about 11 months. Embryos are fully developed and hatch just before the female molts and mates. They hatch as swimming larvae, but they are easily transported by the movements of tides and currents. After feeding on plant and animal plankton for several months and undergoing several body changes with each molt, the larvae settle to the ocean bottom and molt into miniature crabs. Early summer plankton sampling in the waters off Portsite did not collect any king crab larvae, which indicates that those waters are not of particular importance to king crabs in the swimming larvae stages.

The juveniles stay in shallow waters and may aggregate into huge balls. In harbor areas such as at Kodiak, Alaska, the juvenile pods commonly form on the pilings of docks and piers. The pods disperse at night, reforming at dawn. Pods are found year round and are composed of both sexes of similar size. Podding behavior is believed to provide protection against predators. Juveniles molt many times in their first few years, then less frequently until they reach sexual maturity in 4 or 5 years. Juvenile crabs inhabit rock crevices and other protective niches such as kelp beds after the fifth molt and until adulthood (Jewett and Powell 1981).

King crab are opportunistic feeders. They eat mostly invertebrates, fish, and plant material. The stomach contents of male king crab caught in pots set under the ice in April were examined to learn what king crab caught near Portsite had been eating. Seventeen food items were found in the 25 stomachs examined. Forty-six percent of the stomachs contained marine worms, 38 percent amphipods, 37 percent fish remains, 36 percent brittle stars, 16 percent octopus or squid, 12 percent clams or cockles, 12 percent plant materials, and 28 percent contained unidentified materials. These food items found in king crab stomachs at Portsite are similar to food items found in king crab stomachs in others areas (RWJ 2001).

<u>Environmental Influences.</u> Predation is a significant factor influencing the abundance of king crab. High mortality of planktonic larvae occurs from predation by planktivores. Bottom fish and other species of crabs prey on juveniles. Adult crabs in the soft-shelled stage are susceptible to predation and are preyed upon by large fish such as Pacific cod and halibut. Bearded seals have also been observed preying on adult king crab (Jewett and Feder 1981). Commercial and subsistence fisheries are forms of predation by humans. Several diseases and parasites including bacterial rust disease, parasitic Rhizocephalen barnacles, and pseudocoelonates and nemertean worm infestations are known to afflict king crabs.

The migrations of crabs from shallow near-shore waters to deeper offshore areas may involve important bathymetric changes and movements between water masses having distinct oceanographic characteristics including temperature, and to a lesser extent salinity (Freire and Gonzalez-Gurriaran 1998). King crabs are unable to withstand wide variations in salinity (Eldridge 1972), and although they can withstand wider temperature ranges, they are adapted to cold water ranging from –1 to 10 ºC (Bartlett 1976). Summering adults inhabit a temperature range from 0 to 5.5 ºC. The maximum abundance of females occurs from 3 to 5 ºC and the maximum abundance of males occurs at 1.5 ºC (Stinson 1975 in Pereyra et al. 1975.). Larvae can molt successfully at temperatures between 2 and 12 ºC, but a decrease in temperature from 10 to 5 ºC delays the development time (Kurata 1960, 1961). Fair and Nelson (1999) reported summer bottom temperatures ranging from 2 to 10 ºC in the southeastern Chukchi Sea within 25 miles of shore, indicating that summer temperatures are suitable for king crabs in a wide range of depths off Portsite.

Jewett (1999) studied the impacts of bucket-dredge mining in the marine environment at Nome, Alaska, on the migration, spawning, and feeding of Bering Sea red king crabs. This 4-year study described the reactions of king crab to the dredging operation, and may also indicate potential for impacts to red king crab in the Portsite area because the substrate and other environmental conditions off Nome are similar to those off Portsite (relatively flat with a sand/mud veneer and similar currents).

The dredge mining at Nome, mostly to depths of 30 to 66 feet, removed approximately 7.2 million cubic yards of material, changing the substrate relief in areas from relatively flat to one with mounds and depressions. Changes to the local substrate by the settling of dredged materials and turbidity plumes, and the effects of current on re-establishing gradient, were also reported. King crabs were not present in the dredged area during the June through October mining operations, but occupied the area during the March and April near-shore molting and spawning season.

Comparisons between mined and un-mined stations revealed that the mining and displacement of the sediment had almost no noticeable effect on crab population size or distribution. Crab catches, size, quantity, and contribution of most prey groups in crab stomachs were similar between the mined and un-mined areas, but eelgrass (*Zostera marina*) and hydroids that tended to collect in mined depressions, were more common in the stomachs of crabs in the mined areas.

Red, and small numbers of blue king crabs are found in the shallow waters of the southeastern Chukchi Sea (Sparks and Pereyra 1966, Wolotira et al. 1977, Feder and Jewett 1978, Wolotira et al. 1979, RWJ 2000, BSFA 2001), but commercial quantities have not been found. The apparent lack of commercial quantities of king crabs in the southeastern Chukchi Sea (including Portsite) may be related to the conclusion offered by Sparks and Pereyra, who hypothesized that the majority of southeastern Chukchi Sea species are of boreal Pacific origin and the southeast Chukchi Sea populations are limited to the northward drift of larvae from the Bering Sea. Other environmental influences on the distribution of red and blue king crabs include local substrate types, water temperatures, salinity, food availability, and migration.

Data cited in this section from the regional surveys conducted in the southeastern Chukchi Sea and from collections in the marine waters off Portsite report that king crabs are present at least occasionally throughout the general area around Portsite, and may be more abundant in the waters south of Portsite. They were collected only occasionally in waters less than 70 feet deep during the summer, but were much more abundant in shallower water during the winter. This is consistent with general accounts of red and blue king crab biology.

Lyre Crabs.

Distribution. Lyre crabs, also known as toad and Hyas crabs, are represented in Atlantic, Pacific, and Arctic Ocean waters by the principal species *Hyas araneus, H. lyratus*, and *H. coarctatus*. *Hyas araneus* is an Atlantic Ocean species, while *H. lyratus* and *H. coarctatus* are Pacific species. Both Pacific species are widely distributed through the Bering and southern Chukchi seas and the northern Sea of Okhotsk at depths from subtidal to more than 5,000 feet, while *H. coarctatus* is widely distributed in Arctic Ocean waters. Lyre crabs have no commercial or subsistence value in the Chukchi Sea, but have an ecological value as food for ringed and bearded seals.

In the 1959 marine invertebrate survey by Sparks and Pereyra (1966), the greatest abundance of lyre crabs appeared to be in the deeper waters offshore of the Cape Thompson area.

Lyre crab was the fourth-most plentiful invertebrate caught during the 2000 pot survey off Portsite (RWJ 2001). Lyre crabs were caught during the spring under-ice pot survey, but not during the summer pot or trawl survey in the same general areas and habitats. Similar to observations for red king crab, the absence of lyre crab from summer catches could suggest offshore migration to deeper water during the summer months. Lyre crabs are not important commercially or in subsistence.

Biology. The shape of the lyre crab shell resembles a violin or lyre, with the parts separated by a constriction. Lyre crabs are generally a dull, reddish brown color above and a pale off-white below, but their color varies widely. Males are distinguished from females by a smaller and narrower abdominal flap. Males (carapace length to 4 inches) tend to be larger than females (carapace length to 3 inches).

In both sexes, as in other true crabs, lyre crabs do not mature until they complete a final or terminal molt. Lyre crabs cease growing after the terminal molt. Crabs mate during the terminal molt while both male and female are in the soft-shelled condition. This is an important mating, since the female stores sperm for several years to fertilize subsequent batches of eggs. Subsequent mating, however, with the female in the hard-shelled condition serves to replenish the sperm supply. Eggs are carried for about 10 months until they hatch into larvae during the spring and summer. It is likely that most females produce a new clutch of eggs each year.

Lyre crabs eat a large variety of material and organisms, including algae, small crustaceans such as amphipods, small crabs, worms, sea stars, clams, and sea urchins.

Predators of lyre crabs vary with locality and can include octopus, sea otters, seals, and other species of crabs. The two species of Pacific lyre crab, *H. coarctatus* and *H. lyratus,* were found in the stomachs of ringed and bearded seals during Cape Thompson investigations (Johnson et al. 1966).

Environmental Influences. The Pacific lyre crab *H. lyratus* seems to prefer warmer and shallower water, which is demonstrated by their apparent absence in numbers from the Arctic Ocean, where the lyre crab *H. coarctatus* thrives. Shallow areas are often rockier and warmer, and *H. lyratus* may prefer this habitat to the deeper and colder, muddy area inhabited by *H. coarctatus*. Both species may prefer rocky habitat if given the opportunity because they are not especially good at burying themselves in sand and are more dependent on camouflage for protection from predators: a survival adaptation that is easier in rocky areas with a greater variation in background colors and textures.

Helmet Crab.

Distribution. The helmet crab *Telmessus cheiragonus* ranges from the Chukchi Sea (Sparks and Pereyra, 1966) to Monterey, California; however, they are rare south of Puget Sound, Washington. They also are found from Siberia to Japan in the western Pacific. A similar appearing, but larger species, the hair crab *Erimacrus isenbeckii*, is common in the Bering Sea.

In many areas of their range, helmet crab prefer habitat composed of eelgrass beds and rocky areas with algal cover in water depths ranging from low intertidal to 360 feet (NMFS 2001). In near-shore areas of the Chukchi Sea where there are no eelgrass beds, helmet crabs inhabit the soft, homogenous substrates typical of the area. In the early summer, their molted carapaces can be seen in large numbers on the beaches of the eastern Chukchi Sea.

Helmet crabs appear to be the most abundant species of crab in the Portsite area (RWJ 2001). Catches of helmet crabs were common during both the spring and summer Portsite pot survey, suggesting this species is present near shore during both the ice-covered and open-water seasons.

Summer trawling in the Portsite area was an effective collection method. Collection results reported by RWJ (2001) showed substantially more helmet crabs in the waters off Rabbit Creek, about 9 miles south of Portsite, than in collections off Portsite. Water depths at Portsite apparently influenced or were associated with helmet crab abundance. Largest collections per trawling unit of effort were in waters close to shore and depths of less than 40 feet. Catches averaged substantially lower in trawl collections 5 or more miles offshore in water depths of more than 50 feet (table 3-30).

Biology. Helmet crabs can grow to about 4 inches in carapace width. Food for helmet crabs consists of a variety of organisms and plant material, including algae, amphipods and other small crustaceans, small crabs, worms, starfish, clams, and sea urchins. Predators vary with locality and include octopus, sea otters, bearded and ring seals, and other species of crabs. Helmet crabs were found in the stomachs of ringed and bearded seals during the Cape Thompson investigations (Johnson et al. 1966). There is no known commercial or subsistence interest in the Pacific species of helmet crabs.

Environmental Influences. Helmet crabs are widely distributed on a variety of habitats. The distribution and abundance of helmet crabs within their geographical range can result from changes in water temperature and salinity, and the presence and abundance of predators and parasites. Physical and chemical conditions of the environment can also have a role in the presence of viral and bacterial disease. Violent storms are also noted to cast a number of helmet crabs on Arctic beaches.

Shrimp

Distribution. Two families of shrimp likely dominate shrimp in the eastern Chukchi Sea: the family Crangonidae and the family Pandalidae. Crangonid shrimp live mostly on the bottom in holes in the mud and sand. Pandalid shrimp are also benthic (living on or near the bottom). Some species of both families migrate vertically into the water column at times.

Several species of shrimp of the family Crangonidae inhabit the southeastern Chukchi Sea, including *Argis dentate, and A. lar, Crangon comminis, C. dalli,* and *C. septemspinosa,* and *Sclerocrangon boreas* (Kessler 1985). Shrimp of this family are globally distributed and are sometimes collectively referred to as sand or mud shrimp.

The depth range of crangonid shrimp varies from 18 to 600 feet. Seasonal inshore-offshore migrations of these shrimp are commonly displayed, and the depths occupied during fall and winter tend to be deeper than those occupied during spring and summer (ADFG 1986).

Sparks and Pereyra (1966), Wolotira et al. (1977), Fair and Nelson (1999) caught relatively small numbers of mostly crangonid shrimp in waters offshore of Portsite, and Blaylock and Erickson (1983) caught relatively small numbers of mostly crangonid shrimp in waters near Portsite (Section 3.5.2). Small numbers of crangonid shrimp were also caught offshore of Portsite during the spring and summer of 2000 (RWJ 2001). The locations surveyed by RWJ are shown in figure 3-36.

The relative abundance of shrimp caught by Fair and Nelson (1999) on the three stations near Portsite ranged from 0.03 to 3.37 kg\km trawled, with the higher numbers of shrimp caught on the inshore stations north and south of Portsite. Although relatively higher numbers of shrimp were caught on the near-shore stations during the survey, most shrimp are migratory and would likely move to deeper water with season and age. Summer trawling in the waters near Portsite (RJW 2001) found crangonid shrimp predominantly in water ranging from 30 feet deep to the deepest locations trawled, in about 70 feet of water. While crangonid shrimp were broadly, but sparsely distributed in collections directly offshore from Portsite, they were several times more abundant at comparable depths offshore from Rabbit Creek.

Several species of pandalid shrimp are present in the southeast Chukchi Sea and near Portsite, but the humpy shrimp, *Pandalus goniurus*, is the most common. The northern pink shrimp *P. borealis*, and a species of side-stripe shrimp, *Pandalopsis aleutica*, are also present in small numbers. Like the crangonid shrimp, pandalid shrimp were more abundant south of Portsite.

Other shrimps in the family Hippolytidae are also found in the eastern Chukchi Sea and near Portsite, but in very low numbers. These shrimps include the spiny and polar lebbids, *Lebbeus gronenlandicus* and *L. polaris*, and several shrimps in the genus, *Eualus*.

Biology of Crangonid Shrimp. Because crangonid shrimp are likely the most important family of shrimp in the marine food chain of the eastern Chukchi Sea, including waters near Portsite, some aspects of their biology is included in this chapter.

Crangonid shrimp are primarily benthic as juveniles and adults, and are particularly suited to soft bottoms because they can bury themselves into the substrate so only their eyestalks are exposed (Siegfried 1989). All species of crangonid shrimp have a similar, flattened appearance and have similar life histories. Some species of crangonids reach about 5 inches in length, and offshore populations may grow longer than inshore populations of the same species. Larvae and younger shrimp appear to tolerate a wider range of salinity than do older shrimp. Many crangonid species also show migratory patterns from shallow to deeper water with season and age.

In Alaskan waters, eggs are carried from 6 to 11 months. Larvae are planktonic for about 2 to 3 months before passing through six stages to become juveniles in adult form. Larvae migrate to shallow water where they spend their first summer before moving to deeper water to join the adult population during their first winter. The juvenile and adult forms become benthic with daily vertical migrations. Younger crangonid shrimp appear to tolerate a wider range of salinity and temperature than do older shrimp. These shrimp mature at varying rates and females of some species can live to 5 or 6 years.

Adult crangonid shrimp are both scavengers and predators. They eat dead animal material and prey on living organisms including copepods, amphipods, euphausiids, annelids, and other shrimp (ADFG 1986). Larvae of crangonid shrimp are consumed in large quantities by planktivores, while the juvenile and adult shrimp are eaten by a variety of marine fish, birds, and mammals. Crangonid shrimp are often found in the stomachs of bearded and ringed seal in the eastern Chukchi Sea (Johnson et al. 1966), and Bering Sea walrus (Fay et al. 1977). Native hunters also report that bearded seal stomachs sometimes contain quantities of shrimp (R. Adams, Sr. and J. Schaeffer Jr. personal communication) that are likely crangonids. Shrimp are reported in stomachs from seals collected in the spring from throughout the southeastern Chukchi Sea and at varying distances offshore. This indicates that during the spring when ice is present in the Chukchi Sea, shrimp are comparatively abundant and widely distributed in the same general areas as bearded seals. Trawl collections during the summer found the same types of shrimp to be widely distributed, but relatively low in abundance, indicating they may move farther offshore during the ice-free months.

Environmental Influences. The substrate preferences of shrimp appear to be species specific. Most species of crangonid and pandalid shrimp prefer smooth bottoms of mud and silt. Water temperature is the controlling factor for mating in shrimp. Water temperature also has an important role in the development of larvae. Most adult pandalid species prefer deeper water (150 to 1,500 feet) than most crangonid species.

3.5.3 Fish

Fish that inhabit the Portsite area either seasonally or year round can be separated into three groups: marine, anadromous, and freshwater. Marine fish spend their entire life cycle (spawning, hatching, rearing, juvenile and adult stages) in the marine environment. Anadromous fish hatch and rear in freshwater habitats and migrate to the marine environment as juveniles, where they spend their adult lives, returning to freshwater to spawn. Freshwater fish spend their complete life cycle in freshwater streams and lakes. Information about the types and abundance of each of these three groups of fish in the Portsite area is presented in section 3.5.3.

3.5.3.1 Marine Fish

Marine fish are species that are spawned, hatched, and spend their lives in the marine environment. Some marine species, including starry flounder and several species of sculpin, can tolerate brackish water and even freshwater, for limited periods, but spawn and spend most of their lives in the marine environment. Anadromous fish grow to adulthood in salt water but spawn in freshwater. Catadromous fish live in freshwater but spawn in saltwater.

Most of the marine invertebrate surveys in the southeastern Chukchi Sea (Alverson and Wilimovsky 1966, Wolotira, et al. 1977, Feder and Jewett 1978, Wolotira, et al. 1979) also collected marine fish. Like the invertebrate surveys, the surveys that included fish characterized marine fish resources over a broader area offshore from the Portsite. The 1982 surveys conducted by Dames and Moore (1983) during June, July, and August for the 1984 Red Dog Mine EIS were the only early surveys at Portsite.

Twenty species of marine fish were caught during the 1982 Dames and Moore, Inc. surveys with considerable overlap in species between gear types (table 3-34). Starry flounder, Arctic flounder, rainbow smelt, and saffron cod dominated the beach seine hauls. Saffron cod, followed by starry flounder and Pacific herring, dominated the ocean seine hauls. Saffron cod and Atka mackerel dominated the fyke net sets. Yellowfin sole, Alaska plaice, and saffron cod, dominated over 70 percent of the trawl catch.

Table 3-34. Numbers and percent occurrence of marine fish species collected during summer 1982 (Dames and Moore 1983).

Species	**Gear Type and Approximate %**		
	Beach Seine (approx %)	Fyke Net (approx %)	Trawl (approx %)
Starry Flounder - *Platichthys stellatus*	7(15)	7(6)	14(3)
Arctic Flounder - *Liopsetta glacialis*	2(4)	1(1)	17(4)
Yellowfin sole - *Limanda aspera*			94(204)
Longhead dab - *Limanda proboscidea*			16(4)
Alaska plaice - *Pleuronectes quadrituberculatus*			87(19)
Sand lance - *Ammodytes hexapterus*			3(1)
Rainbow smelt - *Osmerus mordax dentex*	2(4)	4(3)	10(2)
Pacific herring - *Clupea harengus pallasi*	5(11)	8(7)	
Saffron cod - *Eleginus gracilis*	24(52)	77(65)	143(31)
Tubenose poacher - *Pallasina barbata*			11(2)
Sturgeon poacher - *Agonus acipenserinus*			9(2)
Atka mackerel - *Pleurogrammus monopterygius*		19(16)	9(2)
Fourhorn sculpin - *Myoxocephalus quadricornis*			6(1)
Slender eelblenny - *Lumpenus fabricii*			20(4)
Arctic shanny - *Stichaeus punctatus*			21(5)
Bering poacher - *Occella dodecaedron*			1(1)
Surf smelt - *Hypomesus pretiosus*	2(4)		
Larval smelt - *Family Osmeridae*	4(9)		
Ringtail snailfish - *Liparis rutteri*			1(1)
Nine-spine stickleback - *Pungitius pungitius*		1(1)	
	46(100%)	118(100%)	462(100%)

As hypothesized by Sparks and Pereyra (1966) and Wolotira et al. (1979), the majority of species in the area appear to be of boreal Pacific origin and have centers of distribution far to the south of Portsite. Both reports noted relatively low catches of fish per unit of effort offshore from Portsite, but Sparks and Pereyra (1966) noted substantially larger catches south of Portsite, closer to Cape Krusenstern.

A trawl survey for marine fish was also conducted off the Portsite in 2000 (RWJ 2001) to identify fish resources in areas that might be dredged or used for disposal for navigation improvements at Portsite. Marine fish species diversity and abundance was not particularly high off Portsite during the survey. Marine fish caught in the trawl were predominantly yellowfin sole, northern sculpin, saffron cod, snake prickleback, sturgeon poacher, Arctic staghorn sculpin, and longhead dab.

Saffron cod often are associated with shallow, less saline near-shore marine waters and in many places along the northwestern Alaska coast are the “tomcod” caught by hook and line through the ice in lagoons and near shore. They also are a principal food of ringed seals. In trawl collections reported by RWJ (2001), they were most abundant in waters less than 40 feet deep and were most abundant in collections off Rabbit Creek, about 9 miles south. Yellowfin sole, the second most abundant marine fish collected by Dames and Moore (1983) also were common in collections reported by RWJ (2001) and were most abundant in about the same water depths and locations as saffron cod. Several species of marine sculpins were collected near Portsite. They, along with saffron cod, make up almost the entire late winter diet of ringed seals at some locations. In summer trawl collections, they were widely distributed in various water depths, but were caught in greatest abundance off Rabbit Creek.

Many marine fish species found during the survey or expected to be in the Portsite area have important positions in the ecological food web. For example, Johnson et al. (1966) found herring, capelin, smelt, cod, sculpin, sand lance, prickle backs, sole, and flounders in the stomachs of ringed and bearded seals. Of these species, cod and sculpin were up to 99 percent of the volume in ringed seal stomachs in some months.

3.5.3.2 Anadromous Fish

Anadromous fish are fish that spawn, hatch, and rear for varying lengths of time in freshwater before migrating to sea as juveniles. Anadromous fish feed at sea while attaining sexual maturity and return to freshwater to spawn. Some species like Pacific salmon die after spawning once, while other species like steelhead, char, and Atlantic salmon can spawn more than once. Most anadromous salmonid species show a strong fidelity to their natal stream and return to spawn in the stream where they were hatched.

Some individuals or entire stocks of an anadromous species never migrate to sea and become “resident” to a particular drainage. These individuals, as is often the case for Dolly Varden in many coastal Alaskan rivers, do not reach the size of their anadromous counterparts. Some river drainages support both resident and anadromous forms of Dolly Varden.

The principal anadromous species in the Portsite area include five species of Pacific salmon and Dolly Varden char. Some smelt, whitefish, and cisco species in the region also are anadromous. Many of these species are not truly anadromous, but can winter in salt or brackish water and then “run” in rivers the same as salmon and char. Dolly Varden run the Wulik River in large numbers while salmon, although larger in size, return in smaller numbers. Whitefish and smelt are present in the Portsite area, but only whitefish are present in numbers significant for a viable subsistence fishery.

The Dames and Moore, Inc. (1982) surveys used beach and ocean seine hauls, fyke net sets, and trawling on transects near Portsite. Their surveys documented six species of anadromous fish, including pink salmon, chum salmon, Arctic char, Arctic cisco, and humpback whitefish. The species identified as Arctic char, *Salvelinus alpinus,* however, was most likely the northern race of Dolly Varden, *S. malma,* from the nearby anadromous streams that have runs of this species, and the Arctic cisco was most likely the Bering cisco, *Coregonus laurettae*. Overall abundance of anadromous fish was low with only 110 caught in 46 seine hauls. Pink salmon and cisco were the most numerous species caught at 46 and 51 fish, respectively. The other anadromous species were caught only infrequently in the beach seine surveys.

Streams closest to Portsite, specifically the Omikviorok River (Ipiavik Lagoon), Agarak Creek and Rabbit Creek have small runs of anadromous fish including char, pink salmon, and chum salmon (Dames and Moore 1983). The Wulik, Kivalina, and Noatak rivers have large runs of Dolly Varden and varying returns of Pacific salmon. The anadromous fish that run the Wulik River are described below.

Dolly Varden. Anadromous Dolly Varden is the principal fish in the Wulik River drainage. They deserve additional discussion because they move past Portsite during their time in saltwater and because they are important to the local subsistence economy. DeCicco (1990, 1996) documented the population structure, overwintering, and migratory habits of Dolly Varden in the Wulik River drainage.

Many researchers consider anadromous Dolly Varden a coastal ranging species, but Dolly Varden can range considerable distances in marine waters. Fish tagged in the Wulik River have been recaptured at distant locations including Point Hope, St. Lawrence Island, and Norton Sound. One fish tagged in the Wulik River was recaptured 336 miles (540 km) up the Anadyr River, 970 miles southwest of the Wulik River (DeCicco 1990). Far-ranging journeys can expose individual fish native to the Wulik River and other drainages near the Portsite to less than optimal water quality conditions in other areas of their range. Dolly Varden are sometimes seen schooling along the beach near Portsite, but they are seldom harvested from marine waters.

Anadromous Dolly Varden overwinter and spawn in freshwater. Overwintering fish descend to saltwater in June, while spawning fish stay in the river and spawn the following fall. Aerial counts of overwintering Dolly Varden in the Wulik River have been conducted intermittently since 1968, with counts ranging from a high of 297,257 in 1969, to a low of 5,590 in 1986. Overwintering areas in the Wulik River (DeCicco 1996) are pictured in figure 3-35. Tagging studies show that the population of Dolly Varden overwintering in the Wulik River spawn in several nearby rivers including the Noatak, Kivalina, Wulik, Kobuk and Pilgrim rivers.

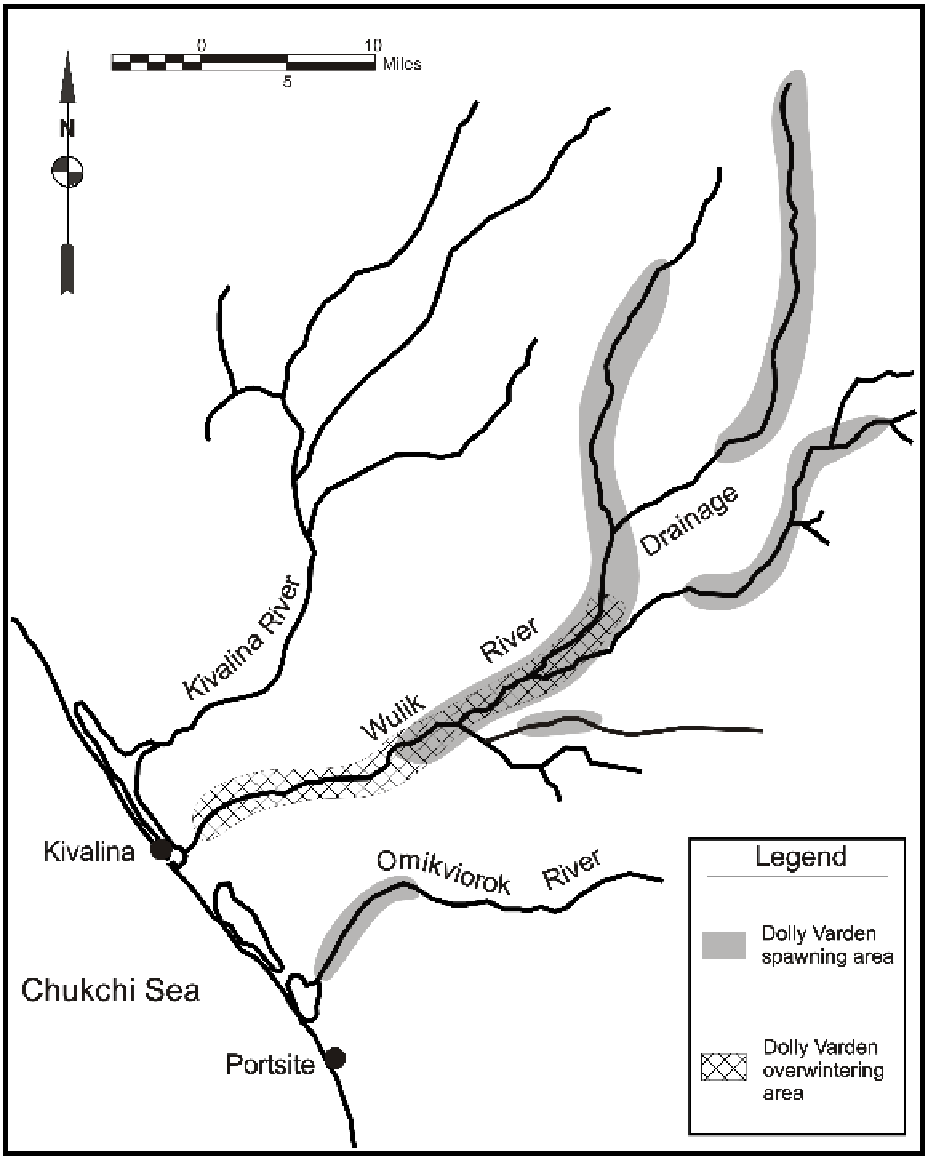


Figure 3-35. The general overwintering and spawning areas for anadromous Dolly Varden in the Wulik River and Omikviorok River drainages (adapted from EPA-DI, 1984, and DeCicco 1996).

Pacific Salmon. Kivalina and Ipiavik lagoons near Portsite have runs of anadromous salmon (Dames and Moore 1983, Blaylock and Houghton 1983). As adults, Pacific salmon use the lagoons for passage to upriver spawning grounds. As juveniles, they use the lagoons as passages to the sea where they acclimate to salt water before the marine transition. Juvenile Chinook and coho salmon also sometimes use the lagoons for wintering or rearing before migrating to sea. Other than occasional strays, Pacific salmon are not found in Agarak or Rabbit Creeks south of Portsite (W. Goodwin personal communication).

The most abundant species of Pacific salmon in the Kivalina and Ipiavik lagoons is pink salmon (Dames and Moore 1983), but lower numbers of the other North American species of Pacific salmon, and particularly chum salmon, are known to spawn in the

Wulik River drainage as far upstream as lower Ikalukrok Creek (EPA-DI 1984, Scannell et al. 2000). Pink and chum salmon fry migrate to sea in large schools almost immediately after emergence and spend little time in freshwater. Chinook, coho, and sockeye salmon sometimes spend from 1 to 3 years in fresh water, and then migrate to sea as smolts similar in size to Dolly Varden smolt. Pacific salmon gain most of their size and weight feeding at sea before returning to spawn, but unlike Dolly Varden that overwinter in freshwater, Pacific salmon deteriorate rapidly after entering freshwater and die soon after spawning.

Whitefish and Smelt. Whitefish and smelt also run the Wulik River drainage. Whitefish are the most abundant and the most important from a subsistence use perspective. Several species of whitefish in the genus *Coregonus*, including Bering cisco, are present in Alaska, and are sometimes collectively referred to as the *Coregonus* complex without identification of species. Whitefish in the Portsite area can include least cisco, Bering cisco, round whitefish, broad whitefish, and humpback whitefish (Morrow 1980).

Most species of whitefish are not truly anadromous in the same sense as salmon and char, but can spend the winters in salt or brackish water. Humpback whitefish appears to be a truly anadromous species. Others are strictly freshwater species. Whitefish are relatively abundant in Kivalina Lagoon and the lower Wulik River.

Sheefish, *Stenodus leucichthys*, is a large anadromous whitefish common to Kotzebue Sound drainages, but is not often found north of Kotzebue Sound. Traditional knowledge, however, tells us that sheefish once followed salmon fry along the coast as far north as Point Hope when a salmon hatchery operated on the Noatak River (W. Goodwin personal communication).

With exception of sheefish, which can grow to 60 pounds in Kotzebue Sound drainages, whitefish are generally smaller fish that grow to less than about 20 inches. Whitefish runs start in spring and early summer, but spawning takes place in the fall and even under the ice after freeze-up. Some whitefish stocks run long distances upriver to spawn while others seldom venture far upstream. Eggs are small and are broadcast over gravel bottoms to hatch in late winter or early spring. Juvenile whitefish feed on zooplankton while adults feed on a variety of mollusks, crustaceans, and insect larvae. Adult sheefish mostly feed on other fish, but isopods are also an important food item (Morrow 1980).

At least three species of anadromous smelt are in Alaska: longfin smelt, rainbow smelt, and eulachon. These smelt enter freshwater in early spring to spawn in the lower reaches of rivers and even in brackish lagoons. Rainbow smelt are found in Kivalina and Ipiavik lagoons.

3.5.3.3 Freshwater Fish

Several species of freshwater fish, including Arctic grayling, whitefish, burbot, northern pike, Alaska blackfish, nine-spine stickleback, and freshwater sculpin are found in the Portsite area. Arctic grayling is of particular importance as a subsistence fish (J. Swan personal communication) and is described below.

Grayling is a common freshwater fish throughout northern Alaska and Canada that is phylogenetically related to salmon, trout, char, and whitefish. It is characterized by a high, elongated dorsal fin resembling a sail. Grayling are found in streams draining into Kivalina and Ipiavik lagoons (Blaylock and Houghton 1983). They also are listed as present in the Omikviorok River and immediately north of Portsite in New Heart Creek (EPA-DI 1984). Grayling are not found in Agarak or Rabbit creeks south of Portsite (J. Mitchell personal communication), but are especially abundant in the Wulik and Kivalina River drainages and are present in Ipiavik Lagoon and the Omikviorok River, about 2 miles north of Portsite.

Grayling can be highly migratory in fresh water, using different streams or parts of streams in a drainage for spawning, juvenile rearing, summer feeding, and overwintering. Some populations complete their entire life without leaving a short section of stream or lake. Grayling are tolerant of low oxygen conditions and winter generally finds them in lakes or the lower reaches and deeper pools of rivers. Their tolerance of low dissolved oxygen levels allows them to survive the long winters in areas where many other salmonids would die. With the coming of spring, grayling begin an upstream migration to spawning grounds. Grayling are faithful to their natal stream and return every year to the same spawning and feeding areas. In northwestern Alaska they spawn for the first time at an age of 4 or 5 years and at a length of about 11 to 12 inches.

Grayling are generalists in their food habits, but drifting aquatic insects, especially mayflies, stoneflies, and caddis flies are their primary food items. At times grayling will gorge upon the eggs of spawning salmon, outmigrating salmon smolts, and terrestrial insects.

3.5.4 Mammals

3.5.4.1 Marine Mammals

Johnson et al. (1966) compiled a list of marine mammals that were reported to occur in the Chukchi Sea from literature available through 1966. The list is presented in table 3-35.

Table 3-35. Marine mammals reported in the Chukchi Sea, 1966

Whales and Porpoises	Seals and Walrus	Bears
Sei whale	Bearded seal	Polar bear
Minke whale	Ringed seal	
Humpback whale	Ribbon seal	
Bowhead whale	Spotted seal	
Finback whale	Fur seal	
Gray whale	Pacific walrus	
Beluga whale		
Orca whale		
Harbor porpoise		
Narwhal		

Source: Johnson et al. (1966).

Many of the marine mammal occurrences that formed the basis of the 1966 list compiled by Johnson et al. dated back to earlier reports by Scammon (1874) and Tomilin (1957). More recent literature indicates that some of the species listed by Johnson are no longer reported to occur in the Chukchi Sea, and especially in the eastern Chukchi Sea (Sydeman 1996, Ferrero et al.2000, Angliss and Lodge 2004). Those species are as follows:

- Sei whales are not recently reported north of the Aleutian Islands (ADFG, et al. 1996)

- Humpback whales are not reported north of the Bering Straits (Ferrero et al. 2000).

- Fin whales are now known to occur in the western Chukchi Sea, but not in the eastern Chukchi Sea (Ferrero et al. 2000).

- The modern range of the northern right whale is believed to be the Bering Sea and North Pacific Ocean (ADFG et al.1996, CBD 2000, Ferrero et al. 2000).

- The narwhal listed by Johnson is considered common in the Canadian Arctic as far west as the eastern Beaufort Sea, but only rare occurrences in the eastern Chukchi Sea are known to traditional knowledge (W. Adams Sr. personal communication).

Some of the other species listed by Johnson, et al. are now known to be only occasional migrants through the eastern Chukchi Sea and the Portsite area. For example, orca (killer) whales in the Chukchi Sea are likely of the “transient” variety that feed on other marine mammals and are occasionally reported to harass beluga whales in the Kivalina area during the open water season. Ribbon seals generally migrate through the Chukchi Sea with the floating ice like the Pacific walrus, and like the walrus, are occasionally seen in the Portsite area. Fur seals were unknown along the eastern Chukchi coast until the 1960’s when three animals were harvested near Point Hope. The eastern Chukchi Sea is considered to be well outside their normal range.

The marine mammals discussed above that either do not range in the Portsite area or occur very rarely (sei whale, humpback whale, fin whale, right whale, narwhal, orca whale, ribbon seal, fur seal) are not further discussed.

The marine mammals discussed in more detail in this section are those that were identified as important during the EIS scoping process or that might be more likely to be directly affected by navigation improvements at Portsite. Those species are: bearded seal, ringed seal, spotted seal, Pacific walrus, beluga whale, bowhead whale, gray whale, harbor porpoise, and polar bear

Bearded Seal.

Distribution. Bearded seals are circumpolar in distribution. They are represented by two subspecies, *Erignathus barbatus barbatus* and *E. barbatus nauticus*. Bearded seals in the Chukchi Sea are members of the subspecies *E. barbatus nauticus*, which ranges from about 85° north (to within about 400 miles from the north pole), and south through the Bering and Okhotsk seas to Hokkaido, Japan (SCS 2000). Although the Alaska population of bearded seal has not been reliably estimated (Hill and DeMaster 1999), worldwide numbers during the 1970's and 1980's were estimated at approximately 600,000 with *E. barbatus nauticus* numbers ranging from about 250,000 to 300,000 (SCS 2000).

There are not enough direct seasonal observations of bearded seals in the literature or in available traditional knowledge to reliably establish complete seasonal range information. Native hunters and other marine mammal experts know that bearded seals are most abundant on or near the edges of the ice pack and along persistent and recurring leads. Ice conditions can be a good indicator of bearded seal abundance when that information can be spot-checked for verification (Stirling 1980, Carlton and Hufford 1989, Lowery 2000).

Using this approach, we developed seasonal distribution maps for bearded seals (figure 3-36), based on observed bearded seal distribution in the Chukchi Sea, and on ice distribution and ice edge information from satellite photos. Figure 3-36 depicts the general direction of the spring and fall migration and dispersal patterns of bearded seals in the Bering and Chukchi seas.

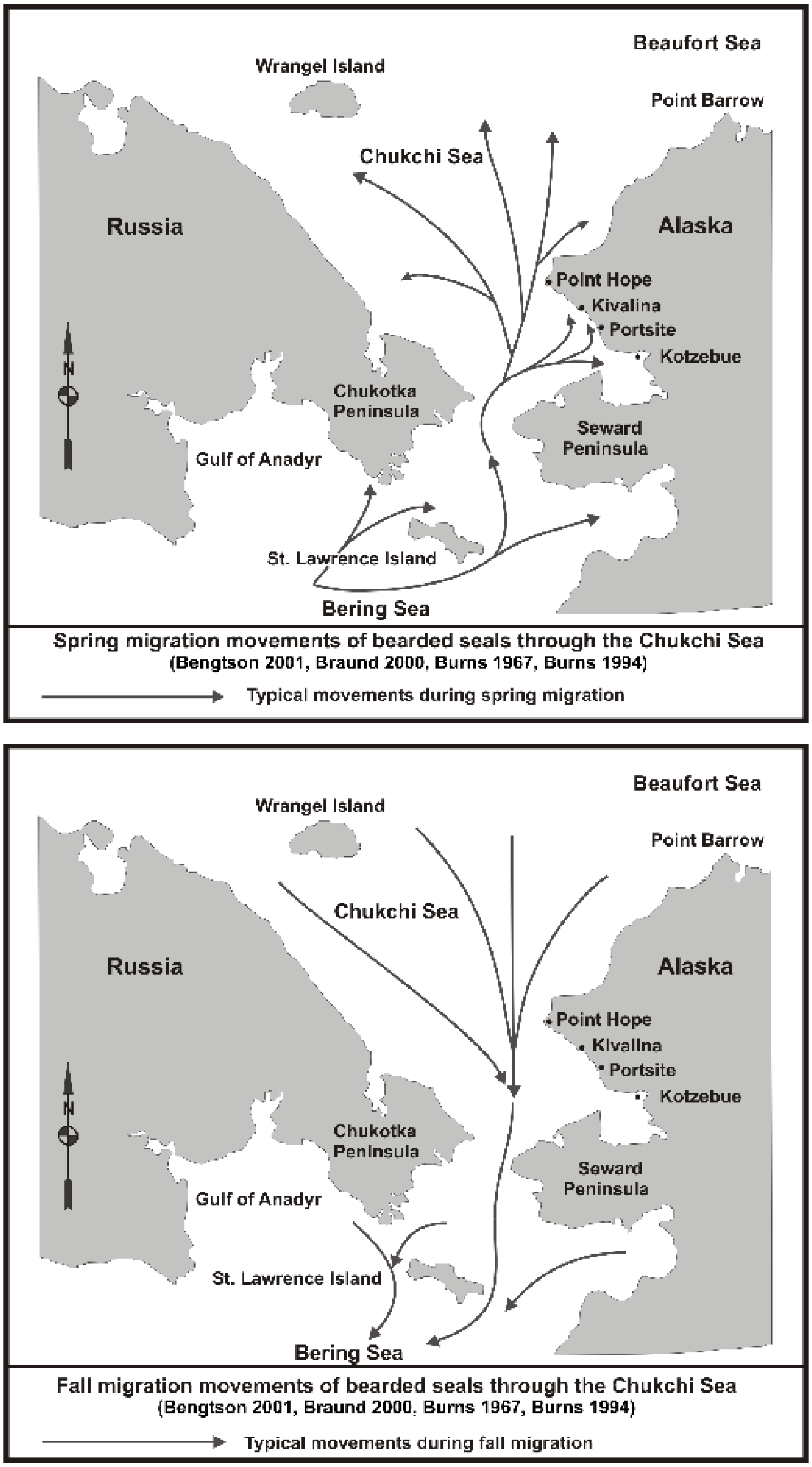
Adult bearded seals generally migrate north and south with the advancing and retreating edge of the polar ice. The majority of the population winters along the ice edge in the Bering Sea, but some spend the winter in leads and polynyas farther north. With the coming of spring, the majority of the bearded seal population migrates north through the Bering Strait and gradually disperses along leads across the Chukchi Sea. As summer progresses, all but a few juveniles follow the edge of retreating ice into the northern Chukchi Sea. In the fall, the majority of the bearded seal population advances south with formation of winter ice.

Bearded seals may be found year round at least occasionally near Portsite, but most of the eastern Chukchi Sea population follows drifting sea ice and their local density changes with the ice conditions. Most bearded seals arrive near Kivalina and Portsite with the advancing ice pack in late fall, move south with the ice, reappear as the edge of the ice pack moves north in spring, then leave with the retreating ice pack in early summer. Bearded seals also show a pattern of increasing abundance as the spring progresses (Dames and Moore 1983, RWJ 2001). A few seals may stay in the Portsite area during the summer.

Bearded seals were counted during the surveys flown for ringed seals in the Portsite area during May and June 2000 by the National Marine Fisheries Service (Bengtson et al. 2001). Figure 3-36 shows the flight lines of the aerial surveys and the locations where bearded seals were observed.

The “no fly zone” around Kivalina depicted in figure 3-37 was not surveyed because of local concerns that low-flying survey aircraft might frighten bowhead whales. Bearded seals ranged in density from 0.03 to 0.47 seals per mi^2 (0.07 to 1.21 seals per km^2), and increased in number with distance from shore. Bengtson et al. (2001) estimated there was a minimum of 2,430 bearded seals between Cape Thompson and Sheshalik Spit during May and June 2000.

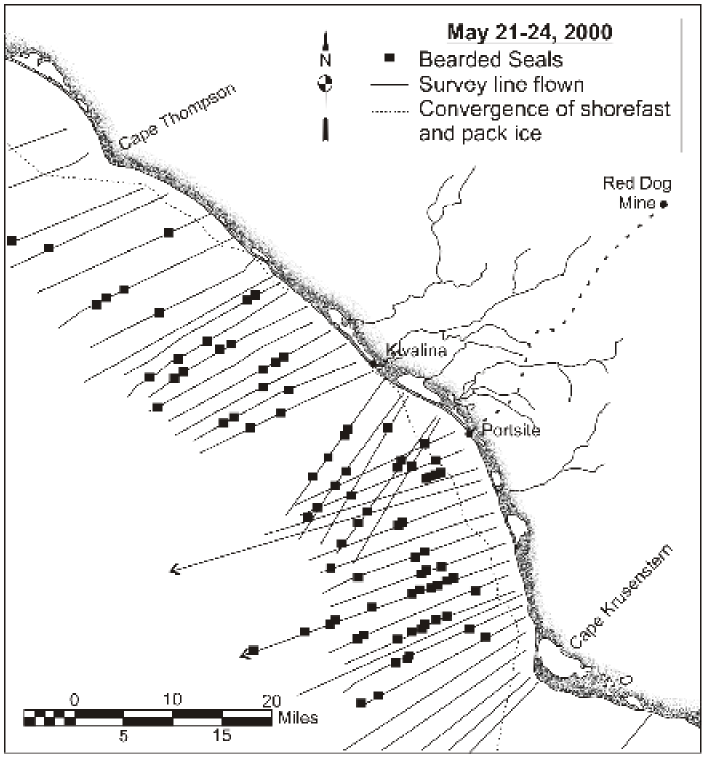
Bearded seals were observed from the DMT shiploader platform at Portsite during the spring of 2000. Native observers who identified and counted the bearded seals included Erik Carter, Willard Adams Sr., and Becky Norton, all of Kivalina, Alaska. Russell Adams Sr. also served as the polar bear watch during on-ice activities and contributed significantly to traditional knowledge.



Spring migration movements of bearded seals through the Chukchi Sea
(Bengtson 2001, Braund 2000, Burns 1967, Burns 1994)

Fall migration movements of bearded seals through the Chukchi Sea
(Bengtson 2001, Braund 2000, Burns 1967, Burns 1994)

Figure 3-36. Seasonal movements of bearded seals through the northern Bering Sea and the Chukchi Sea.



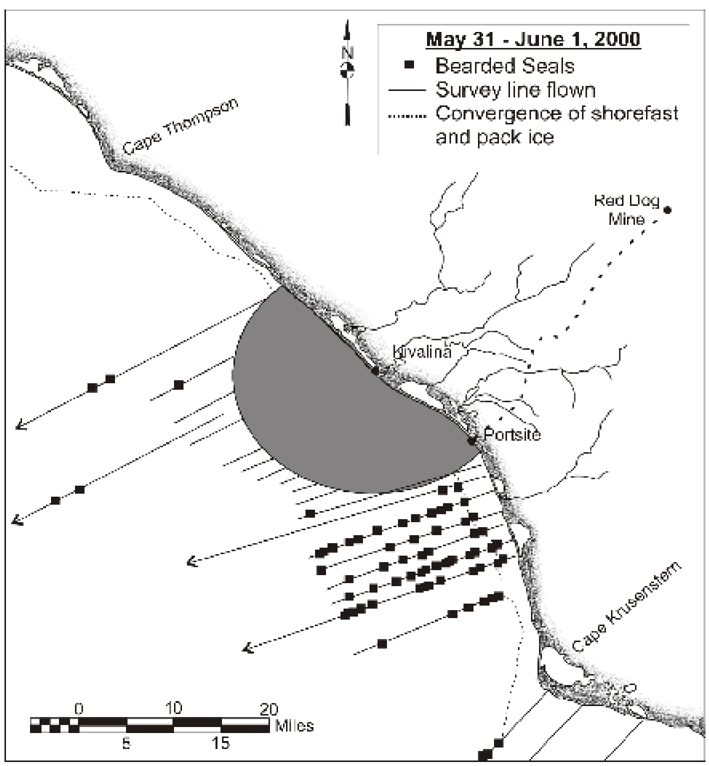


Figure 3-37. Distribution of bearded seals near Portsite May 21-24 (upper) and May 31-June 1 (lower), 2000 (Bengtson et al. 2001). Shaded area is the no-fly zone.

Observations from the shiploader platform indicated that bearded seals were generally more abundant south than north of Portsite, and they were more abundant along open leads, new ice, and larger cracks and fractures. Local Native observers attributed the higher density of bearded seals in the southern quadrant to the presence of thin and fractured new ice in that area. It was only toward breakup of the shorefast ice in mid to late June, when larger cracks in the shorefast ice appeared, that bearded seals were observed within 1 mile of the shiploader.

As illustrated in figure 3-38 more bearded seals were observed during the afternoon basking periods than in the morning. For example, over 500 individual bearded seals were counted during the afternoon on June 17 and 18 compared with less than 200 seals during the mornings of those days.

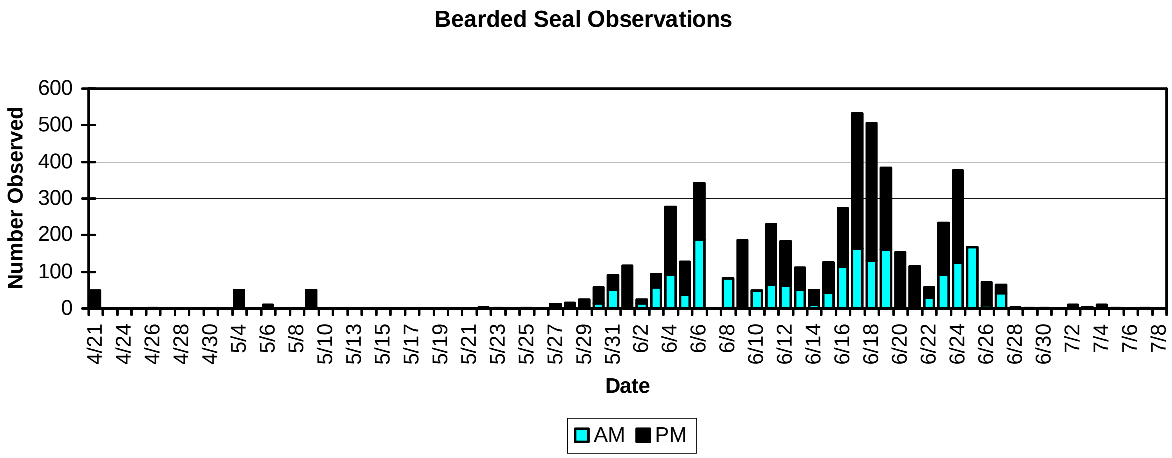


Figure 3-38. Observations of bearded seals from the DMT shiploader platform during the 21 April through 11 July 2000 surveys of marine mammals at the DMT (Source: RWJ 2001).

<u>Life History.</u> Bearded seals get their common name from their comparatively long whiskers (mystacial vibrissae). Adult female bearded seals average slightly longer, at about 7.5 feet in length, than adult males whose average length is about 7 feet. Both adult males and females, however, average about 500 pounds in weight, although they can attain a weight of more then 750 pounds during winter and early spring (Burns 1994). Their color varies from a tawny-brown or silver gray to dark brown. They are the only Alaskan seal without bands or spots. They are also distinguished from other seals by their rounded foreflippers on which the middle of five digits is the longest, relatively small eyes, and four mammary teats rather than two as on other Alaskan seals. Bearded seals live to about 30 years old, but their teeth wear rapidly. Most bearded seals older than about 8 or 9 years appear toothless, which sometimes leads to estimates of much greater age.

Most female bearded seals bear a single pup between March and early May. They nurse the pups for 12 to 18 days, while the pup gains weight rapidly. Females typically breed within two weeks of weaning the pup but implantation is delayed until about July. Gestation is 11 months including delayed implantation, and the average weight of newborn pups is about 75 pounds. The incidence of pregnancy is about 85 percent and the sex ratio of the Alaska population slightly favors females (Burns 1994). Bearded seals pup and molt on the ice. They usually molt during the May and June peak haulout period, but molting is reported to take place during other times of the year in some areas (SCS 2000). Predators of bearded seals include polar bears, orca whales, certain predatory walruses, and people. Other sources of mortality might include disease and parasitism.

Bearded seals eat mainly crab, shrimp, snails, and clams, although benthic fish including sculpin, flatfish, and cod are also sometimes eaten (Johnson et al. 1966, Burns and Frost 1979, Lowery et al. 1980). Bearded seals prefer to feed in areas less than about 425 feet deep where the bottom is relatively flat. The continental shelf underlying the Bering and Chukchi seas provides the largest continuous area of favorable bearded seal habitat in the world (Burns and Frost 1979).

Bearded seals can reach the bottom in all shelf areas of the Chukchi Sea, and could use the same food species as ringed seals. They do not depend on fish to the same degree as ringed seals, however. Johnson et al. (1966) found that during February, when the diet of ringed seals was 90 percent fish, the diet of bearded seals was only 24 percent fish. Shrimp and other bottom organisms were of major importance in the diet of bearded seals near Kivalina and Point Hope during the 1966 Johnson et al study. Shrimp also are a major food in the diets of newly weaned pups (Burns and Frost 1979).

Fresh, undigested shrimp are often found in the stomachs of bearded seals harvested near Portsite (R. Adams, Sr. personal communication, W. Adams Sr. personal communication, Braund 1999). This traditional knowledge of bearded seal diet is consistent with the findings of Johnson (1966), Burns and Frost (1979), Lowery et al. (1980), and the limited collections made more recently. Johnson et al. (1966) also noted that the average volume of stomach contents in bearded seals peaks in February and then gradually drops through June and during the molting season.

Two bearded seal stomachs were collected offshore from the Portsite during the spring 2000 DMT studies (Bengtson et al. 2001). Those stomachs contained mostly shrimp, clams, and crabs, but also held the otoliths of several species of fish. The diets of these bearded seals appeared similar to those analyzed by the Johnson team about 40 years earlier (Johnson et al 1966), suggesting that the available food organisms and diet of bearded seals in the Portsite-Kivalina area has been relatively consistent since the Johnson et al. 1966 study.

Ringed Seal. Ringed seal is the most abundant marine mammal on the Northwest Alaska Arctic coast.

Distribution. Ringed seal are circumpolar in distribution and are represented by five subspecies (Webster and Zibell 1970; Anderson et al. 1977). Ringed seals are found in all Arctic Ocean seas and the Bering Sea. They range as far south as Newfoundland and northern Norway in the Atlantic Ocean, and the Aleutian Islands in the Pacific Ocean (SCS 2000, Jaap 1999). Isolated populations in Europe and northern Asia represent the other four subspecies of ringed seals. Only the Alaska stock of the Arctic ringed seal is recognized in U. S. Waters (Hill and DeMaster 1999).

There are no accurate population estimates of Arctic ringed seals, but they are believed to be the most abundant subspecies due to their widespread distribution. A very rough estimate of 2.3 to 7 million for all subspecies was made in the late 1980's, with 1 to 1.5 million in Alaska waters (Hill and DeMaster 1999, SCS 2000).

Figure 3-39 depicts the general direction of the spring and fall migration and dispersal patterns of ringed seals in the Bering and Chukchi seas.

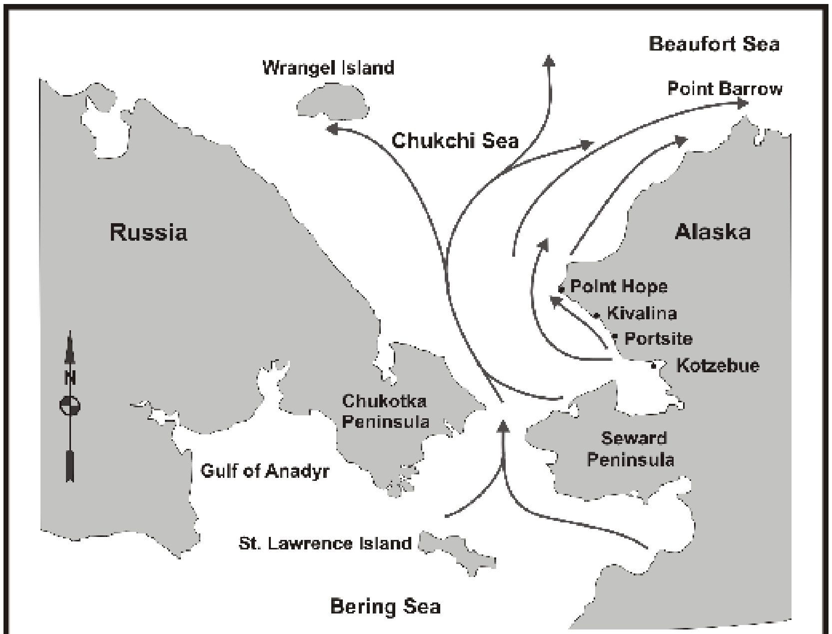
Ringed seals are closely associated with sea ice and much of the population migrates north and south with the advancing and retreating polar ice pack. They spend the winter dispersed along the southern edge of the ice pack. In the spring they move north with the receding ice edge and join other ringed seals that may have stayed behind on the pack ice during the winter. They continue north into the northern Chukchi Sea and spend the summer dispersed along the edge of the polar ice. In late fall, the ringed seals migrate south with the advancing ice edge to the southern wintering area. Some ringed seals will disperse to mostly near-shore wintering areas when ice and feeding conditions are favorable.

Ringed seals are in the Portsite area during the months when ice cover is present. Densities of ringed seals reportedly decrease with distance from shore (Bengtson et al. 2001). Ringed seals typically arrive in the Portsite area with the advancing ice pack in late fall, and leave with the retreating ice pack in early summer. Ringed seals can reach the bottom throughout the Point Hope and Kivalina areas sampled by Johnson et al. (1966). The Point Hope polynya often extends south to near Portsite, giving the seals a large feeding range. Ringed seals are typically not near Portsite except as occasional visitors during shipping and loading operations.

Johnson et al. (1966) surveyed the distribution and density of ringed seals on the ice from Cape Thompson to Cape Krusenstern. They found an average of one seal per square mile surveyed and reported that most ringed seals along the coast between Cape Krusenstern and Cape Thompson remain within a few miles of shore.

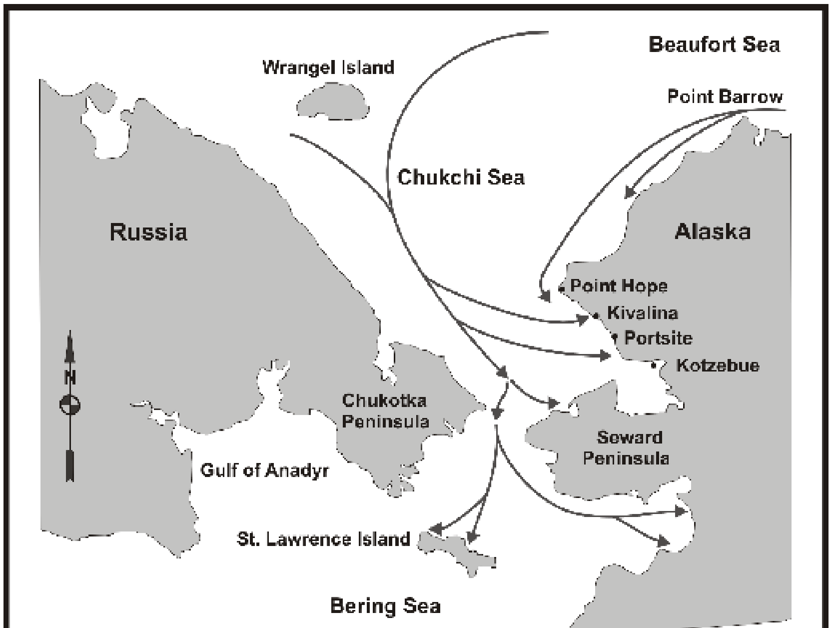
The average ringed seal density ranged from 1.89 to 3.25 seals per square mile during surveys flown by the Alaska Department of Fish and Game from 1976 to 1987 (Frost et. al. 1985, Frost and Lowery 1988).

The most recent survey of the distribution and density of ringed seals offshore of Portsite was by the U. S. National Marine Fisheries Service, Marine Mammal Laboratory during May and June 2000 (Bengtson et al. 2001). The flight lines flown during the aerial survey and the results of the survey observations are shown on figure 3-40. The greatest ringed seal densities were observed close to shore with numbers diminishing with distance from shore. Ringed seals were observed on shorefast ice and pack ice, with the highest densities in coastal waters south of Kivalina. Densities surveyed ranged from 0.6 to 4.5 seals per square mile, with an estimated total of at least 55,220 ringed seals between Cape Thompson and Sheshalik Spit from May though June 2000.



Spring migration movements of ringed seals in the Bering and Chukchi Seas
(Frost et al. 1989, Bengston 1999, Bengston 2000, NSF 2001)

Typical directions of spring migration



Fall migration movements of ringed seals in the Bering and Chukchi Seas
(Frost et al. 1989, Bengston 1999, Bengston 2000, NSF 2001)

Typical directions of fall migration

Figure 3-39. Seasonal movements of ringed seals through the northern Bering Sea and the Chukchi Sea.

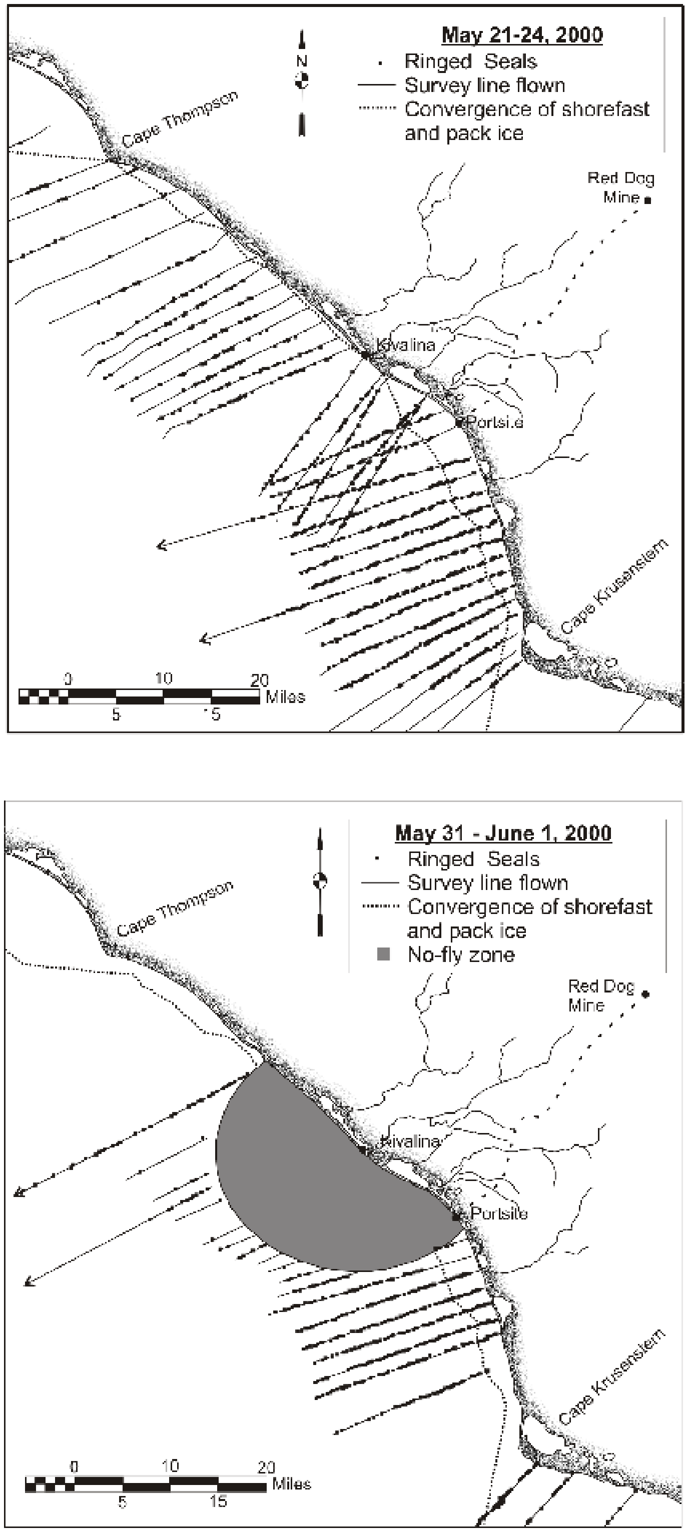


Figure 3-40. The distribution of ringed seals near Portsite, May 21-24 (upper) and May 31-June 1 (lower), 2000 (Bengtson et al. 2001). The shaded area shows the no-fly zone.

Results from the wildlife survey conducted for this draft EIS from the shiploader platform at the DMT facility during April, May, and June 2000 are shown on figure 3-41. A total of 87,258 ringed seals were observed from the shiploader platform during the survey, with the highest densities observed to the south. *Note: Many of the same seals were counted during two or more counting periods.* More ringed seals were usually counted in the afternoon surveys than morning counts because more seals tended to bask in the afternoon. The number of ringed seals within counting range of the platform increased as spring progressed due to migrants from the south, seal pups on the surface of the ice, and improving weather conditions that promoted basking.

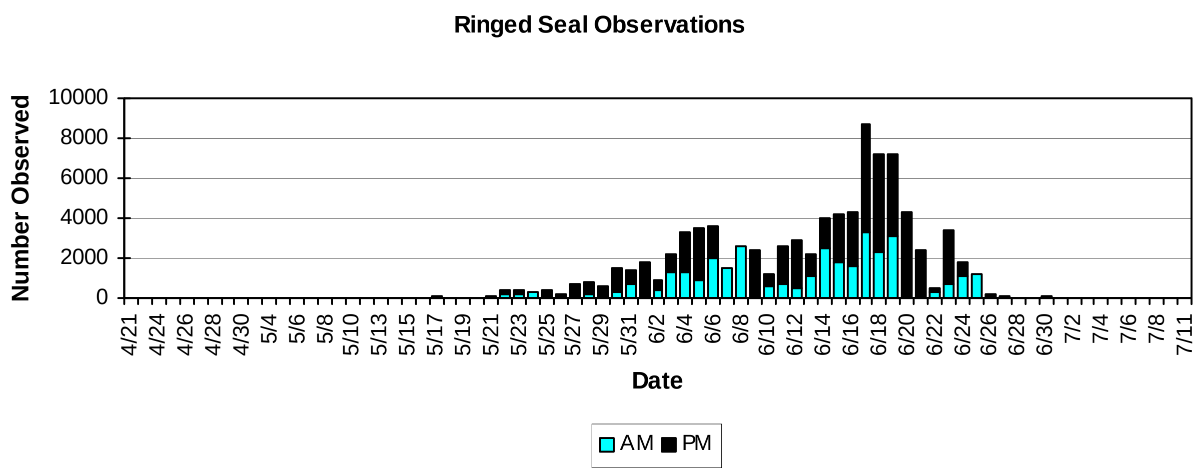


Figure 3-41. Observations of ringed seals from the DMT shiploader platform during the 21 April through 11 July 2000 surveys of marine mammals at the DMT (Source: RWJ 2001).

<u>Life History.</u> Ringed seals are the smallest of the Arctic seals, and adults rarely exceed 5 feet in length and 150 pounds in weight. Adult males are larger than adult females. Although the color of ringed seals is quite variable, most ringed seals have a gray back with black spots and a light belly. They get their common name from the pattern of black spots ringed with light marks that is characteristic on their hair. Mature bull ringed seals sometimes have a dark-colored face and head.

Ringed seals construct lairs under the snow on the ice at breathing holes. These lairs are often multi-chambered and are used for protection from predators, extreme environmental conditions, and birthing. Ringed seals typically construct and maintain two or more lairs up to about 3 miles apart. Predators of the ringed seal include polar bears, orca whales, certain predatory walruses, Arctic fox, wolverines, wolves, Steller sea lions, large birds such as gulls and ravens, and people. Traditional knowledge and other sources tell us that polar bears and Arctic fox are particularly adept at preying on ringed seal pups while they are in their lairs.

Ringed seals molt on the ice during May and June when they spend long periods of time on the ice basking in the sun. The haul-out behavior of ringed seals may change abruptly from using lairs beneath the snow to basking on the surface in late May.

Female ringed seals become sexually mature between 4 and 8 years old, while males become sexually mature between 5 and 7 years old (SCS 2000). Females bear one pup from mid-March to mid-April in a lair. Unlike the bearded seal, it is born with a white coat that is shed 4 to 6 weeks after birth. Pups nurse up to about 8 weeks after birth and wean as the ice breaks up. The average weight of pups at birth is about 10 pounds, but they double their weight before weaning. There is evidence that females that construct their birthing lairs on solid, shorefast ice are more successful in raising pups than females with birthing lairs on drifting pack ice (Eley 1994). Female ringed seals breed within 1 month after giving birth, but implantation is delayed until July or August. Pregnancy lasts about 11 months. Ringed seals are known to live up to 43 years (SCS 2000).

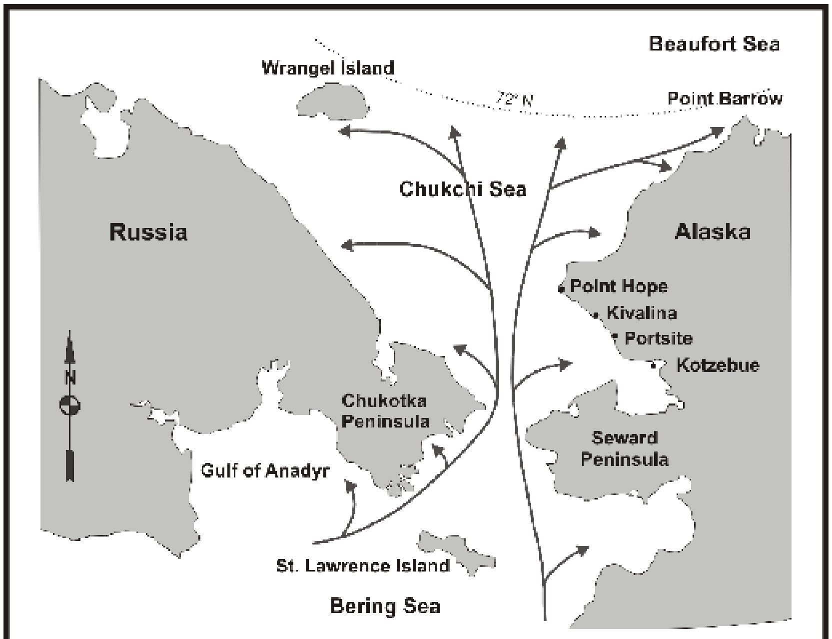
Ringed seals see and hear well underwater, and some phocid seals may have the most efficient hearing of all pinnipeds in the air (King 1983). Phocid seals (seals with no external ear), however, are not as sensitive as otarid seals (seals with external ears) to sounds in the air.

Ringed seals have several under water vocalizations, including barks, yelps, and chirps (Calvert and Sterling 1985), that are not audible above water and whose function is not known (Eley 1994), but may be involved with reproduction and territoriality (Calvert and Sterling 1985). Vocalizations on the surface consist of moans, whines, and grunts.

Johnson et al. (1966) examined the stomachs of 1,893 ringed seals at Point Hope and 30 ringed seals at Kivalina. They reported that the diet of ringed seals consisted predominantly of small fish less than 8 inches long, *Sclerocrangon* shrimp, and *Hyas* crabs. This extensive study suggests that ringed seals take whatever food species is available to them. Food species found in the stomachs of seals examined at Point Hope were similar to those examined at Kivalina.

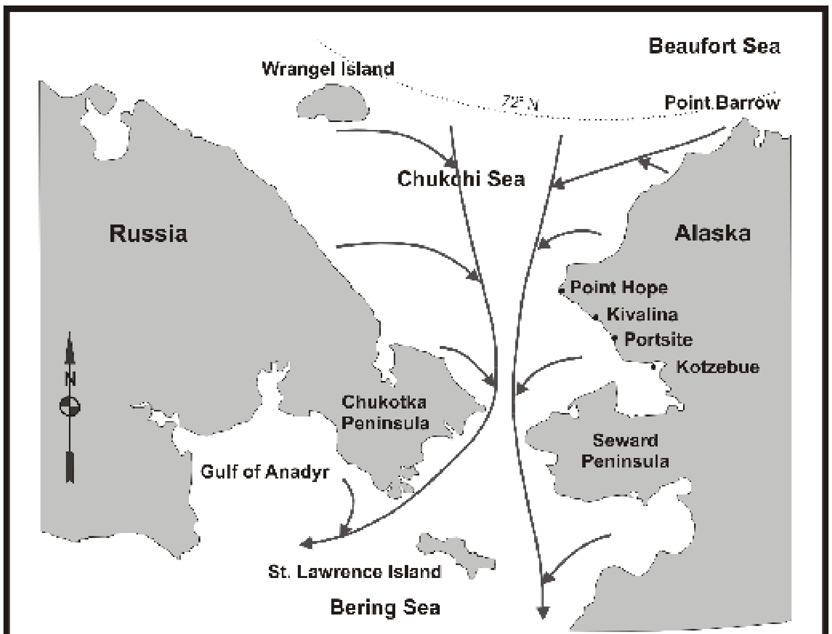
Johnson and his team reported that the quantity and diversity of prey species varied by month of sampling. They speculated that the diversity in prey species observed in seal stomachs was associated with the availability of food species, but that preferences could also have been a factor. Arctic cod were often the only food species present in the stomachs during winter, while food became more diversified during spring and included more invertebrate species.

Spotted Seal. Spotted seals (*Phoca largha*) are closely related to harbor seals (*P. vitulina richardsi*) and their ranges overlap along the southern range of the spotted seal. Harbor seals do not range as far north as Portsite. Little is known about the migration of spotted seals, but tagging studies indicate they follow the receding ice edge north from the Bering Sea to about latitude 72° N in the Chukchi and Beaufort seas, and inhabit near-shore areas of the Russian and Alaska coasts along the way (figure 3-42). Spotted seals winter in the Bering Sea along the edge of the ice pack. Recent population estimates for spotted seals are not available, but early estimates in the 1970's (Ferrero et al. 2000) suggest the population ranged from 335,000 to 450,000 seals. Spotted seals are sometimes seen near the mouth of rivers and lagoons in the Portsite area during summer where subsistence hunters sometimes harvest them. Only one stock exists in Alaska waters and it is not considered depleted, threatened, or endangered.



Spring migration movements of spotted seals (Ferrero et al. 2000)

Typical migration route



Fall migration movements of spotted seals (Ferrero et al. 2000)

Typical migration route

Figure 3-42. Seasonal movements of spotted seals through the northern Bering and Chukchi Seas.

Pacific Walrus.

Distribution. Walrus are Arctic circumpolar in distribution and are represented by two subspecies, the Atlantic walrus (*Obdobenus rosmarus rosmarus*) and the Pacific walrus (*Obdobenus rosmarus divergens*). Pacific walrus, the larger of the two, are found in the North Pacific Ocean and Arctic Ocean from the East Siberian Sea to the western Beaufort Sea.

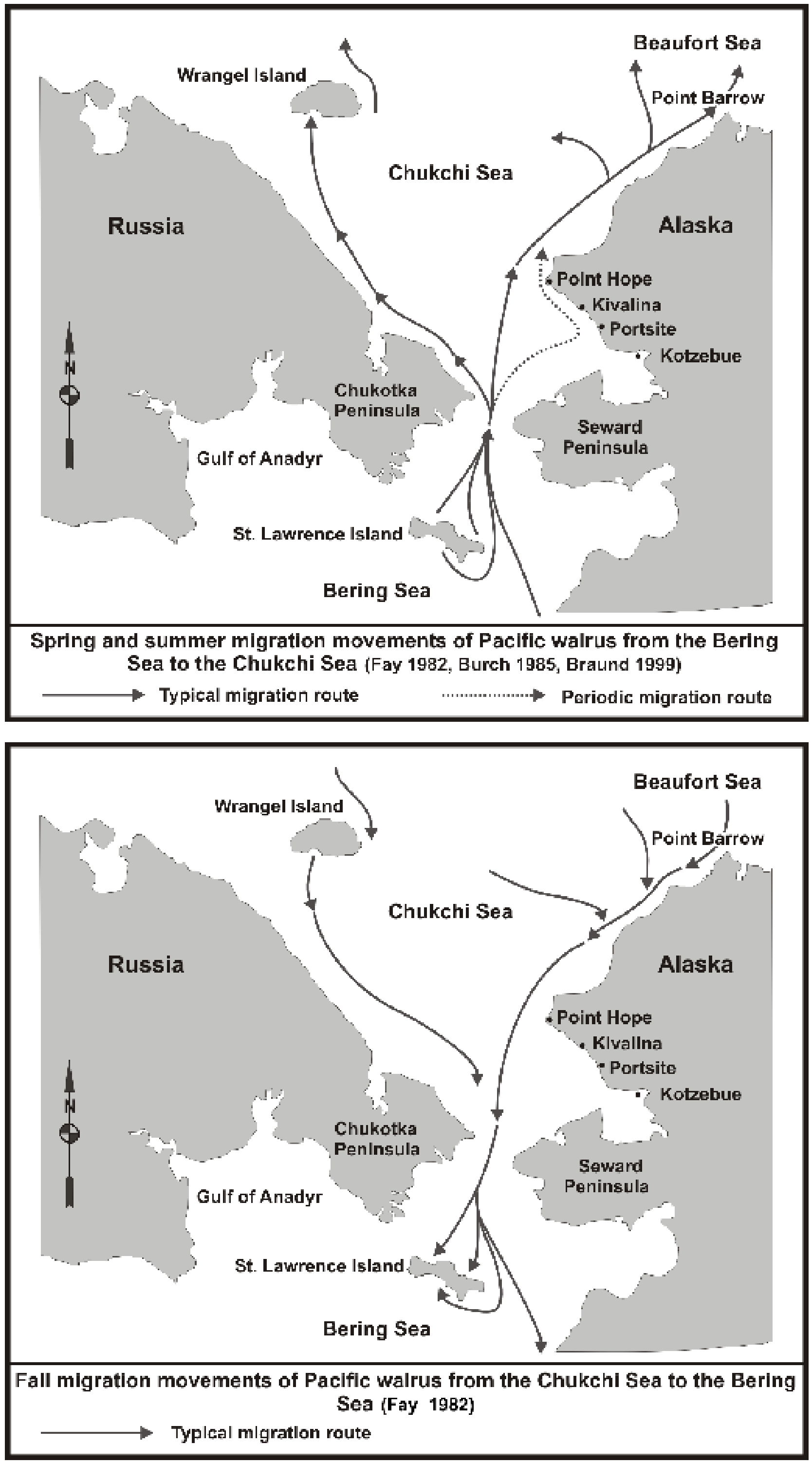
A 1990 population estimate for the Pacific walrus was 201,000 animals, but recent calf-to-cow ratios suggest the population is in decline (Kelly and Taras 2000).

Pacific walrus are not listed as “depleted” under the Marine Mammal Protection Act, or as “threatened” or “endangered” under the Endangered Species Act. Because there is minimal interactions between walrus and any U.S. fishery, the Pacific walrus population is not classified as a “strategic” stock with respect to managing incidental take under Section 118 of the Marine Mammal Protection Act. The status of this stock relative to its Optimum Sustainable Population size is unknown.

Most Pacific walrus spend the winter in the Bering Sea then migrate north with the receding ice pack in the spring. They pause around the rich feeding grounds near Saint Lawrence Island, and after passing through the relatively constricted Bering Strait, they disperse northward through the central Chukchi Sea and spend the summer along the edge of the polar ice. They generally migrate far offshore from Portsite, but in some years currents and wind can bring drifting ice and their migration route closer to shore. In the fall, walrus migrate south through the Bering Strait along the edge of the advancing ice pack.

Compared with other Arctic pinnipeds, Pacific walrus have a fairly complex migration pattern (figure 3-43). Most of the eastern Bering Sea stock winters in the Bristol Bay region. In spring females and juveniles typically follow the edge of the sea ice as it retreats north into the Chukchi Sea. Most of the bulls stay behind on Round Island in Bristol Bay through the summer, then migrate north in late fall to meet the females and juveniles near Saint Lawrence Island as they migrate south along with the advancing winter ice pack. Some local populations may not migrate at all. Walrus typically migrate 30 to 40 miles offshore as they pass the Portsite and Kivalina areas along the edge of retreating pack ice in June. Walrus would typically not be near Portsite during the July through September shipping season. Walrus are more accessible from Point Hope, Wainwright, and Barrow in July and August than they are from Kivalina. These communities are closer to better walrus feeding areas or the migratory routes to those feeding areas.

Life History. Walrus are easily differentiated from other northern Pacific Ocean marine pinnipeds by their immense size, elongated canine tusks, and high mobility on solid surfaces. The tusks of walrus are used for display, fighting, defense, and for mobility on land and ice. Walrus can weigh as much as 2 tons and attain a length of 12 feet. They are highly gregarious and mass in herds of hundreds of animals.



Spring and summer migration movements of Pacific walrus from the Bering Sea to the Chukchi Sea (Fay 1982, Burch 1985, Braund 1999)

Fall migration movements of Pacific walrus from the Chukchi Sea to the Bering Sea (Fay 1982)

Figure 3-43. Seasonal movements of Pacific walrus through the northern Bering and Chukchi Seas.

Walrus have poor eyesight but excellent senses of smell and hearing. They are vocal and communicate with a variety of grunts, clangs, and bell-like sounds.

Like all pinnipeds, walrus undergo molt. Most molting takes place gradually from June through August, but females may molt over a longer period.

Predators of Pacific walrus include polar bear, orca whale, and people. Other sources of mortality might include disease, parasitism, and starvation, trampling and crushing in the herd, and fighting among the bulls. Hunters report that walrus are aggressive toward humans when a member of the herd is injured and will attack boats.

Walrus are long-lived and have a relatively low reproduction rate when compared with most other pinnipeds. Most females do not breed until they are 6 or 7 years old. They breed in January or February but implantation does not occur until about mid-June. The actual period of fetal growth, therefore, is about 11 months. Female walrus calve on the ice in late April or May. Calves weigh about 100 to 160 pounds at birth and are nursed for at least 18 months and up to 2 ½ years. Most females reproduce only every 2 years and older females every 3 to 4 years. Female walrus aggressively defend their calves.

Feeding walrus make long furrows in the sea bottom as they uncover clams, snails, and other invertebrates. These furrows typically are about 20 inches wide, several inches deep, and up to 150 feet long. The furrows are present on as much as 36 percent of the Chukchi Sea bottom (USGS 1996). Several billion tons of the Chukchi Sea floor are tilled annually by feeding walrus. In the process, they contribute to suspended sediment loads and turbidity in the Chukchi Sea. This reworking of the bottom material also performs important functions in nutrient cycling by bringing buried nutrients to the surface, where they are available to plankton, filter-feeding animals, and other organisms.

Walrus are generally associated with areas of more plentiful bottom-dwelling life forms. They gather prey from the sea floor by brushing the substrate with their broad, whiskered muzzles and propelling jets of water through their mouths. Walrus in the Chukchi and Bering Seas depend primarily on clams for their diet (Lowery et al. 1980), although they also eat worms, snails, shrimp, crabs, and occasionally seals, fish, and seabirds.

The areas in the northern Bering Sea and Chukchi Sea known to have high benthic biomass, including clams that might attract walrus, are shown in figure 3-44. Some walrus, however, also eat the skin and blubber of seals. These “rogue” walrus are reported to be mostly solitary or paired young bulls and are dangerous to hunt (E. Toolie personal communication). The skin of these rogue bulls is dark and oily, and the flesh uneatable. The tusks are yellow and streaked with dark grooves. They “suck” the skin and blubber from seals, tearing off square pieces that are swallowed whole. According to the U.S. Fish and Wildlife Service (USFWS 2000), the frequency of walrus stomachs containing sealskin and blubber is generally less than 10 percent, but seems to have increased in recent years.

Major Environmental Influences. There is much traditional knowledge on walrus, particularly in the Bering Strait area including Saint Lawrence Island, where they are hunted in large numbers. However, little has been compiled in printed form. Alaska and Chukotka Peninsula Natives know the migration timing and paths of the walrus, and people in the areas where walrus are plentiful use this knowledge to hunt them.

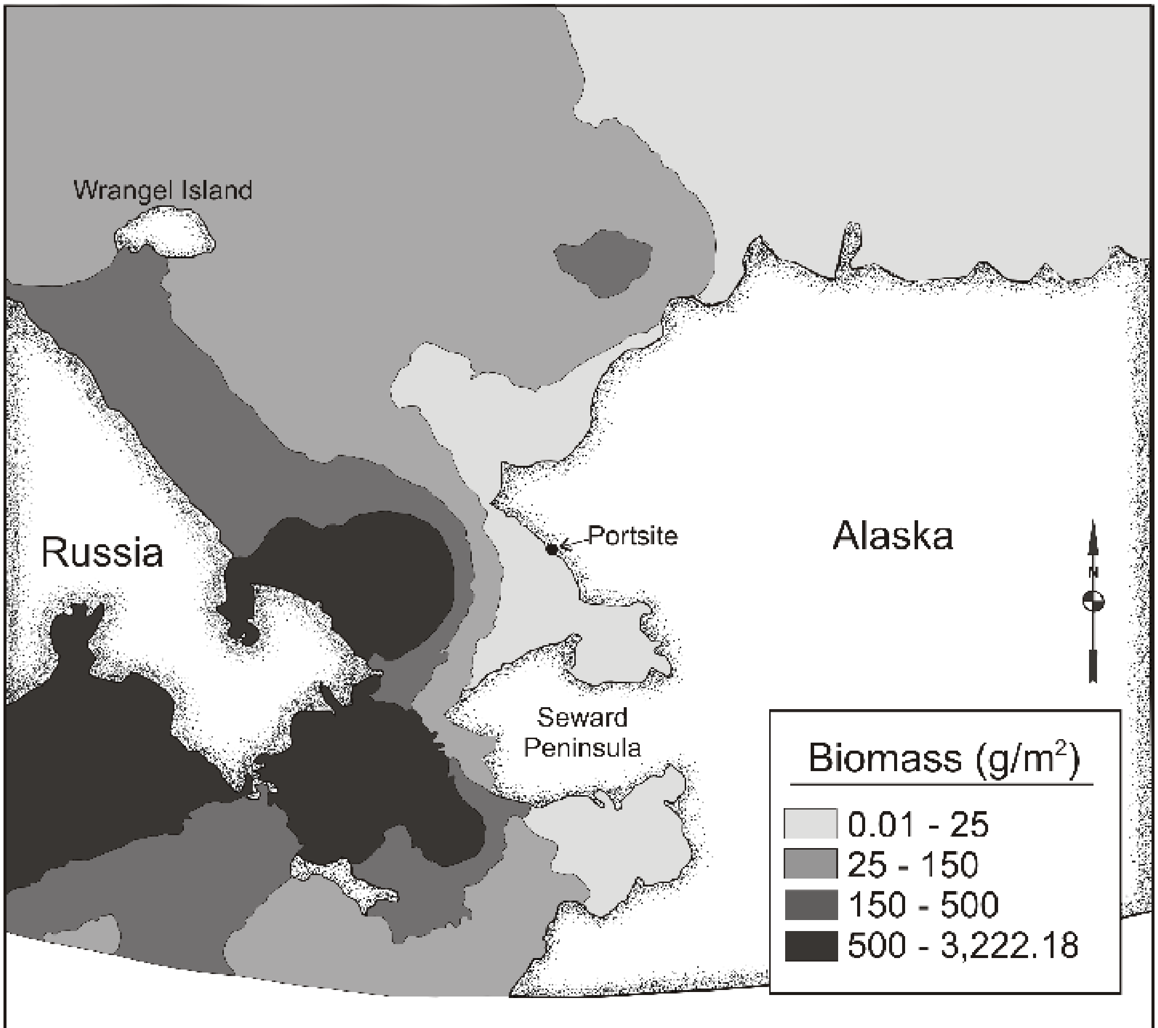


Figure 3-44. Benthic biomass (g/m^2) in the northern Bering Sea and in the Chukchi Sea.

Distribution of walrus in the Chukchi and Beaufort seas may correlate with an abundance of clams, principally *Sterripes groenlandicus*, and other invertebrates (Lowery et al. 1980). As shown in figure 3-46, the biomass of benthic invertebrates, including clams and cockles, in the central and western Chukchi Sea is many times greater than the abundance along the Alaska coast in the eastern Chukchi Sea. Hunters observed that available food resources have a large part in determining the distribution and migration paths of walrus, and there appears to be much less food for walrus near Portsite than in some other areas of the Chukchi Sea. This may explain why the main walrus migration pathway is well offshore from the coast at Portsite. No walrus were observed during the spring and summer 2000 surveys undertaken for this draft EIS.

Hunters note that walrus are largely restricted to certain ice conditions that support large herds over areas with an abundance of food. The type of ice also influences the distribution of walrus. Young, thin ice does not support large herds, and walrus sometimes cannot haul out onto old ice when it is too thick and edges are too steep. Females need the correct ice conditions for haulout for giving birth and nursing their calves. Native peoples compare current ice conditions to traditional knowledge and conclude that the Arctic ice is thinning and that thinner ice appears to be affecting the migration timing, paths, and seasonal distribution of walrus.

Beluga Whale.

Distribution. Beluga whales are Arctic and subarctic in range. Five distinct stocks of beluga whales have been identified in Alaska waters, (Hill and DeMaster 1999) based on the geographic approach of Dizon et al. (1992). Those stocks comprise (1) the Beaufort Sea stock, (2) the Eastern Chukchi Sea stock, (3) the Eastern Bering Sea stock, (4) the Bristol Bay stock, and (5) the Cook Inlet stock. A recent molecular genetic study by O'Corry-Crowe (2001) confirmed this system.

The O'Corry-Crowe study, and previous studies (e.g. Frost et al. 1983), indicate that two of the five stocks in Alaska waters–the Beaufort Sea stock and the Eastern Chukchi Sea–stock pass Portsite, Kivalina, and Point Hope during their spring and fall migrations. Figure 3-47 shows the general direction of the spring and fall migration and dispersal patterns of the Beaufort Sea and Eastern Chukchi Sea stocks. The spring and fall migration and dispersal patterns of these two stocks are described below.

Beaufort Sea Stock. The Beaufort Sea stock (minimum population 32,453) spends the summer in the Mackenzie River estuary in western Arctic Canada and the winter in coastal areas of the Bering Sea, possibly off Cape Navarin in the Gulf of Anadyr (Simirov and Litovka 2001). This stock passes the Portsite area on their northward migration in April and May.

Offshore leads determine how close to Portsite the earlier (Beaufort Sea) stock passes during their spring migration. Traditional knowledge from Native hunters tells us that if more than one lead is available, the early beluga migration naturally takes the farthest seaward lead, making it very difficult or impossible for hunters to intercept them from the shore. Historically, although some of this stock passes near Portsite, the majority of the stock migrates farther off shore (figure 3-45). When the leads are open, these belugas are said to pass Portsite and Kivalina without stopping; and would stop only if they became trapped in a lead. When belugas have become trapped in a lead that is accessible to hunters, the chances of harvesting them in April and May are good.

In the fall (beginning in mid-August) the Beaufort Sea stock migrates from the Mackenzie River estuary and northern Arctic summering areas west across the Chukchi Sea to the Siberian coast and then south through the Bering Strait to winter in the coastal areas. Recent satellite tagging studies (Richard et al. 2001) and Russian observations (Kochnev 2001) confirm this general fall migration pattern.

Eastern Chukchi Sea Stock. The eastern Chukchi Sea stock (minimum population 3,710) winters in the Bering Sea coastal areas, which they share with the Beaufort Sea and other stocks (Simirov and Litovka 2001). In the spring the eastern Chukchi Sea stock migrates to the Kotzebue Sound/Eschscholtz Bay area, where they calve and molt (figure 3-47). In late June and early July some of this stock leaves Kotzebue Sound and migrates north along the coastline past Portsite and Kivalina to the Kasegaluk Lagoon at Point Lay and Icy Cape. In contrast to the earlier Beaufort Sea stock that migrated past Portsite through offshore leads, the eastern Chukchi Sea stock typically migrates past Portsite and Kivalina close to shore after breakup. Their proximity to the shore may make hunting them easier.

In the fall this eastern Chukchi Sea stock leaves the Point Lay/Icy Cape summering area and migrates south through the Chukchi Sea and the Bering Strait to winter in the Bering Sea coastal areas. Native hunters at Kivalina report occasional strikes of beluga passing fairly close to shore during fall, although the main fall migration route for this stock is farther off shore.

During the spring and summer 2000 surveys conducted for this EIS, a small number of belugas were observed migrating between Portsite and Kivalina. On Sunday, May 12, 2000, several beluga whales were observed milling about in a closed lead about 3 miles off shore between Kivalina and Portsite. Several females with calves were evident in this group. The Native guide explained that this group had stayed behind the main migration because the calves were not yet able to pass the distance under the ice to the next open lead.

A beluga was reported struck and lost along this same lead during several days of hunting effort after the May 12 sighting, but no other belugas arrived in the lead. Evidently, the main portion of the spring beluga migration had passed this lead by the time the hunters arrived. Hunters, however, harvested about 10 to 14 beluga north of Kivalina just prior to this sighting, leading some hunters to theorize that although the beluga had passed Kivalina, ice conditions farther north had forced them near the community.

In June during biological surveys at Portsite, two belugas were observed passing near the DMT shiploader platform. The belugas, a female with a calf, swam around the outer loading cell and disappeared from sight to the northwest among ice floes.

Life History. Beluga whales are toothed whales in the family Monodontidae. Narwhal, another Arctic species, is the only other member of this family. Beluga whales actively pursue and catch fish and other marine organisms. They can generate sounds that are used to communicate with others of their species, and use a type of audible “echo locating sonar” (echolocation) to identify what is around them and to help find food. Belugas are extremely vocal and as a result have been given the nickname “sea canary.” Hearing and vision senses are also highly developed.

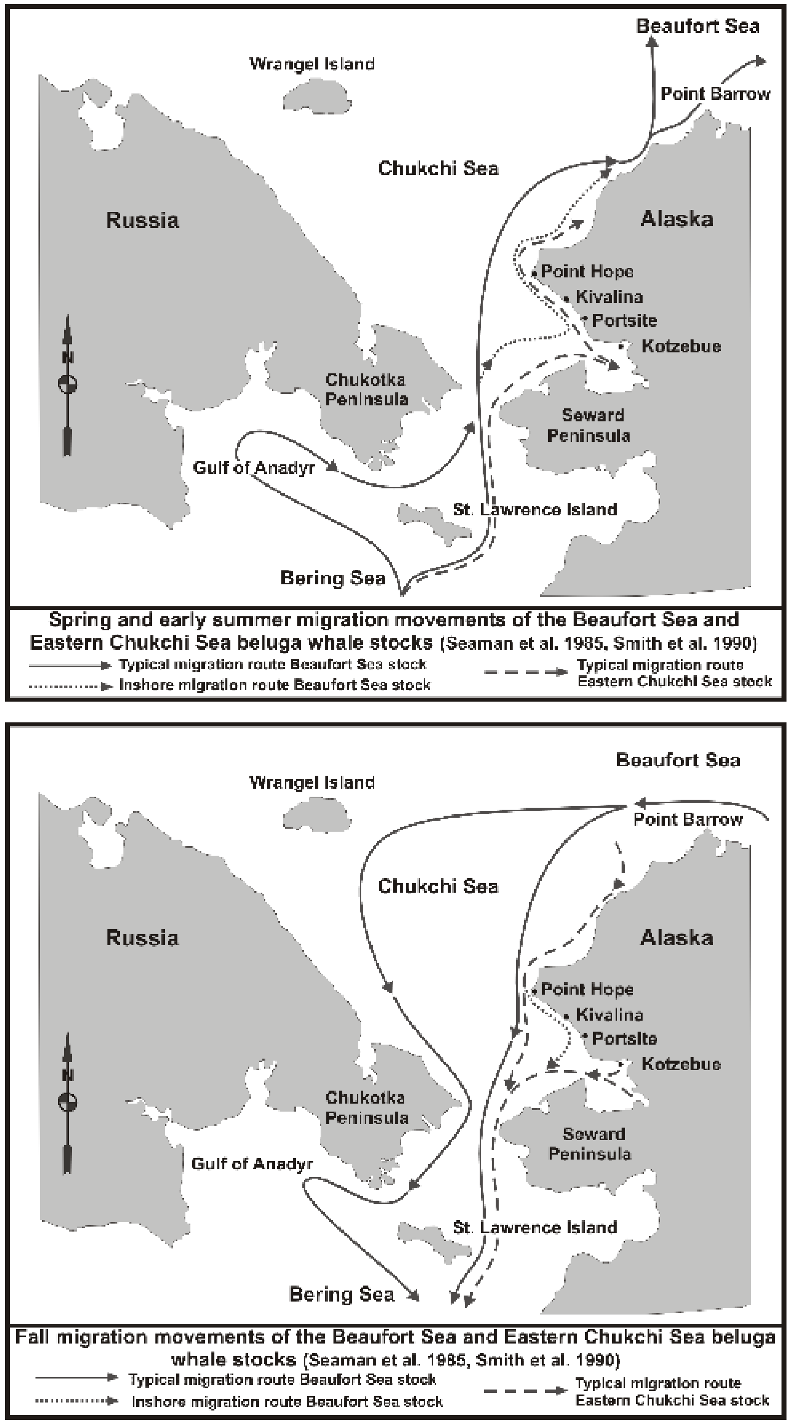


Figure 3-45. Seasonal movements of the Beaufort Sea and eastern Chukchi Sea stocks of beluga.

Belugas shed skin or molt by rubbing off old skin on the sea floor or on ice. Belugas are known to molt when they gather in Eschscholtz Bay (Huntington and Mymrin 1996, Morseth 1997), but there is no mention in traditional knowledge accounts of molting near Portsite.

Beluga whales are opportunistic predators and feed on a wide variety of fish and benthic animals. Principal prey includes octopus, squid, crabs, clams, snails, worms, and a variety of fish species. They forage mostly in shallow water up to 100 feet deep and swallow their food whole. Belugas may have taste receptors, but have no olfactory lobes and no sense of smell.

Belugas are perhaps the best adapted of all the cetaceans (whales and dolphins) for life in shallow, turbid, icy waters because of their agility and superb echolocation capabilities. They appear to be unaffected by freshwater or salinity changes, or by turbidity. They are adapted to maneuver in very shallow, turbid water with narrow, twisting channels, and they readily move over habitat with sharply varying depths. They are known to ascend rivers and have been seen at least 830 miles up the Yukon River drainage and 1,240 miles up the Amur River in Asia. In some parts of their range, their ability to move into and survive in shallow, turbid water appears to be an effective strategy for avoiding predatory orca whales.

In addition to orcas, predators of beluga whales include polar bears and people. Other sources of beluga mortality include stranding, disease, pollution, starvation, entrapment under ice, entanglement in fishing nets, and collisions with boats (Huntington and Mymrin 1996, Martineau 2001).

Belugas live in cohesive social groups called pods. A pod consists of 2 to 12 individuals with an average size of 10. A single male usually leads a pod and females with calves often form separate pods during calving season. Pods sometimes join into large groups of several hundred and even several thousand whales. Male beluga whales grow to about 15 feet long and 3,300 pounds, while females grow to about 13 feet long and 3,000 pounds. Beluga whales live 25 to 30 years, and reach full size in about 10 years.

Female belugas become sexually mature at 4 to 5 years old, while males mature slightly later (Lowry 1994). Breeding is in March and April, and gestation is about 14.5 months. Traditional knowledge is that female belugas calve near ice and use the ice to assist in the birth (Huntington and Mymrin 1996). If ice is not present at calving, two males are said to assist the female during delivery. Calves are born tail first, are closely attended by their mother, and nurse for about 2 years. Beluga calves are dark skinned when born and turn white with age. The shade of color, dark to light, is sometimes used to estimate the age of belugas in their natural environment.

Estuaries probably serve as nurseries for birthing and nurturing calves, and as a place to molt. Belugas show a fidelity to summering areas. Females bring their calves back to their birth site, thereby ensuring subsequent generations will continue to migrate to their ancestral grounds (O'Corry-Crowe 2001). A known calving area for belugas is Eschscholtz Bay in Kotzebue Sound (Huntington and Mymrin 1996), and particularly in Goodhope Bay where they are undisturbed by noise (W. Goodwin personal communication). Belugas were also said to calve on the north side of Kotzebue Sound at Sheshalik, but apparently they no longer calve at this location (W. Goodwin personal communication). Kivalina hunters also say that belugas calve "up north," i.e. north of Kivalina (Braund and Assoc 1999), and Point Lay hunters see females with young calves in Kasegaluk Lagoon at Point Lay (Huntington and Mymrin 1996). Female belugas harvested at Point Lay are occasionally pregnant, or have recently given birth (Suydam et al. 1999), suggesting that calving could take place in the Point Lay area.

Major Environmental Influences. A common theme in traditional knowledge among people living along the Northwest Alaska coast and the eastern shore of the Chukotka Peninsula is that beluga whales are sensitive to noise and to noise from outboard motors in particular (Huntington and Mymrin 1996). Negative reactions of belugas to outboard engines in the Kotzebue Sound area were recognized in the 1950's and early 1960's (Fejes 1996:38, Foote and Cook 1969:30) in the 1970's (Morseth 1997), and recorded in scientific literature as early as 1983 (Frost et al. 1983).

Hunters from Kivalina report that the migration patterns and harvest areas of beluga whales, particularly belugas of the summer stock, have changed because of noise from Portsite and shipping activity, although noise from other sources, particularly outboard motors, is also blamed. They report that belugas approaching Portsite from the south during June and July are diverted 3 to 10 miles seaward, or turn and swim back south. They report the belugas diverted seaward by Portsite return to shore approximately 17 to 18 miles north of Kivalina. The summer harvest of beluga whales once took place a few miles south of Kivalina, but now the summer hunt takes place along a narrow, near-shore band from Kotlik Lagoon (about 17 miles south of Portsite) north to Cape Thompson (See Figure 3-6).

Richardson et al. (1995) identified two behavioral responses in belugas (and other whales) to noise stimulus: habituation and sensitization. Habituation is the condition in which repeated experiences that have no important consequences for the animal lead to a gradual decrease in response, while sensitization is the situation where an animal shows an increased behavioral response over time to a stimulus that has an important consequence for the animal. For example, whales may often show little response to vessels that move slowly and are not headed toward them (Richardson et al. 1995), but may leave an area where vessel noise is related to hunting (Huntington 1999, Huntington and Mymrin 1996).

Other studies and surveys involving the reaction of belugas to industrial noise generally support Richardson's definition of two behavioral responses. Some investigators report that if opportunity for escape is available, beluga whales may avoid subsistence hunting activities that involve high-frequency sounds produced by outboard engines and snowmachines (Frost and Lowery 1990, Huntington 1999, Huntington and Mymrin 1996). This is corroborated by traditional knowledge of Native hunters in Cook Inlet who state that beluga whales actively avoid approaching skiffs powered by outboard motors, particularly those that were frequently used to hunt belugas (Huntington 1999). In the Beaufort Sea, belugas in water about 6 feet deep were observed to respond to tugs pushing barges by moving away, while at other times, belugas were observed to approach heavy shipping traffic, then retreat (Fraker 1984).

Some of these same studies, and other studies, report that beluga whales tolerate large vessel traffic and intense commercial fishing activity (Richardson et al. 1995, Huntington and Mymrin 1996). In a study in the Port of Anchorage, belugas were commonly found among the dock pilings and sometimes were within a few feet of maneuvering and docking containerships and tugs (Balsiger 2000). In another study, scientists who observed belugas in the Mackenzie Estuary of the Beaufort Sea concluded that neither logistics nor the construction of artificial islands had any serious effects on use by belugas or on the success of Native hunters (Fraker 1984). In that same study, Fraker (1984) concluded that it seems more likely that if any long-term disturbance to a local whale population was going to occur, it would likely result from repeated traumatic experience from hunting activity.

At Sireniki, hunters reported that construction on shore did not frighten belugas, and that animals, including belugas, in the Anadyr River did not avoid construction, large vessels, or normal activities. They noted that the belugas in the Anadyr River are not hunted (Huntington and Mymrin 1996).

Increased noise from large aircraft has also been blamed for shifts in migration patterns of the beluga in Kotzebue Sound. "Residents of Kotzebue Sound believe that noise during incoming tides (and especially noise produced by low-flying jets, which as one resident said, 'shake the whole bay all the way to Sisualik') frightens beluga attempting to enter the bay" (Morseth 1997). In Cook Inlet, however, belugas are seasonally abundant beneath airspace that is heavily used by arriving and departing military and commercial air traffic.

Noise from shore activities and debris in the water has also been cited as a reason for belugas to change their course. People in Wainwright noted that the belugas used to come close to shore; but now move around the community. "The people blame this on the accumulation of garbage, barrels, and junk that litters the ocean bottom in front of the village. Also, there are engines running almost constantly (e.g. the Native store generator), which may produce enough noise or vibration to frighten them away" (Nelson 1969). Joe Swan Sr. (1996) of Kivalina also stated that after the dock was built at Portsite, the belugas no longer traveled along the shoreline in the summer, picking a new migration path instead. He stated that the belugas did not go past the Portsite because of the noise associated with the dock. In the winter the migration routes were dependent on the broken ice.
Previously, people kept quiet and dogs were prevented from barking before a beluga hunt. The boats were loaded ahead of time and not launched until the tide was high (Huntington and Myrmin 1996, Moreseth 1997). People avoided walking along the beach so they would not scare the belugas away from the shore (Huntington and Mymrin 1996). Increased CB radio use (radios that broadcast in UHF) is also believed to drive away the belugas, although VHF or line-of-sight radios do not have this effect (Huntington and Mymrin 1996).

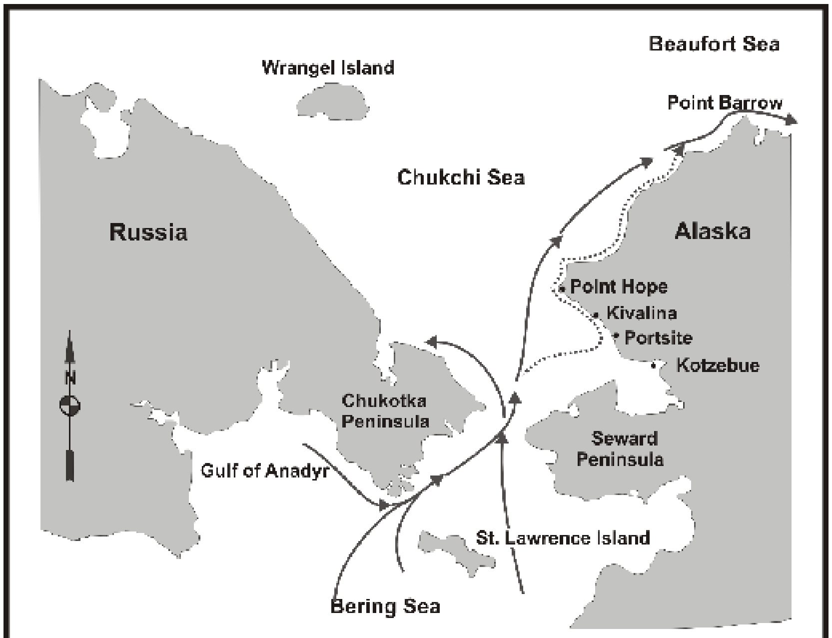
Noise and other manmade environmental changes are generally understood in Northwest Alaska to have altered near-shore migratory routes and behavior of beluga whales during open-water periods. Principal concerns about those effects are related to the potential that the noise and activity may deny critical habitat to belugas and that noise and activity could affect the ability of hunters to harvest beluga. There is no indication that critical feeding, molting, or calving habitat is close to Portsite. There also appears to be general consensus among coastal hunters and elders in the NAB that the presence of open leads or leads with thin ice is the principal factor that influences nearshore migration routes in the spring before the icepack opens up.

Bowhead Whale.

Distribution. An estimated 50,000 bowhead whales once ranged over Arctic seas in two main stocks: the eastern and western Arctic stocks, with more than 30,000 in the eastern stock. Commercial whaling reduced the eastern Arctic stock to fewer than 1,000 whales between the 1600’s and 1800’s. The western Arctic may have had two stocks of bowheads: those summering in the Bering and Chukchi seas and those summering in the eastern Beaufort Sea.

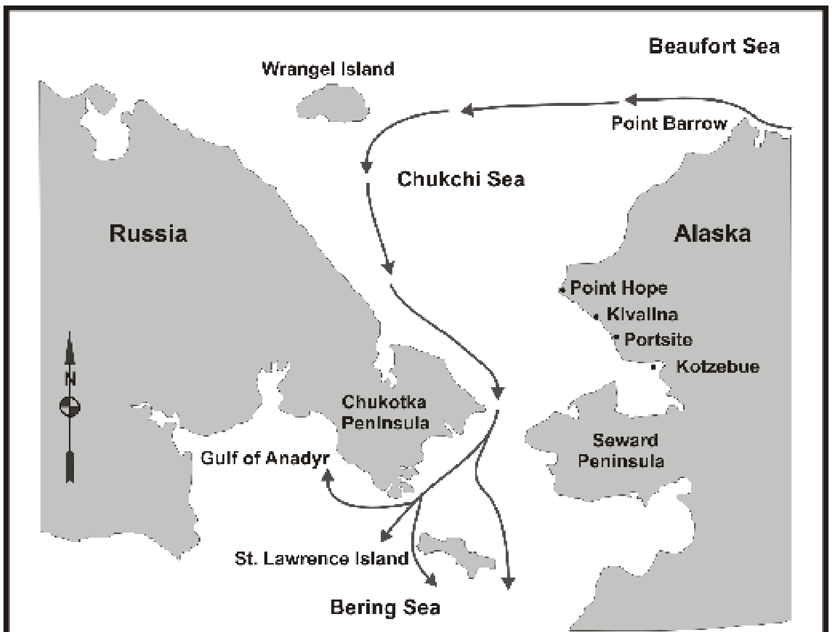
The Bering Sea and Chukchi Sea stock, which once numbered about 18,000 whales, was greatly reduced during the late 1800’s and early 1900’s (Carroll 1994, Fraker 1984), and is likely extinct because bowheads no longer summer in the Bering and Chukchi seas. The current stock, the western Arctic stock, summers in the eastern Beaufort Sea and winters in the Bering Sea (Hill and DeMaster 1999). The western Arctic stock has a minimum population of about 7,738 bowhead whales and increased at an estimated rate of 3.2 percent during a 1978 through 1993 survey period.

Figure 3-46 depicts the general direction of the spring and fall migration and dispersal pattern of bowhead whales in the Bering and Chukchi seas.



Spring migration movements of bowhead whales to the Chukchi and Beaufort Seas (Burns et al. 1993)

Typical migration route — Inshore lead migration route



Fall migration movements of bowhead whales from the Chukchi and Beaufort Seas (Burns et al. 1993)

Typical migration route

Figure 3-46 Seasonal movements of bowhead whales through the northern Bering Sea and Chukchi Sea.

Bowhead whales winter in the Bering Sea south of Saint Lawrence Island and in the Gulf of Anadyr, and begin to migrate north through the Bering Strait along leads in early spring (figure 3-46). During spring migration, pods of migrating bowheads generally follow fractures and leads in the sea ice and along the shear zone between shorefast ice and pack ice around the coast of Alaska. Researchers using hydrophones have detected bowheads traveling through lead systems that appear to be completely covered with ice (Carroll 1994). If open leads are not available, bowhead whales can push hummocks in thin ice or break ice up to 2 feet thick with their heads.

Kivalina hunters told Braund (1999) that most of the northward-bound bowheads migrate far off shore in the spring from Wales (the eastern shore of the Bering Strait) to Point Hope. They do not migrate close to Kivalina and Portsite very often, but occasionally follow near-shore leads past Kivalina (Braund 1999). Bowheads come relatively close to land more often at Point Hope, and some bowheads continue northward along the coast until they arrive on their summer feeding grounds in the Beaufort Sea.

No bowhead whales were sighted during the spring 2000 marine mammal surveys conducted for this EIS, and during several visits to off shore leads between Portsite and Kivalina, although leads along the shear zone were often clearly visible from the Portsite bargeloader platform. Several whaling camps were pitched by Kivalina and Noatak hunters for about a week near open leads starting 6 miles northwest of Portsite, but no bowhead whales were taken from those leads during the 2000 survey period (April-June).

Bowheads summer in the rich feeding grounds of the Beaufort Sea but are occasionally seen in other waters. Bowheads have been seen off Portsite in July (Braund 1999), but such sightings are rare. Most bowheads migrate west from the Beaufort Sea in September. They move from Point Barrow in a general route along the 60-foot depth contour across the northern Chukchi Sea to near Wrangel Island (Fraker 1984) before continuing south along the east coast of Russia and through the Bering Strait (figure 3-46). The migration tends to be dispersed over time and area. Hunters at Kivalina reported that bowhead sometimes migrate south along the Kivalina coast in August and September, although Kivalina hunters do not participate in a fall hunt.

Life History. Bowhead whales can grow to a maximum of about 60 feet long and weigh more than 60 tons (Carroll 1994). Calves are about 14 feet long and 2,000 pounds at birth and grow rapidly to about 26 feet long during their first year. Growth slows after weaning. Female bowheads are sexually mature at about 41 to 46 feet and probably about 15 years old. The age of bowheads is hard to determine but several recent findings of ancient stone and ivory harpoon heads in subsistence-harvested whales point to ages of 150 years or more (AP 2000). Segregation by sex and age is evident during certain phases of their migration (ACS 1996, Braund 1999).

Bowheads make a variety of complex sounds, many of which are loud. The sounds produced can be described as moans, growls, roars, screams, or purrs. Other physically produced sounds include “tail and flipper” slapping, breaching, and expelling air from blowholes. All sounds produced by bowheads probably serve in transmitting some kind of information to other bowheads. Based on the hearing ability of species that can be tested, it is assumed that bowheads can hear or detect sounds above ambient noise levels in the frequencies that they produce. Unlike belugas, bowheads do not have echolocation abilities.

Predators of bowhead whales are primarily orca whales and people. Other sources of mortality can include disease, collisions with vessels, and in rare circumstances, suffocation under the ice if breathing holes cannot be found or made. Entanglement of whales in fishing gear and lines is also becoming more common.

Bowheads strain small fish, copepods, euphausiids (krill), and other small invertebrates from the water through baleen plates by swimming with their mouths open. They feed at all depths from the surface to the bottom using a variety of strategies including feeding under the ice and swimming in a V-shaped phalanx to increase feeding efficiency. Bowhead swim slowly (1.2 to 3.7 miles per hour) and generally dive for 6 to 17 minutes before surfacing and blowing from about 4 to 9 times (Carroll 1994). Dives up to 33 minutes have been recorded. Little is known about how baleen whales actually find food, but because baleen whales do not echolocate like toothed whales, they may depend on hearing to locate swarms of krill and other prey by the sound the prey makes.

Major Environmental Influences. All behavioral research on the effect of noise on bowhead whales involves the development and operation of oil facilities in the bowhead's summer feeding grounds in the Beaufort Sea. Noise generating industrial activity in the feeding grounds includes drilling, dredging, seismic exploration, vessel and aircraft traffic, ice breaking, and the construction of artificial islands. Scientists have been recording reactions of bowheads to industrial activity since the early 1970's (Fraker 1984). Vessel and aircraft traffic appear to be the most disrupting to bowhead behavior. When approached by vessels, some responses include subtle changes in respiration and diving behavior. At a distance of 0.5 to 2 miles, bowheads generally swim away, but may stop moving after the vessel passes. Bowhead-vessel encounters were found to temporarily disrupt whale activities, but did not cause them to leave the area. Bowheads feeding cooperatively were disrupted for longer periods of time than bowheads feeding alone. Seleona Rexford (1978) of Kaktovik noted that sharp noises made on the ice would cause whales in the lead to dive. Outboard motors were frequently cited as a source of distress for the whales. Whalers reported these observations from Kaktovik (Rexford 1978), Barrow (Archie Brower 1978), and Nuiqsut (Napageak 1996).

Fraker (1984) documented the reaction of bowheads to a sizeable dredging operation that consisted of a large suction dredge operating in 60 feet of water, a barge camp, two tugs, barges, and auxiliary equipment. Aerial surveys and observations by personnel reported bowheads over a wide area surrounding these activities. Sightings of bowheads in the 50-foot, 1,200 to 1,800- foot, and +2,500-foot range from operations were common throughout the dredging operation. It can be concluded that either the bowheads did not find the dredging activity disturbing or that food resources were so important to them that they used the area despite the dredging activity.

Observations of bowhead reaction to shore-based stations in the Beaufort Sea, such as artificial island drilling platforms, are inconclusive. The natural dispersal of bowheads on the feeding grounds in the Beaufort Sea appears to be highly variable from year to year. In some years bowheads are abundant near industrial activities while in others they are not. These observed variances may be related to annual variances in food availability rather than the industrial activity itself. In some instances, the availability of food resources may require bowhead whales to increase their tolerance of industrial activity, or conversely, bowheads may not pay any particular attention to noise that they do not perceive to be a threat.

There are no critical feeding, calving, or other important resources near Portsite. Surveys of productivity and invertebrates in the southeastern Chukchi Sea indicate that productivity is higher in deeper water well west of Portsite, indicating that waters near Portsite are not of particular biological importance to bowheads if they feed during their spring-early summer migration northward through the Chukchi Sea.

Gray Whale.

Distribution. Gray whales are coastal baleen whales that migrate along the Pacific Coast between Arctic seas and wintering areas in more temperate waters. At one time there were three gray whale populations: a north Atlantic population, now extinct; a Korean or western north Pacific stock, now very depleted; and the eastern north Pacific population, the largest surviving population. The eastern north Pacific population of gray whales makes one of the longest of all mammalian migrations, averaging 10,000 to 14,000 miles (16,000-22,530 km) round trip. The whales begin to leave their feeding grounds in the Bering and Chukchi seas in October and head south for their mating and calving lagoons in Baja California, Mexico. The southward journey takes 2 to 3 months. The whales remain in the lagoons for 2 to 3 months, allowing the calves to build up a thick layer of blubber to sustain them during the northward migration and keep them warm in the colder waters. The return trip north takes another 2 to 3 months. Mothers and calves travel very near shore on the northbound migration. Some individual gray whales are found year round in the Straits of Juan de Fuca between the State of Washington and Vancouver Island, Canada, and possibly off the central California coast.

Hunted to the edge of extinction in the 1850's after the discovery of the calving lagoons, and again in the early 1900's with the introduction of floating factories, gray whales were given partial protection in 1937 and full protection in 1947 by the International Whaling Commission (IWC). Since that time the eastern north Pacific gray whale population has recovered, and the 1997/1998 censuses estimated their population at 26,635.

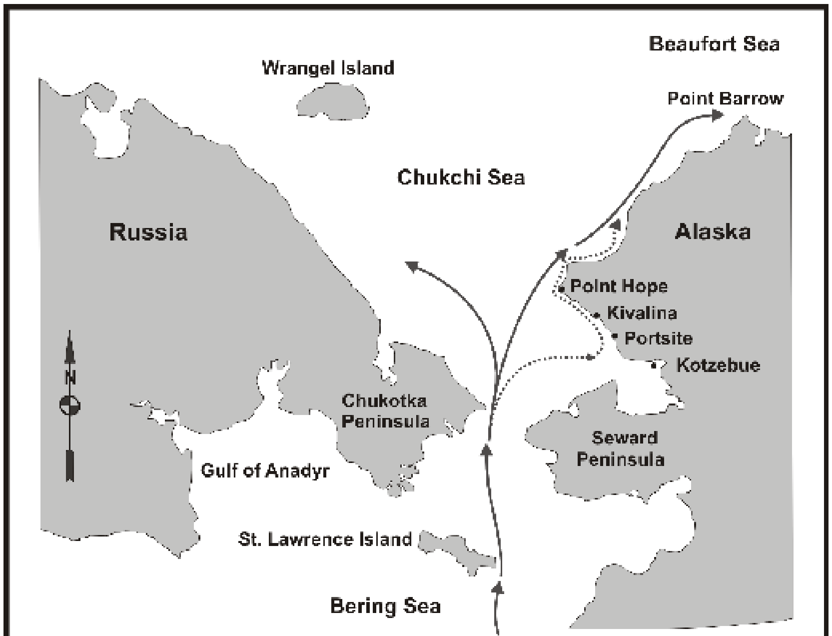
Members of the eastern north Pacific stock seasonally inhabit waters in near-shore areas of Kotzebue Sound including waters near Portsite (figure 3-47), and coastal waters of the Chukchi Sea north of 69° north latitude (USEPA et al. 1984). The southward migration appears to be along the western Chukchi Sea coast of Russia.

Life History. The gray whale's shape is streamlined with a narrow, tapered head. The whale received its name from the gray patches and white mottling on its dark skin. Adult males are as long as about 46 feet, and adult females are slightly longer. Both sexes weigh 30 to 40 tons at maturity. Causes of mortality in gray whales include orcas, collisions with boats, entanglement with fishing gear, and entrapment in ice, stranding, disease, starvation, the Siberian harvest by Russian hunters, and occasional harvest by North American Native hunters.

The Red Dog Mine EIS (USEPA et al. 1984) suggested that gray whales are more likely than any other whale to collide with the Portsite loading facility structures proposed for construction at Portsite. However, in the 15 years the present loading facility at Portsite has been operating, there have been no reports of collision or other source of injuries to gray whales from the dock, tugs, ships, or other facilities.

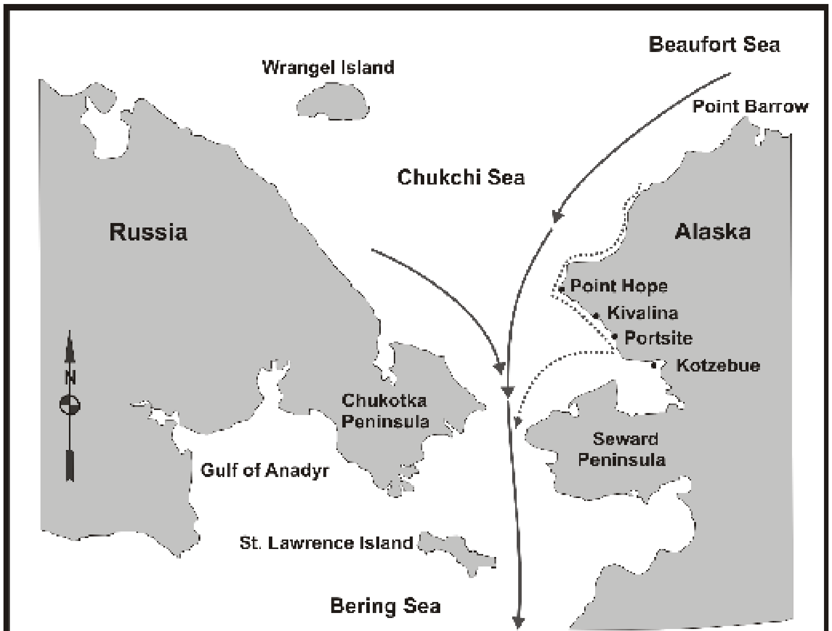
Gray whales reach sexual maturity between 5 and 11 years of age, when they reach 36 to 39 feet in length. Courtship and mating behavior are complex, and frequently involve three or more whales of mixed sexes. Mating and calving both occur primarily in the lagoons of Baja California, Mexico, although both have been observed during the migration. Females bear a single calf at intervals of 2 or more years. Gestation is 12 to 13 months. Newborn calves are dark gray to black, although some may have distinctive white markings. Calves weigh from 1,100 to 1,500 pounds, are about 15 feet long at birth, and nurse from 7 to 8 months.

Gray whales emit low frequency moans, and the portions of the brain that are dedicated to hearing suggest they have well developed hearing, especially in the lower frequency ranges. Like other whales, they have small external ear openings on each side of their head that lead to a narrow auditory canal. The effectiveness of sound reception and hearing through the ear canal is unknown, but the middle and inner ear follow the basic mammalian ear structure. Gray whales have adaptations for vision in low-light conditions and are nearsighted in air.



Spring migration movements of eastern Pacific Ocean stock gray whales to the Chukchi and Beaufort Seas (Ferrero et al. 2000)

Typical migration route   Inshore migration route



Fall migration movements of eastern Pacific Ocean stock gray whales from the Chukchi and Beaufort Seas (Ferrero et al. 2000)

Typical migration route   Inshore migration route

Figure 3-47. Seasonal movements of gray whales through the northern Bering and Chukchi Seas.

Gray whales feed on the rich bottom substrate of the Bering and Chukchi seas, where feeding areas correspond with abundance of shrimp, amphipods, and worms. Those are the same clam-rich feeding areas of walrus. Amphipods are believed to be the principal food of gray whales. They feed primarily during the summer months of long daylight hours in the cold Arctic waters of the Bering and Chukchi seas. To feed, a whale dives to the bottom, rolls on its side, and draws bottom sediments and water into its mouth. As it closes its mouth, water and sediments are expelled through the baleen plates, which trap the food on the inside near the tongue to be swallowed.

Nelson (USGS 1996) reported that gray whales disturb hundreds of square miles of the sea floor during feeding by excavating pits from 11 to 54 square feet in area and up to a foot deep. Nelson calculated that in the Chirikov Basin, south of the Bering Strait, up to 172 million tons of bottom material each year are resuspended in the water column through the feeding activity of (mostly gray) whales. The resuspended sediments increase turbidity and recycle nutrients that can be used by many marine invertebrates.

There are no identified important feeding areas or other critical habitats for gray whales in the southwestern Chukchi Sea.

Harbor Porpoise. Harbor porpoise is the smallest species of cetacean in Alaskan waters, reaching a length of just 5 feet. Harbor porpoises range from Point Barrow in Alaska, south to Point Conception in California. Relatively high densities of porpoises are found in the more temperate parts of their range while fewer are found in Arctic waters.

Three stocks are recognized in Alaskan waters. The stocks include the Bering Sea, Southeast, and Gulf of Alaska stocks. A partial-range survey of the Bering Sea stock in 1991 estimated about 11,000 porpoises (Ferrero et al. 2000). There are likely more porpoises in the Bering Sea stock because only the southern part of their range was surveyed.

Harbor porpoises are sometimes seen around the mouths of rivers and in shallow near-shore areas along the eastern Chukchi Sea coast during summer. Commercial trawl fisheries are the principal source of human-induced mortality. A few porpoises are occasionally entangled in subsistence nets along shore, but subsistence hunters do not target this species (Ferrero et al. 2000). Orca whales are the principal natural predator of harbor porpoises. A likely migration path based on the range, distribution, and timing of the Bering Sea stock (Ferrero et al. 2000) is shown in figure 3-48.

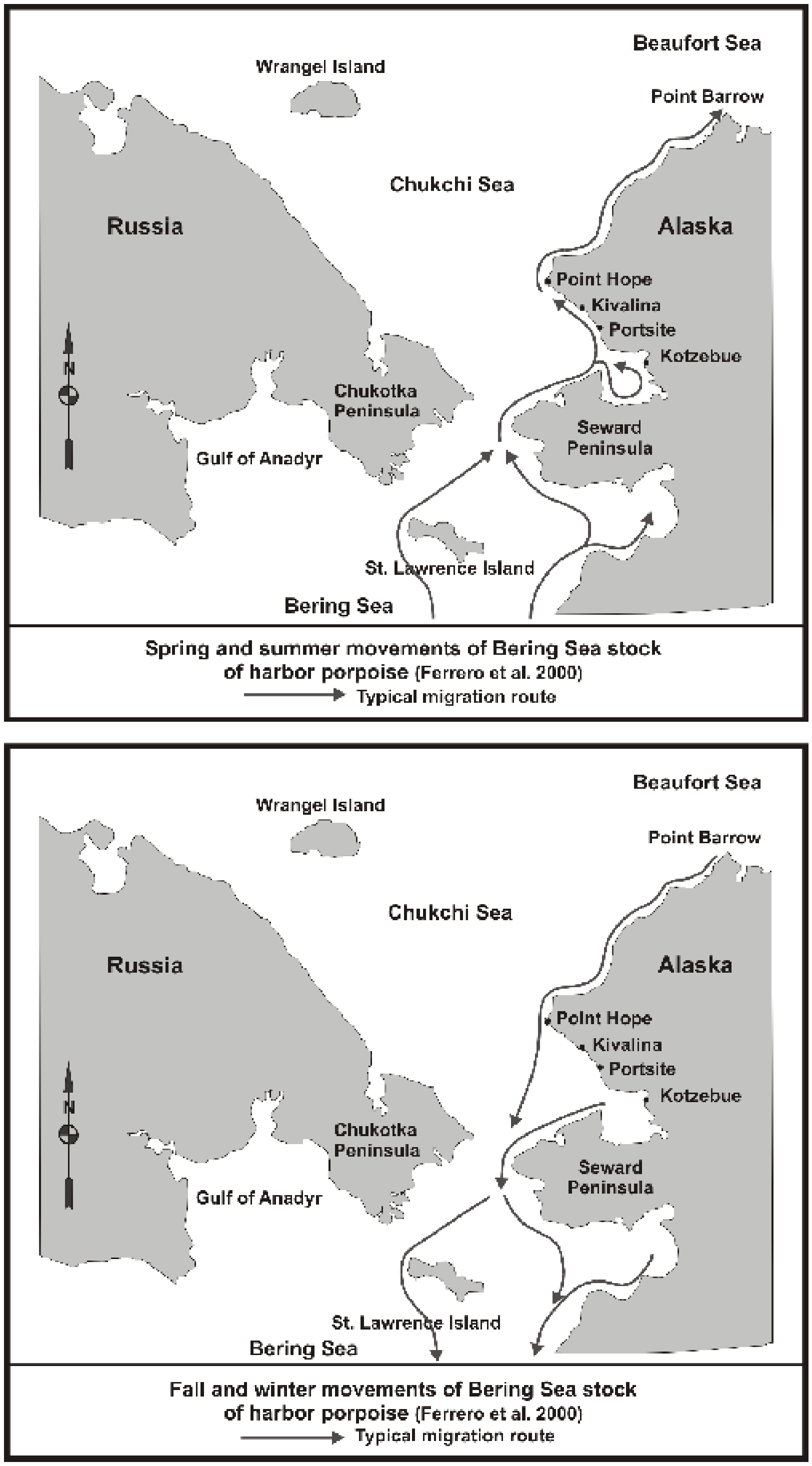


Figure 3-48. Seasonal movements of harbor porpoise through the northern Bering and Chukchi Seas.

Polar Bear.

Distribution. Polar bears are circumpolar in distribution and comprise several stocks. In Alaska, there are two stocks of polar bears: the Beaufort Sea stock and the Chukchi Sea stock. The ranges of the two stocks overlap in the northeastern Chukchi Sea between Point Hope and Point Barrow (Ferrero et al 2000, Kalxdorff 1997). Polar bears occasionally seen near Portsite are from the Chukchi Sea stock.

A reliable population estimate of polar bears in Alaska does not exist, but recent estimates place the number of bears in the Chukchi Sea stock at from 2,000 to 5,000 bears (USFWS Marine Mammal Assessment, 2002). The Beaufort Sea stock probably numbers around 1,800 bears.

Polar bears are more abundant near coastlines and the southern edges of sea ice than on the central Arctic ice pack. During winter, many polar bears of the Chukchi Sea stock are found in the northern Bering Sea where they sometimes venture as far south as the Kuskokwim Delta. Most migrate only as far south as Saint Mathew Island (Kalxdorff 1997). Some polar bears also winter along coastal areas farther north in the Chukchi Sea where there are concentrations of seals and marine mammal carcasses (Kalxdorff 1998). In the spring most polar bears that winter in the northern Bering Sea follow the ringed seals and receding ice north through the Bering Strait and Chukchi Sea. In some years when the ice abruptly recedes, some polar bears can be stranded on Saint Lawrence Island where they spend the summer.

Polar bears of the Chukchi stock normally live along the edge of the polar ice pack north of about latitude 72° during the summer months (Kalxdorff 1997). Some of the Chukchi Sea stock polar bears move to the vicinity of Wrangel Island when walrus are present, and many of the pregnant females den for the winter and birth on Wrangel Island. Most polar bears that den on land in Alaska den east of Point Barrow, but some of the Chukchi Sea stock den between Point Hope and Point Barrow where they intermix with the Beaufort Sea stock (USGS 2001). Polar bears of the Chukchi Sea stock also den on the ice pack north of Point Barrow. There is no information from local residents of polar bears denning on land in the vicinity of Portsite, although people from Kivalina have reported polar bears denning on the offshore pack ice (Kalxdorff 1997).

Figure 3-49 depicts the general direction of the spring and fall movements and dispersal pattern of polar bear in the Bering and Chukchi seas.

Polar bears are known to make infrequent feeding excursions up the Wulik River and are occasionally present in the Portsite area during winter. Kalxdorff (1997) reported two observations of polar bears (1974 and 1992). They are reported as relatively frequent visitors to the Kivalina dump and have been seen at Portsite.

Three polar bears were seen from the Portsite shiploader platform during the spring 2000 survey. The bears, a pair and one single bear, were briefly observed as they moved swiftly between the jagged pressure ridges of the pack ice just offshore of the shear zone. Additionally, the Cominco Alaska environmental specialist assigned to the port facilities reported seeing a polar bear from the bargeloader platform during February 2000. Unlike seals and whales, the polar bears appear to be curious about noises or movement and may be attracted by them (Napageak 1996).

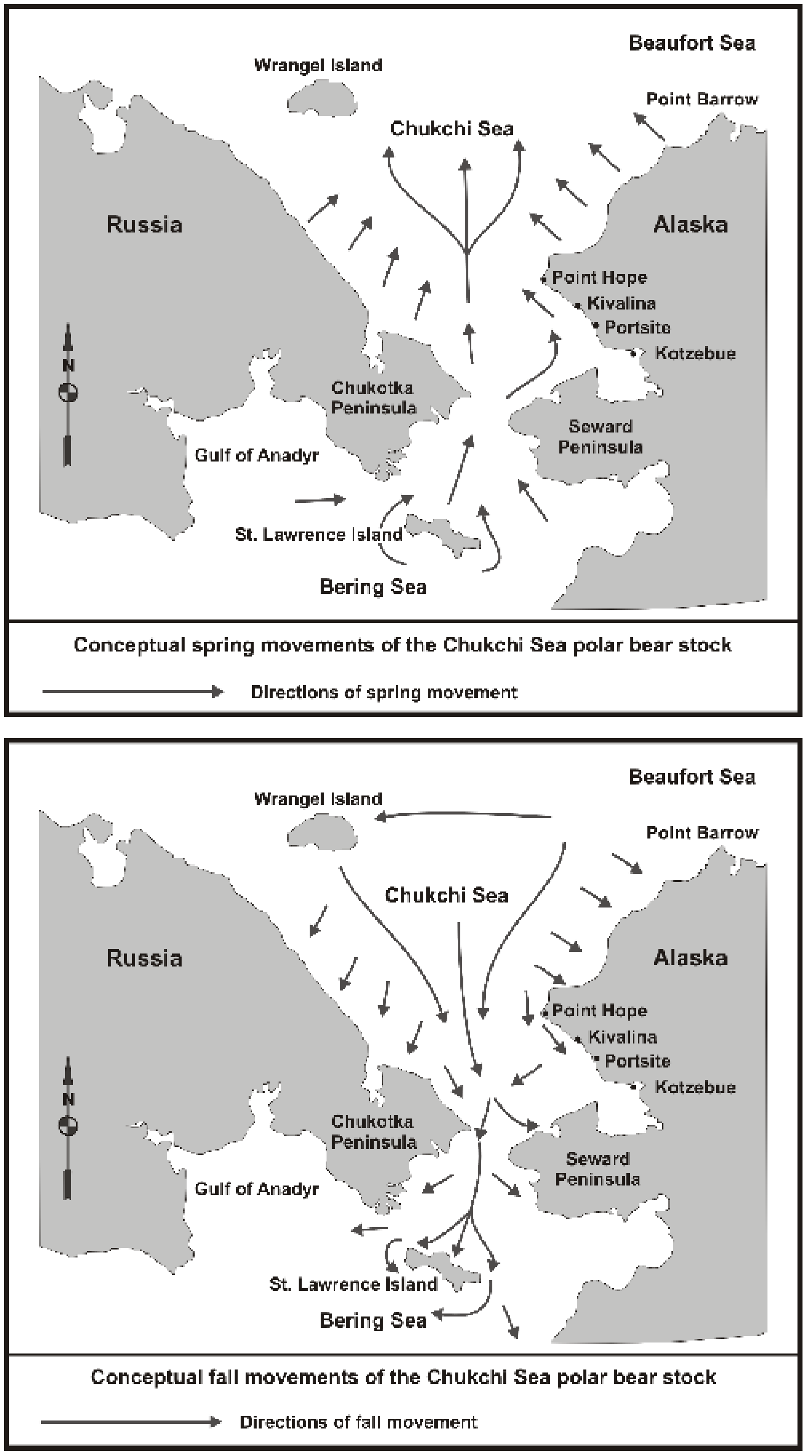


Figure 3-49. Seasonal movements of polar bears through the northern Bering and Chukchi seas.

Life History. The polar bear is the largest land carnivore on Earth. Newborn polar bears weigh about 1.5 pounds at birth. By the time they reach adulthood, male polar bears weigh from 800 to 1,500 pounds and may stand almost 10 feet tall, while adult females normally weigh from 330 to 550 pounds and are up to 8 feet tall. Female polar bears reach sexual maturity when they are about 4 years old, while males reach sexual maturity at about 6 years old. Males, however, do not successfully mate until they are about 8 years old. Cubs are born every 3 years in some populations and every 2 years in others. Adult females can gain as much as 440 pounds between conception and denning. Polar bears can live as long as 20 to 30 years in the wild, but few are thought to live past 18 years.

Predators of the polar bear are man and other polar bears, particularly the larger, cannibalistic males that prey on cubs and smaller juveniles. Other sources of mortality include disease, parasitism, and starvation.

Iñupiaq hunters observed that ringed and bearded seals are the principal prey of the polar bear, although other species of seals, young walrus, and even beluga whales are sometimes taken (Kalxdorff 1997, 1998; Lowery et al. 1987). Carrion such as dead whales, walrus, and seals also are eaten, as are occasionally caribou, fish, and seabirds and their eggs.

Polar bears can be right or left handed by traditional knowledge. Iñupiaq hunters from the Point Hope area 80 miles north of Portsite, view polar bears as left handed (Lowenstein 1980), while hunters of the Siberian Yupik culture on Saint Lawrence Island see polar bears as either right or left handed (E. Toolie personal communication). The dominant hand of polar bears influences how polar bears capture their prey and how they are hunted on Saint Lawrence Island. On Saint Lawrence Island, hunters watch to see which side a polar bear favors and then stalk them from the opposite side (E. Toolie personal communication).

The area around Portsite and the seas offshore from Portsite support a sparse distribution of polar bears that occasionally are seen near existing facilities. There is no indication that the southeastern Chukchi Sea contains more than comparatively sparse populations of polar bears at any time of the year or that it contains critical feeding, denning, or other important habitat.

3.5.4.2 Terrestrial Mammals

Terrestrial mammals of the general Portsite area include caribou, moose, brown bear, red fox, arctic fox, musk ox, Dall sheep, wolf, ground squirrels, lemmings, voles, shrews, weasels, porcupines, snowshoe hares, muskrats, river otters, and wolverines. Of these species, porcupines, hares, muskrats, and river otters are relatively uncommon and are restricted to limited habitats, while the other species are more common.

Caribou is seasonally the most abundant large terrestrial mammal present in the area near Portsite. Caribou are common during winter and spring along the DMTS road and on the tundra rises east of Portsite. Musk oxen are also commonly seen in small numbers along the road. Red fox and ground squirrels are common at Portsite. Brown bears and moose are known to occasionally approach the site. Abundance of lemmings, voles, and shrews in the surrounding tundra is cyclic in response to environmental factors. Arctic fox are present in varying numbers in winter on the sea ice where they scavenge from polar bear kills and from ringed seal pupping dens.

Caribou, moose, and Dall sheep are important subsistence mammals in the area around Portsite and the surrounding region. Fur of other species including fox, wolf, and wolverine is sold or used to make Native crafts and trim for traditional clothing. Caribou and moose are the principal terrestrial mammals hunted in the area, and these two species were identified as resources of special concern during the EIS scoping meetings. They are discussed in more detail in the following paragraphs.

Caribou. Caribou in the Portsite area are part of the Western Arctic Caribou Herd (WACH), which has been subject to radical population swings. The population dropped abruptly to very low numbers in the 1880's causing widespread famine. In the decades that followed, WACH caribou were almost nonexistent in the Portsite area. In the early 1900's, reindeer, domesticated Eurasian caribou, were introduced to the region and flourished through the 1930's, when they too began to decline in number. Then during the late 1940's and early 1950's, the WACH began to increase and once became more common in the Portsite area. The remaining domesticated reindeer then joined the wild caribou migrations and were assimilated into the WACH. The range of the WACH is now from the Arctic Slope south to the Seward Peninsula, as shown in figure 3-50.

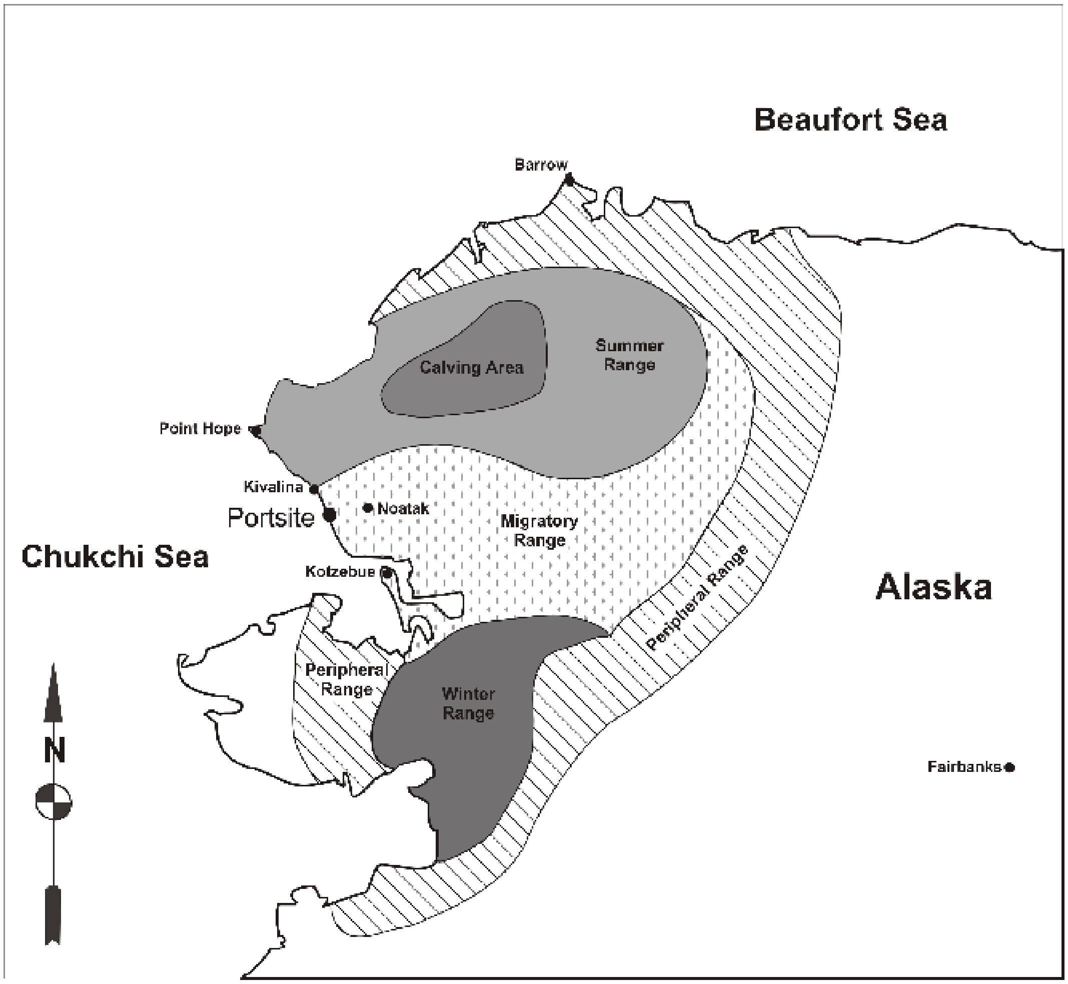


Figure 3-50. Seasonal ranges and calving area of the western Arctic caribou herd (Dau 2001).

The size of the WACH over the past 30 years, based on ADF&G census data, is shown in figure 3-53. Based on those data, the herd increased substantially from about 1975 through 1990, then growth slowed from about 1990 to 1996. More recent census data suggest the WACH might be in a slight decline since 1996 from a peak abundance of about 463,000 caribou. The slower population growth rate and possible decline in recent years may be more attributable to declining recruitment rather than increasing adult mortality (Dau 2001b). Diminishing food resources may be contributing to declining numbers. There is no evidence that environmental contaminants or disease are substantially affecting population size.

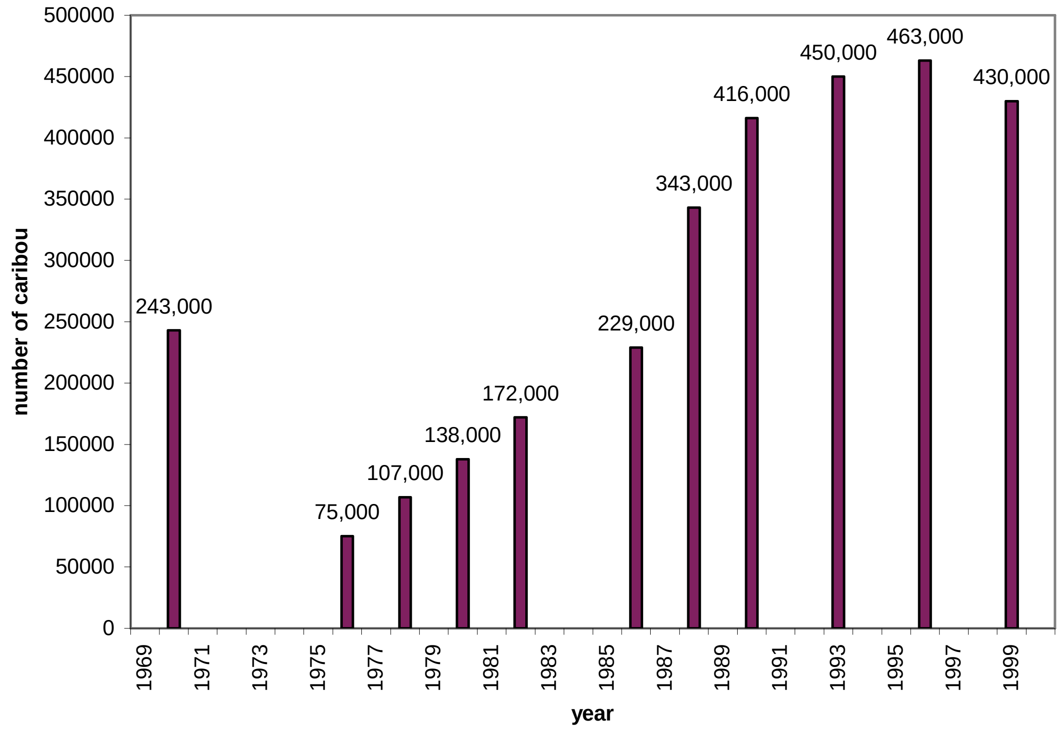


Figure 3-51. Trends in numbers of caribou in the Western Arctic Caribou Herd from 1970 through 1999 (Dau 2001b).

The Portsite area is at the edge of caribou summer range and in the area they use during migration (figure 3-50). Based on census data, a large portion of the WACH has wintered on the Seward Peninsula during the last 15 to 20 years. During the winter of 2001, slightly more than half of the WACH (225,000 caribou) wintered there, while about 15,000 caribou wintered on the North Slope between Wainwright and Umiat. Smaller groups of caribou wintered in the Kotzebue Sound area from the Lisburne Peninsula to the Purcell Mountains and upper Kobuk River, in the Portsite area, and the upper Noatak River drainage (Dau 2001b).

The northward spring migration of the WACH usually begins in late March or early April. In 2001, the spring migration began in May, about 5 weeks later than usual. Typically, pregnant cows are the first to move north, but in 2001, all caribou started moving at the same time, and once they began migrating north, they traveled unusually fast (Dau 2001b).

The WACH typically calves on the western Arctic slope (figure 3-50). Usually, calves are born on the North Slope near the headwaters of the Colville River. In 2001, however, most (70 percent) of the calves were born south of the Brooks Range, with many in the Noatak, Kobuk, and Buckland River drainages. The late spring breakup in 2001 may have been a contributing factor (Dau 2001b).

Caribou migrate through the general Portsite area and feed throughout the area. There is no indication that Portsite or the immediate vicinity is calving habitat or that it serves any other critical function for regional caribou populations.

Moose. The moose (*Alces alces*) is a member of the deer family, and Alaska moose (*Alces alces gigas*) are the largest in the world. In Alaska, moose occur from the Stikine River in the Panhandle to the Colville River on the Arctic Slope. Although moose are widespread both north and south of the Brooks Range in Northwest Alaska, they are relative newcomers to northwestern Alaska. They were first hunted in the Portsite area in the early 1950's.

Bulls in prime condition may weigh from 1,200 to 1,600 pounds. Only the bulls have antlers, which are shed as early as November, but mostly in December and January. Adult cows weigh 800 to 1,300 pounds. In the wild, moose rarely live more than 16 years.

Moose breed in late September and early October. Newborn calves usually weigh between 28 and 35 pounds and can grow to over 300 pounds within 5 months. Calves are born from mid-May to early June in the project area.

Moose eat a variety of foods, particularly sedges, equisetum (horsetail), pondweeds, and grasses. During summer, moose feed on vegetation in shallow ponds, forbs, and the leaves of birch, willow, and aspen.

Typically, moose make seasonal movements for calving, breeding, and wintering. In the Portsite area, moose typically are found in tall shrub communities along riverbanks and streams during winter. A winter use area for moose is in the middle of the Wulik River drainage, about 35 miles northeast of Portsite, and the Rabbit Creek drainage, about 10 miles south of Portsite. In late spring, moose tend to disperse to shrub habitat at higher elevations. Dispersal to higher elevations continues through the summer and into autumn, and with the approach of winter, they tend to move into the riparian habitat.

Although the Alaska Department of Fish and Game does not currently census moose in the project area, the population of moose is likely similar to that estimated by the Alaska Department of Fish and Game in the early 1980's, when 150 moose were counted in the Wulik and Kivalina drainages (Hinman 1981, J. Dau personal communication). While critical winter and calving moose habitat has been identified in the region, Portsite is not in or immediately adjacent to critical moose habitat.

Brown Bear. Brown bears (*Ursus arctos*) are often seen along the DMT road and are sometimes seen in the Portsite area. During winter brown bears den in higher elevations, but occupy the coastal areas during summer. The diet of brown bears in the area is variable. Ground squirrels, caribou, moose calves, small rodents, winterkill carrion, stranded marine mammal carrion, spawning salmon, and vegetation are all important to the diet of brown bears. Brown bears sometimes feed in the Kivalina landfill (R. Adams Sr. and J. Swan Sr. personal communications). There is no landfill at Portsite. Trash is burned in an incinerator, and brown bears are not attracted to Portsite because of trash.

Male brown bears in the general area of Portsite have larger home ranges than do the females (Ballard et al 1993). The home range of male brown bears averages 555 square miles, while the average home range of females averages 383 square miles. The density of brown bears in high quality denning habitat in the Portsite area is estimated at one bear per 19 square miles, while the density for bears in year-round habitat is lower at one bear per 27 square miles. The average density of adult bears around the Red Dog Mine is about one bear per 25.7 square miles. Brown bear numbers in Kotzebue Sound-Western Brooks Range area (Game Management Unit (GMU) 23) are increasing and some residents of GMU 23 complain that there are "too many bears" (Brown Bear Management Report, 2002). A population estimate for brown bears in GMU 23 is not available, but if half of the GMU were suitable brown bear habitat, the population could be as high as almost 900 bears.

Brown bears show a high fidelity to denning areas, but do not necessarily use the same den site annually. Brown bears are known by local traditional knowledge to be left-handed (Georgette1989). There are no denning or other critical brown bear habitats at or in the vicinity of Portsite.

3.5.5 Birds

Most species of birds found along the northwest coast of Alaska are seasonally present in the Portsite area. The National Park Service (NPS 1996) compiled a comprehensive list of birds in the Krusenstern National Monument that includes the species likely to use the Portsite area.

Recent wildlife surveys in the Portsite area conducted in 1998, 2000, and 2001 included observations of birds in the Portsite area (RWJ 1999, RWJ 2001a, RWJ 2001b). The discussion of birds presented in this section is based primarily on the observations made during those recent surveys, on traditional knowledge from conversations with local hunters, and supplemented with information from earlier bird studies in the area.

Earlier investigations of birds in the Portsite area were conducted in the 1960's and in the 1980's. Williamson, et al. (1966) and Swartz (1966) studied the birds between Kivalina and Point Hope during the early 1960's for the Project Chariot investigations (Wilimovsky and Wolfe 1966). A baseline study of birds in the Portsite area was conducted as part of the preparation of the Red Dog Mine EIS (Dames and Moore 1984). Although other species were included, the primary focus in these earlier studies was on waterfowl and raptors. Major bird families and habitat associations are listed in table 3-6.
.

3.5.5.1 Birds Observed at Portsite During Recent Wildlife Surveys

Bird species seen at Portsite during the early spring months of the surveys were willow ptarmigan, common ravens, and snow buntings. These species are also likely to be present in the general Portsite area throughout winter. Several species of gulls were observed to arrive in early May, followed by dabbler ducks, sea ducks, geese, loons, sandhill cranes, shorebirds, songbirds, owls, and hawks later in the month. Portsite and the area around it is general habitat for a variety of resident birds and is on the general migratory flyways for many of the other bird species that summer in northern Alaska. Portsite is not in or adjacent to any identified critical habitat for any species of bird, although there is some nesting at and near Portsite. An expanded discussion of the major bird groups observed during the wildlife surveys at Portsite follows.

Table 3-36. Major bird families and general habitat where found near Portsite.

Major Bird Families	General Habitat [a]
Passerines	Tall and low shrub, tundra, tall grass, and man-made structures.
Waterfowl (including seaducks)	Chukchi Sea, lagoons, and ponds, and tundra.
Shorebirds (including phalaropes)	Chukchi Sea, marine shoreline, lagoons, ponds, and tundra.
Raptors (including jaegers)	Tall and low shrub, tundra, and tall grass, Chukchi Sea.
Gulls and Terns	Chukchi Sea, lagoons, and ponds.
Cormorants	Chukchi Sea.
Loons	Chukchi Sea and lagoons.
Seabirds (alcids)	Chukchi Sea.
Grouse	Tundra.
Cranes	Tundra.
a. General type of habitat where found around Portsite.	

Passerines. Passerine birds are those characterized as perching birds and/or songbirds. Snow bunting was the most frequently seen passerine in early spring. A pair of ravens was also observed nesting on the ladder of a DMT fuel storage tank during the early spring. As summer progressed, Lapland longspurs and Savannah sparrows replaced snow buntings as the predominant passerines in the Portsite area. Fox sparrows and white-crowned sparrows are also likely to have been present in their respective habitats, but the surveys did not differentiate those species. More than one pair of ravens also likely resides in the Portsite area because the fuel-tank nesting pair was noted to press vigorous attacks on other passing ravens. A few yellow or white wagtails (species uncertain) were also occasionally observed near Portsite.

Waterfowl. Observations made during the recent surveys confirm local knowledge and provide an overview of the general behavior of migrating waterfowl in relation to the existing loading facilities. Survey observations reported and traditional knowledge confirmed (W. Adams Sr. personal communication, Burch 1985) that the direction and velocity of the winds in the area influence the migratory behavior of some waterfowl and shore birds in the area. On days with strong northerly or easterly winds, many migrating geese, ducks, and loons tend to fly northward very low along the beach. On calm days and days with southerly winds, many waterfowl apparently migrate inland and fewer waterfowl migrate along the beach line. Traditional knowledge of Native wildlife observers also says that most sea ducks migrate along offshore leads during spring, and are sometimes blown inshore during storms.

Observers noted how migrating waterfowl reacted to the presence of the DMT bargeloader during the spring migration in 2000. The bargeloader is painted gray with white and black accents, and is about 90 feet above the surface of the ice at its highest point. A high-intensity strobe flashes from the highest point. Behavior of waterfowl as they approached the bargeloader varied. Some flocks reacted by flying a few hundred yards seaward and gaining a few hundred feet in altitude to clear the bargeloader, while other flocks of the same species would fly directly over the bargeloader with only a slight gain in altitude to clear the structure. There was no apparent difference in the flocks or in activity on or around the loader that would explain this variation in behavior.

Other waterfowl including harlequin ducks, oldsquaw ducks, and common eiders were often seen swimming or resting on ice floes near the bargeloader during breakup. Those species were not as frequently seen near the bargeloader after the ice had melted and ore loading operations had started.

Shorebirds. Shorebirds inhabiting the Portsite area were noted incidental to observations of waterfowl, loons, and other bird families. Shorebirds of many migratory species were present along the Chukchi Sea shore, around lagoons and ponds, and on the wet tussock tundra near Portsite. Some shorebirds were more noticeable than others because they occurred in flocks of up to several dozen individuals. The more notable species included the bar-tailed godwit, whimbrel, golden and black-bellied plovers, semipalmated plover, spotted sandpiper, long-billed dowitcher, dunlin, turnstones, pectoral sandpiper, semipalmated sandpiper, knot, and western sandpiper. Although pelagic and not technically shorebirds, phalaropes were relatively common in near-shore waters and on lagoons. Northern phalarope were more commonly seen than red phalarope. Common snipe were also frequently seen and heard on the tundra between Portsite and the concentrate storage building about ½ mile inland from Portsite.

Falcons, Hawks and Owls (Raptors). The Portsite and Red Dog Mine area was surveyed for raptors during the baseline studies for the Red Dog Mine EIS (Dames and Moore 1983). Gyrfalcon, rough-legged hawk, peregrine falcon, bald eagle, and golden eagle were species seen during these surveys (Erickson 1983).

The following raptor species were seen in the Portsite area during the Corps' spring and summer surveys.

- Short-eared owl
- Northern hawk owl
- Northern harrier
- Rough legged hawk
- Peregrine falcon
- Swainson's hawk

Although snowy owls are known to be common in the Portsite area during winter, none were seen during the surveys.

Short-eared owls were the most common raptor in the Portsite area. They arrived in May and were often seen hunting along the beach berms during spring and summer. Occasionally up to a dozen short-eared owls were sighted at the same time. Several rough-legged hawks and a few pairs of northern harrier hawks (marsh hawks) were also seen hunting along the beach berms near the DMT bargeloader.

Rough-legged hawks were also seen in the upland tundra along the DMTS road leading to the mine. A few peregrine falcons were seen crossing the DMTS road in April and

May, and one Swainson's hawk was seen along the DMTS road. The hawk owl should be relatively common on northern tundra, but only one of these small, long-tailed owls was seen near Portsite.

Short-eared owls, rough-legged hawks, and harriers probably nest in the general Portsite area. They were observed throughout the summer and obvious harrier pairs were noted. The surveys were not designed specifically to search for nests and no nests or fledgling birds were reported.

Gulls and Terns. During the surveys, gulls were observed to be among the first arrivals in the Portsite area in spring. The large white glaucous gull was common as was the smaller herring gull and the darker-winged mew gull. These gull species exhibited different behaviors near Portsite. Glaucous gulls were usually observed as singles and groups of two or three, while the herring and mew gulls generally sat on the beach in larger flocks. Those smaller species also used the bargeloader as a roosting structure. Other gull species seen in the area, but in far fewer numbers, included Sabine's gull, blacklegged kittiwake, and Bonaparte's gull.

Arctic terns also were frequently seen in the Portsite area during summer. This member of the gull family was often encountered vigorously defending nesting areas along the beach berms.

Other gull-like species seen in the area during the surveys included long-tailed, parasitic, and pomarine jeagers. Long-tailed jeagers were relatively common and several were seen during any late spring through summer observation period. Slower-flying pomarine and parasitic jeagers were mostly observed migrating north in small groups during early spring.

Cormorants. Cormorants were often seen from the observation platform during the open-water period as singles or in small flocks flying parallel to the beach. Their flight behavior as they encountered the bargeloader was to fly around the seaward end with a slight gain in altitude.

Loons. All species of loons found in North America were observed to migrate through the Portsite area in spring, with the Arctic loon appearing most frequently, and the common loon less often. Many loons were observed flying low over the water along or near the beach as singles, pairs, and in small flocks. Loons were often seen on the larger lagoons during their migration.

Seabirds (Alcids). A few common or thick-billed murres, and several flocks of unidentified seabirds that were most likely murres, were observed during the surveys. Both species of murres are locally known as "crowbills" and nest in sea-cliff colonies north of Kivalina near Cape Thompson. Swartz (1966) discusses the murre colonies at Cape Thompson in more detail. Several large flocks of dark-colored, unidentified seabirds (probably murres) were seen resting in open leads along the shear zone during early spring.

Grouse. Willow ptarmigan apparently are year-round residents of the Portsite area. During early spring in 2000, a flock of over 100 was often seen foraging on the tundra around the Portsite buildings, on the beach berm, and at times, in the parking lot. This flock was visible almost every day and appeared to split into several groups during the day and to reform at dusk. When nesting season approached, they were observed to distribute in pairs over the nearby tundra to nest.

Cranes. Sandhill cranes appeared to be common in the Portsite area. On calm days during the spring migration they could be seen (and heard) flying high over the Portsite in flocks. Later in the summer small numbers of cranes were heard calling from the tundra behind the Portsite. Small flocks of sandhills, assumed to be non-breeding birds, were often seen feeding near lagoons between Portsite and Kivalina, while pairs of nesting sandhills were occasionally disturbed when observers were walking on the tundra.

3.5.5.2 Use of Lagoons near Portsite.

Table 3-7 lists the most commonly observed species seen using lagoons and riparian habitat in the Portsite vicinity during Corps surveys.

Table 3-37. Species of birds seen during wildlife surveys at Portsite in summer 2000.

Harlequin sea duck	Black scoter sea duck	Whitefront goose
Old squaw sea duck	American widgeon duck	Long billed dowitcher
Common eider sea duck	Northern pintail duck	Common snipe
Mallard duck	Shoveler duck	Red phalarope
Canvasback duck	Greenwing teal duck	Northern phalarope
Redhead duck	Common teal duck	Whimbrel
Greater scaup duck	Bartailed godwit	Arctic loon
Yellow-billed loon	Common loon	Red-throated loon
Red-breasted merganser	Red-necked grebe	Common loon
White-wing scoter	Canada goose	Black brant goose
Tundra swan	Snow goose	Plover, turnstone, sandpipers
Short-eared owl	Willow ptarmigan	Sparrow sp.
Harrier hawk	Snow buntings	Wagtails and larks
Rough-legged hawk	Long-tailed jeager	

The majority of these species were transitory, but pintail and widgeon ducks, and Canada geese are known to nest in the riparian habitat near the lagoons (D. Lovett, personal communication). Northern phalaropes were frequent summer visitors and sandhill cranes were often heard on the tundra behind the lagoons during the summer. Several species of passerine birds and raptors were commonly seen using tall-grass habitat around the lagoons.

3.5.6 Special Status Resources

The Corps consulted with the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) regarding special-status species and habitats that could be affected by navigation improvements at DMT. Of the 12 species listed by these agencies for Alaska, three species–spectacled eider, Steller's eider, and bowhead whale–were identified by these agencies as inhabiting the Portsite area. Those three species, along with the northern right whale, finback whale, and humpback whale were also identified during scoping as species of concern to be addressed in the EIS.

3.5.6.1 Consultation with Federal Agencies

Section 7 of the Endangered Species Act, (16 U.S.C. Section 1536(a)(2)) requires Federal agencies to consult with the United States Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS), as appropriate, for actions that may affect species listed as threatened or endangered under the Act, or their designated habitat.

The Corps consulted with the USFWS and the NMFS to determine which, if any, listed species are present in the eastern Chukchi Sea and in the Portsite area. Letters of correspondence with these agencies are in Appendix 4. The spectacled eider, Steller's eider, and the bowhead whale were identified as Federally listed species known to be or likely to be present in the area. These species are briefly discussed below.

Spectacled Eider. Spectacled eider is a threatened sea duck that in Alaska nests on coastal Arctic tundra north of Cape Lisburne, about 100 miles north of the Portsite area, and winters in the Bering Sea south of Saint Lawrence Island. The USFWS does not list the area around Portsite as critical or nesting habitat for spectacled eiders, but areas used by non-breeding spectacled eiders are not well known (USFWS 1999). It is likely they migrate along leads in the ice offshore of Portsite, where they may fly less than 100 feet above the sea.

The studies for the Red Dog Mine in 1983 (Dames and Moore 1984) reported small numbers of spectacled eiders migrating north through the Kivalina area during the spring of 1982. Small numbers of spectacled eiders were also found in lagoons north of Kivalina Lagoon during summer (Erikson 1983). Spectacled eiders may also molt in marine waters adjacent to Portsite, but confirmed molting areas for the species are in Ledyard Bay north of Cape Lisburne and in the Bering Sea's eastern Norton Sound (USFWS 1999).

Steller's Eider. Only the Alaska nesting population of Steller's eiders is threatened. Although the more abundant Asian population (not listed as threatened) cannot be identified separately from the threatened Alaska nesting population, for purposes of compliance with the Endangered Species Act, all Steller's eiders are considered threatened. Steller's eiders migrate through the Portsite area, generally along offshore leads. The Portsite area is not designated as critical habitat for this species and they do not nest in the Portsite area.

Steller's eiders molt and winter in areas of the Bering Sea and North Pacific Ocean, and the southward migration route is thought to be far offshore from Portsite. They can occasionally be blown inshore to the Portsite area on strong southwest winds during their spring migration. Four small flocks of Steller's eider (up to about 35 birds per flock) were observed migrating past Portsite during the Corps' spring 2000 wildlife observation surveys. A Steller's eider fitted with a satellite tag near Barrow, Alaska, was tracked to a coastal location about 50 miles northwest of Portsite during August 2000 (P. Martin, personal communication). Dames and Moore (1983), however, did not observe Steller's eiders near Portsite during spring coastal migration surveys, and local elder hunters say the species is seldom seen near Kivalina and Portsite (W. Adams Sr., J. Swan Sr. personal communications).

Bowhead Whale. Bowhead whale was listed as endangered under the Endangered Species Conservation Act, the predecessor to the Endangered Species Act (ESA), on June 2, 1970 (35 FR 8495; codified at 50 CFR 17.11). The species was listed as endangered under the ESA in 1973 because of low population numbers. Over-harvesting by commercial whalers was the principal cause of the decline.

Factors related to habitat have not been identified as a factor in the decline of the species and critical habitat has not been designated for bowhead whales (NOAA 2002).

Relatively small numbers of the bowhead population migrating north during spring to the Beaufort Sea migrate along leads in the ice offshore from the DMT. The fall migration back to the Bering Sea is through the central and western Chukchi Sea along the eastern coast of Siberia (see Section 3.5.4.1 for more information on bowheads).

Other Species. Other species in Alaska (not in the Portsite area) listed as endangered by the USFWS or NMFS include the following:

- Short-tailed albatross
- Eskimo curlew
- Leatherback sea turtle
- Steller sea-lion
- Finback whale
- Humpback whale
- Blue whale
- Right whale
- Aleutian shield fern

Short-tailed albatross is listed by the USFWS and the State. This species has been documented in the Bering Sea but not in the Chukchi Sea (AKNHP 1998b). Short-tailed albatross are not present near Portsite.

Although listed as endangered by the USFWS and the State of Alaska, Eskimo curlew is likely extinct, with the last documented sighting in Texas in 1962 (Ambrose 2001).

Leatherback sea turtles are uncommon visitors to Alaska, with the northern-most portion of its range including the Gulf of Alaska, south of the Bering Sea. There were 20 reported sightings of leatherback turtles in the Gulf of Alaska between 1960 and 1998 (Bruce and Wing 2000). They have not been reported in the Chukchi Sea.

The Steller sea lion are in the Bering Sea, but not in the Chukchi Sea (Ferrero and DeMaster 2000).

Finback and humpback whales are found in North Pacific Ocean waters. Finback whale have been observed in the western Chukchi Sea in recent history, but not in the eastern Chukchi Sea (ADFG, et al. 1996, Ferrero et al. 2000).

Humpback whales are found in the Bering Sea as far north as Saint Lawrence Island and the Bering Strait, but are not reported as inhabiting the Chukchi Sea (ADFG, et al. 1996, Ferrero et al. 2000, IFAW 2002a).

Blue whales and northern right whales are found in the Bering Sea as far north as Saint Lawrence Island, but not in the Chukchi Sea (ADFG et al. 1996, IFAW 2002c, IFAW 2002d).

The Aleutian shield fern is known to exist only on Adak Island in the central Aleutian Islands, and its range does not include the Portsite area (USFWS 1998).

There are no Federally listed threatened or endangered species of terrestrial mammals or fish in the Portsite area.

3.5.6.2 State Listed Species of Concern

The State of Alaska maintains a list of endangered species (ADFG 2001, AKNHP 1998a). Federally listed species native to Alaska are included on the state list. The Alaska Department of Fish and Game (ADFG), the Alaska Natural Heritage Program (AKNHP) and the U.S. Geological Service Biological Research Division (USGS-BRD) also maintain lists of species of special concern. The Corps consulted those lists to determine which species are known to be or are likely to be present in the Portsite area.

Species of concern to the state that are known to be seasonally present in the Portsite area are as follows: spectacled and Steller's eiders, oldsquaw (long-tail) duck, common eider, black scoter, and the king eider (AKNHP 2000). Declining population trends have been detected among these species and are the principal reason for state concern. Reasons for declining numbers of the listed species vary and include pollution, habitat loss, and lead-shot poisoning. During the Corps' spring and summer 2000 DMT wildlife surveys, oldsquaw ducks, common eiders, and black scoters were noted to be relatively common in the Portsite area, but king eiders were not seen in the Portsite area during the surveys.

Other state species of concern that may range into the Portsite area include the gray-cheeked thrush, blackpoll warbler, and Arctic peregrine falcon. The gray-cheeked thrush is reported to be an occasional visitor, and the black poll warbler is reported as a rare visitor to the Cape Krusenstern National Monument south of the Portsite (NPS 1996). During the spring and summer 2000 wildlife survey, peregrine falcons were occasionally seen along the DMTS road east of Portsite, but not at the DMT.

The State of Alaska's rare plant list (AKNHP 2000) was consulted, and the ranges of the listed plants were checked in standard references (Hulten 1974; Lipkin and Murray 1997). The U.S. Fish and Wildlife Service, National Park Service, Bureau of Land Management, and U.S. Forest Service were also consulted about distribution of those plants. Although local populations of three rare plants (Muir's fleabane, Barneby's locoweed, and Kobuk locoweed) are reported in several areas of northwest Alaska, none are reported in the Portsite area (AKNHP 2000), and none were found during the summer 2000 biological survey.

3.5.6.3 Essential Fish Habitat

The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) amendments mandate that Federal agencies assess the effects of Federal projects on essential fish habitat (EFH), and consult with the Department of Commerce (50 CFR 600.905-930). Essential fish habitat is defined as waters and substrate necessary to commercial fish for spawning, breeding, feeding, or growth to maturity.

NMFS has developed an online database of commercial fish species in Alaska waters that require a determination of effects on EFH. Five species of North American salmon, selected species of forage fish including rainbow smelt and herring, selected species of groundfish, and three species of king crab are determined by NMFS to need EFH (NOAA 2002). Their online database was consulted to identify species having EFH in the Portsite area. Although several species having EFH in other areas of Alaska are known to be present near Portsite during some stage of their life histories, only salmon are listed in the database as having EFH in the Portsite area.

Of the drainages near Portsite, only those that have runs of salmon are EFH. The Wulik River, about 15 miles up the coast from the DMT, is the most important EFH river in the area. Five species of Pacific salmon return to the Wulik River to spawn. The Wulik River and nearby Kivalina Lagoon are also important to juvenile salmon for rearing and acclimatization to marine waters.

Other EFH freshwaters close to Portsite are the Omikviorok River and Ipiavik Lagoon, about 2 miles north. This small drainage has a small run of chum salmon and a few pink salmon. The juveniles of these species also use Ipiavik Lagoon for transition to marine waters during the spring.

Dames and Moore (1983) reported that Agarak and Rabbit creeks (about 4 and 9 miles south of Portsite, respectively) have small runs of anadromous fish including pink and chum salmon. Local traditional knowledge, however, is that only occasional pink or chum salmon strays are found in Agarak and Rabbit creeks (W. Goodwin personal communication).

3.6 Cultural Resources

Northwest Alaska has been occupied continuously for about 11,500 years. Much of the cultural research in the region has focused on the archaeological record or contemporary culture, but the people who live there have a long and well-known history.

3.6.1 Precontact period

The Cape Krusenstern and Kivalina areas were part of Beringia, the land bridge between Asia and North America during the late Pleistocene. Pleistocene mammoth and mastodon tusk fragments have been recovered from the Chukchi Sea floor 31 miles west of Kivalina and 46.5 miles west of Kotzebue by the National Oceanic and Atmospheric Administration (Dixon 1983). The topography of the area off the shore of the Portsite is

low and flat and has a low potential for containing archaeological sites.
Anderson (1984) and McClenahan (1993) divided the pre-contact history of northern Alaska into four periods that reflect the more significant changes in culture and habitat: the American Paleoarctic, Northern Archaic, Arctic Small Tool, and Northern Maritime traditions (Anderson 1984).

The American Paleoarctic tradition (11,500-8,000 before present [BP]) was first identified at Onion Portage in the Kobuk Valley in Northwest Alaska and in an assemblage from the lower levels at Trail Creek caves on the Seward Peninsula. The tool assemblage includes large cores, end scrapers, gouges, several kinds of knives, and shaft smoothers (Anderson 1984; West 1998). Anderson (1984) suggested that the Akmak assemblage from Onion Portage was a habitation site, while other American Paleoarctic sites were short-term campsites.

Archaeological sites with Northern Archaic tradition (6,000-4,000 BP) assemblages generally have been described in the interior of Alaska. This includes the Mesa site in the upper Colville River drainage, Tuktu in the Central Brooks Range, and Onion Portage in the Kobuk Valley. Generally, Northern Archaic tool assemblages had a variety of bipointed and lanceolate projectile points, end scrapers, and notched pebbles (Anderson 1984; McClenahan 1993; Workman 1998). As the spruce forest spread into southern reaches of the arctic around 6,600 BP, the Northern Archaic tradition appeared. At that time, the cultures of the Northwestern Arctic began to resemble woodland cultures of the boreal forest (Anderson 1984). Subsistence activities apparently focused on large and small game, fishing, and taking birds (Workman 1998).

The succeeding Arctic Small Tool tradition (4,250-1,050 BP) has been divided into the Denbigh Flint complex, Old Whaling, Choris, Norton, and Ipiutak cultures (Anderson 1984; McClenahan 1993). The numerous specialized tools throughout this tradition are indicative of increasingly efficient adaptation to the environment (McClenahan 1993).

Arctic Small Tool tradition (4,500 to 500 BP) assemblages have been described at many sites throughout northern Alaska and Canada from the Alaska Peninsula to Greenland. The assemblage is marked by microblade, core, and burin technology that is apparently rooted in the Paleoarctic tradition. The earliest Arctic Small Tool tradition sites are found in Northwest Alaska and spread southward and eastward (Helmer 1998; McClenahan 1993). The tradition has a variety of tool types, indicating an “efficient adaptation to the arctic coast and adjacent tundra environment unknown in preceding cultural traditions” (McClenahan 1993). The diet of Arctic Small Tool tradition people relied heavily on caribou and anadromous fish. There is little evidence they hunted seals on the ice or used dog traction (Dumond 1987). In northern Alaska, the Arctic Small Tool tradition includes several complexes – the Denbigh Flint Complex (proto, classic, and late phases) and Choris.

The Denbigh Flint complex is the perhaps the best defined of the Arctic Small Tool complexes. The oldest coastal sites in Northwest Alaska are attributed to Denbigh people. Along the coast, these occupation sites are interpreted to represent sealing camps. However, it is thought that Denbigh peoples also hunted caribou and fished in the Interior (Anderson 1984; Dumond 1998a). Choris culture was distinguished by a “loss of bipointed arrowhead endblade insets, triangular endscrapers that have been shaped bifacially on the proximal end, mitten-shaped burins, microblades," and the flaking technique commonly associated with Denbigh (McClenahan 1993). In most aspects, Choris culture has many similarities to Denbigh and is thought by some researchers to be part of the Arctic Small Tool tradition. The Denbigh-Choris transition (around 3,600 BP) and Choris assemblages have been found at sites along the northwest and north coasts of Alaska, the northwest coast of Yukon and Northwest Territory, at numerous sites in the Brooks Range and North Slope, and at the Trail Creek caves on the Seward Peninsula (Anderson 1984; Gerlach 1998a).

Following the late Denbigh period (approximately 3,150 BP), a coastal culture called the Old Whaling culture appeared at Cape Krusenstern. The large implements of Old Whaling indicate an economy reliant on whaling. These included "lance heads, weapon insets, and long-bladed butchering tools" (Anderson 1984). Anderson was careful to state "Old Whaling implements bear little stylistic relation to implements elsewhere in the Arctic" (Anderson 1984).

Choris culture in northern Alaska remained basically the same until about 2,500 BP, when subsistence and settlement patterns began to change. This new culture is known as Norton and was marked by an increase in coastal settlements north and south of the Bering Strait. Concurrently, more emphasis was placed on sea mammal hunting on the coast and on fish in the south. Norton assemblages included "end blade and side blade insets for arming seal-hunting and caribou-hunting weapons, notched net-sinkers, bifaced knives, scrapers, ground burin-like implements, ground adze blades, linear and checked stamped pottery, and clay and stone lamps" (Anderson 1984). This, combined with harpoons and seal bones, indicates an increasing focus on coastal resources (Anderson 1984; Dumond 1998b).

Not long after the appearance of Choris, Ipiutak culture appeared in northwestern Alaska approximately 2,000 BP. This tradition was much like Norton, but it is marked by a reliance on ground slate, as well as a lack of pottery and oil lamps. Ipiutak and Ipuitak-related sites have been found along the shores of northwestern Alaska, the Brooks Range, along lakeshores in Northwest Alaska tundra, the upper Koyukuk River drainage, and along the Kobuk River at Onion Portage. Assemblages attributed to this tradition include evidence of the earliest use of iron in arctic Alaska and the addition of highly crafted burial goods (Anderson 1984; Gerlach 1998b). In other aspects, Ipiutak people continued to make implements in the Norton tradition style of their predecessors. This included pottery, ground slate, lamps, houses with tunnels, and whale hunting equipment (Anderson 1984; Gerlach 1998b). Some researchers (Anderson 1984) have postulated that Ipiutak peoples moved between the Interior in winter and the coast in summer.

Around 1,550 BP, there is a distinct cultural shift in the archaeological record in coastal northwestern Alaska called the Northern Maritime tradition. Giddings and Anderson (McClenahan 1993) divided the Northern Maritime tradition into three cultural periods: the Birnirk period (1,550 to 1,050 BP), the Western Thule period (1,050 to 600 BP), and the Kotzebue period (600 BP to early 19th century). Throughout the Northern Maritime tradition, the climate slowly warmed and offshore ice decreased. This required the development of new sea mammal hunting techniques adapted to the open sea. At this time, whale hunting increased at some coastal sites (McClenahan 1993). Archaeological sites with Birnirk culture deposits include sites around Point Barrow, Cape Prince of Wales, Cape Krusenstern, and near Nome. The semi-subterranean houses were heated and lighted with lamps rather than open fires. The Birnirk culture included tools for hunting on the ice, decorated and plain thick-walled clay lamps and cooking pots, and ground slate knife and ulu blades (Anderson 1998). Ivory and other organic materials were commonly used in art objects, implements, and tools (Anderson 1984). While the stone tool types were clearly derived from Ipiutak, the several aspects of Thule tradition are thought to be derived from Birnirk, including winter ice-hunting, hunting with kayak and umiaq on the open sea, a subsistence focus on whale hunting, continued use of some land-based resources, dog traction, and settlement in large communities (Anderson 1984; Morrison 1998).

Western Thule period sites were reported at Point Hope, Cape Prince of Wales, Cape Krusenstern, Walakpa, Point Barrow, Onion Portage, and Ahteut in the Interior. Anderson believes the tools during the Western Thule phase were "an elaboration of items developed in Birnirk times" (Anderson 1984). During the Western Thule period, there was an increase in the use of specialized tools and an increasing diversity in the subsistence base (McClenahan 1993). This included new sea mammal hunting techniques adapted to the open sea and increasing whale hunting at coastal sites. By late Western Thule times, Western Thule people were ancestral to contact-period Eskimo people (McClenahan 1993). Material culture items known from ethnographic records have been recovered from Western Thule period sites (McClenahan 1993).

Western Thule was followed in the Bering Sea region by the Kotzebue period, around 600 BP. Kotzebue culture at Cape Krusenstern is described as being a descendant of Thule culture, but without whale-hunting technology (McClenahan 1993). Remains from this period are found extensively from Kotzebue Sound to the southern Seward Peninsula (McClenahan 1993). J. Louis Giddings divided the period into two phases he called "Old Kotzebue" (AD 1400) and "Intermediate Kotzebue" (AD 1550: McClenahan 1993).

3.6.2 Traditional Territories and Ethnographic Histories

Dorothy Jean Ray (1967; 1975) and Ernest Burch (1994; 1998) worked with elders whose memories extended back to before 1880. They were able to identify between 12 and 14 distinct territories around Kotzebue and Norton Sound. The following section provides a brief background of the history, social structure, and seasonal subsistence round of the traditional territories of Kivalina and Noatak.

Iñupiaq nations were socio-territorial groups composed primarily of bilaterally extended families, linked to each other through kinship ties, with separate territories (Burch 1998). They were "socially and economically self sufficient," but traded with other nations for resources they did not have access to (Magdanz, *et al.* 2002:20). The borders of these territories were flexible, but normally respected. If people crossed into another territory, they were greeted as guests or met with force. Burch (1998) made several important points regarding these territories: (1) although the entire territory was not continually being used by its members, all parts of it held important resources that would be used at some point of the year and, (2) it was not uncommon for people to use parts of other nations' territories, at least some of the time, every year.

Use of lands or water belonging to another family typically required permission and some type of payment. Ray (1967) provides the following insight into land use and payment:

> Women of the family gave permission to gather eggs, roots, greens, and berries, especially salmonberries. The more plentiful cranberries and blueberries found on hillsides and hilltops were usually not included within a fishing site. Permission to fish was accompanied by a payment of a certain percentage of fish caught. On the other hand if a man or woman asked to help with fishing (or possibly had been asked to help) he would also be paid with fish.

Generally, these family-owned fishing and berry-picking lands continue to be recognized throughout Northwest Alaska. Allotments and camps are spread across the landscape in order to maximize access to traditional resource harvest areas, and it is not uncommon for these allotments to be on camps used by many generations.

Kivalina lies within the boundary of the *Kivalliñigmiut* territory and Noatak is in the *Napaaqtugmiut* territory. According to Burch's research (1998), the *Nuataagmiut* from the upper Noatak Basin began to form alliances with the *Kivalliñigmiut* and *Napaaqtugmiut,* and some people in the *Qikiqtagru?miut* territory on the extreme lower reaches of the Noatak River and parts of Kotzebue Sound, in the 18th century. The *Kivalliñigmiut, Napaaqtugmiut, Nuataagmiut,* and *Qikiqtagru?miut* were all involved in an alliance against the *Tikigagmiut* (Point Hope people) in an effort to keep them from gaining control over the entire region (Burch 1998). The allied groups attacked the main village at *Tikigagmiut* and then at *Nuvua* (Burch 1981).

3.6.2.1 Ethnohistory of the Kivalliñigmiut.

The *Kivalliñigmiut* people occupy part of the upper Kukpuk valley, the Kivalina and Wulik River drainages, and about 50 miles of the Chukchi Sea coast near the mouths of those rivers (figure 3-52; Burch 1998). *Kivalliñigmiut* are descended from a family that lived along the Wulik River (Burch 1998). Burch (1998) calculated that the modern population of the Kivalina area was founded "no later than the early 1870's" (Burch 1998). Chester Seveck (born in 1890), Regina Walton (born 1885), Myra Hawley (born early 1890's), and Fay Kayoulik (born around 1900), are all direct descendants of the founding couples (Burch 1998).

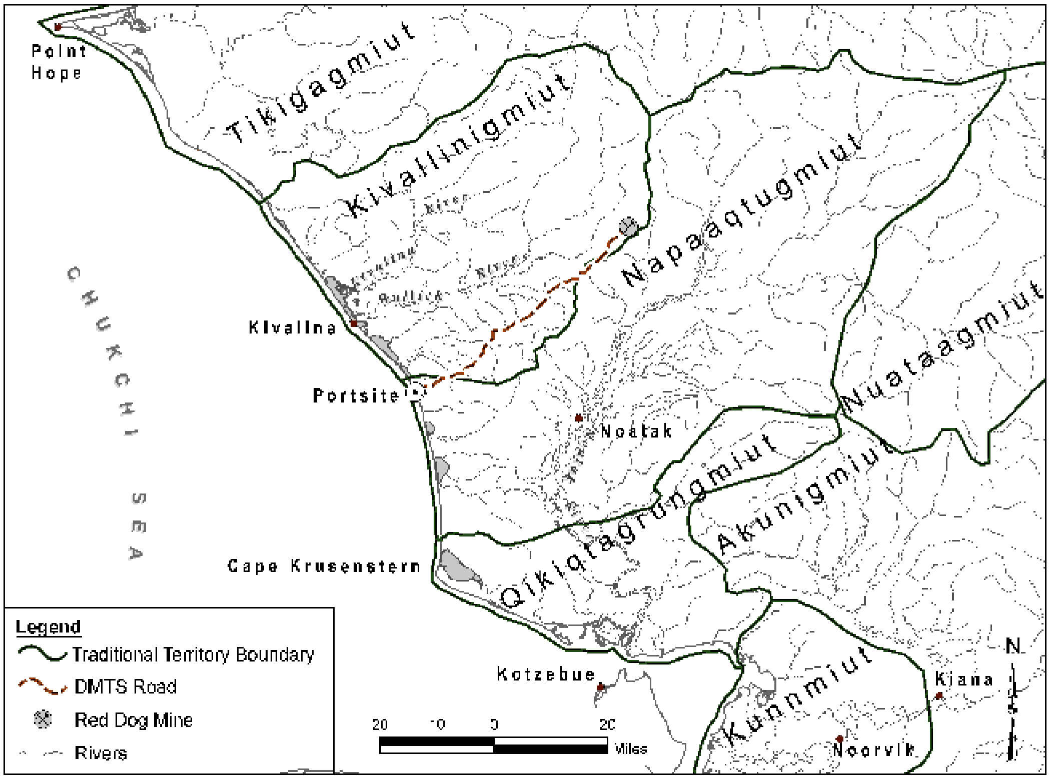


Figure 3-52. Traditional territory boundaries around 1850 (Adapted from Burch 1998).

Trade fairs, feasts, and festivals regularly brought the *Kivalliñigmiut* into contact with their neighbors. In the first week of July, a festival was held at *Kivalliik*, across the mouth of the Wulik River south of the modern town of Kivalina (Burch 1998). At the end of summer, the *Kivalliñigmiut* went to the Sheshalik Fair, near Cape Krusenstern. Everyone then returned to the coast for another festival held at the mouth of the Wulik River (Burch 1998).

In the fall, people moved back up the rivers to their winter homes, where they built new houses, repaired old ones, built fish weirs in narrow spots in the river, picked berries, and hunted ground squirrel and grizzly bear (Burch 1998). On the south side of the Wulik River, caribou were caught in snares hung across openings in the willows. The corral method was used more commonly on the north side of Kivalina River (Burch 1998). Corrals were made of a semi-circle of poles. The spaces between the poles were filled either with brush or snares that were tied to caribou antlers buried in the ground (Burch 1998).

The *Kivalliñigmiut* moved back to the coast and onto the ice around late March, where they hunted bearded seals through the cracks and leads in the ice. After the ice became too rotten to venture out on but too solid for boat travel, the Kivalina hunters pursued geese and ducks (Burch 1998).

3.6.2.2 Ethnohistory of the Napaaqtugmiut

The *Napaaqtugmiut* live mainly in the lower Noatak River Basin, part of the Chukchi Sea coast, and the hills in between (see figure 3-54; Burch 1998). *Napaaqtugmiut* traditions recall that they have always lived in this area and Burch states that they may be descendants of Thule or older cultures from the area (Burch 1998).

Napaaqtugmiut settlements extend from the southern most *Kivalliñigmiut* spring settlement to northernmost *Qikiqtagru?miut* spring settlement (Burch 1998). In the spring, the entire population was concentrated in small settlements along the Chukchi Sea coast, where they hunted bearded seal (Burch 1998). Ringed seal, beluga, ducks, geese, and Dolly Varden also were important at this time (Burch 1998).

Around late June or early July, the *Napaaqtugmiut* would travel to Sheshalik for the trade fair (Burch 1998). After a few weeks, they would return to their winter settlements to fish for salmon and hunt caribou (Burch 1998). Caribou were taken with drive fences along Ahaliknak and Kangiakrok creeks near the Maiyumerak Mountains (Burch 1998). Some caribou were driven into Lake Narvakrak then speared from kayaks, while others were taken with bow and arrow in the mountains between the Kugururok and Nimiuktuk rivers (Burch 1998).

Fall and winter settlements were usually inland near good late fall salmon fishing and for char, grayling, and ling cod fishing after freeze-up (Burch 1998). The proximity of willows for shelter, fuel, and for ptarmigan and hare hunting was also a consideration (Burch 1998). Burch (1980) noted that there were a number of one-house settlements along the Noatak River. People began to move back to the coast in late March (Burch 1998). The largest settlements were usually at *Ukalliqsuuq* and *Qiligmiaq* (Burch 1998).

3.6.3 Russian Period

Few early European explorers visited the Kivalina and Noatak districts. Most kept their ships some distance off shore when passing along this section of the coast because of the shallow water. On July 17, 1820, the members of the Vasil'ev and Shishmerev expedition saw "a large settlement" on the Kivalina coast and when Beechey's expedition sailed along the coast between July 31 and August 2, 1826, three *umiat* came out to trade (Burch 1998).

In August of 1838, A.F. Kashevarov landed at a summer camp at *Kivalliik*, but did not record details of the encounter (Vanstone 1976). At *Ki?iktuuraq,* however, he recorded, "[e]ight baydaras, each with 14 men, approached us from this camp. A crowd of more than 150 persons stood on shore" (Burch 1998).

Shishmerev, Beechey, and Kashevarov made no observations of the Noatak people. This may have been because they were often confused with the *Nuataagmiut* of the upper Noatak. In 1849, many American whaling ships began to work along the Chukchi Sea and the Franklin Search Expedition began a detailed study of the coast of Northwest Alaska, but they focused mainly on the Kotzebue Sound and Point Hope regions (Burch 1981; Burch 1998).

3.6.4 American Period

Captain Michael A. Healy on his ship, the *Corwin,* encountered a number of people along the coast on July 19, 1880, that he described as "definitely *Kivalliñigmiut*" (Burch 1998).

The *Corwin* sailed into Kotzebue Sound in 1883 and 1884. Healy sent Revenue Marine officer Lieutenant John C. Cantwell to survey the Kobuk River and to prepare a report about its resources. Neither Healy nor Cantwell kept detailed records about the Kivalina and Noatak River areas.

A famine, known as the Great Famine of 1881-1883, reduced the *Kivalliñigmiut* population by half (Burch 1998). The *Napaaqtugmiut* were apparently struck by the same famine. The famine was caused by a general resource failure (Burch 1998). The survivors fled north to the Arctic coast and east along the Kobuk River (Burch 1998). Later, they resettled with people from the upper Noatak, Kotzebue, and Kivalina (Burch 1998).

In the early 1890's, many people from the Seward Peninsula, known as *Sakmaliagruk*, were taken to Point Hope to work for the whalers. On the return trip to the Seward Peninsula, they passed along the nearly uninhabited Kivalina coast and settled there. Burch (1998) estimated that about "180 Seward Peninsula people" lived in the area during the 1890's (Burch 1998). Eventually, most of the *Sakmaliagruk* moved back to the Seward Peninsula or elsewhere (Burch 1998).

Like the *Kivalliñigmiut*, the make-up of the *Napaaqtugmiut* has changed in the last two centuries. In many early accounts, the *Napaaqtugmiut* were confused with the people of the upper Noatak River, the *Nuataagmiut* (Burch 1998). When a mission and school were built in a *Napaaqtugmiut* settlement in 1908, the site was renamed Noatak and its inhabitants also came to be known as *Nuataagmiut* (Burch 1998).

In 1890, Captain Healy proposed to Dr. Sheldon Jackson, Territorial Commissioner of Education, that some reindeer be transported to Alaska from Siberia. In the summer of 1891, Capt. Healy and his crew acquired 16 reindeer from Siberia, which they landed on the Seward Peninsula. Over time, more reindeer were added to the small Alaska herd and Saami (or Laplander) reindeer herders were brought to Alaska to teach the Alaska Natives herding techniques (Harper 2000).

Chester Seveck was famous to Alaskans as a movie star, tour guide, author, and general celebrity. He was directly descended from the founding family of Kivalina. His memoirs include accounts of reindeer herding near Kivalina. Seveck and George Onalik were hired as apprentice herders in 1908 by the Superintendent of Reindeer Service (Seveck, *et al.* 2001). By 1928, Onalik and Seveck combined their herds with two others into one large herd of 6,122 reindeer and formed the Kivalina Reindeer Company (Seveck, *et al.* 2001).

Burch (1998) estimated that there were six occupied houses and less than 50 people in the *Napaaqtugmiut* district in 1885 (Burch 1998). In 1895, when Reverend John Driggs was on the lower Noatak, he reported that inhabitants were "few, very far between, and poor" (Burch 1998). He also observed only two small settlements and a few scattered houses. One of the settlements – probably *Agvigiaq* – had seven houses. Other *Napaaqtugmiut* reportedly lived in the Kotzebue Sound area, while others lived in *Ivruqtusuk* in the Kivalina district. They also began to go to Point Hope in the spring to work for the American whalers (Burch 1998).

During the winter 1899-1900 census, there were 75 people in the lower Noatak territory, 50 of which were *Napaaqtugmiut* living along the river (Burch 1998). The others settled along the coast (Burch 1998). The census also recorded "14 *Napaaqtugmiut* in Point Hope, 6 on the Ikpikpuk River, and 6 in other settlements on the Arctic Coast" (Burch 1998). When the school was built in Kivalina in 1905, some families moved there. Some also moved to Noatak in 1908 for the same reason. In 1910 the population of *Napaaqtugmiut* was 153 (Burch 1998).

Today, the people of the Kivalina and Noatak regions live, for the most part, year-round in Kivalina, Noatak, Point Hope, or Kotzebue. These settlements are made up of Kivalina, Upper Noatak, Lower Noatak, Seward Peninsula, Point Hope, and other peoples. Many people still travel to camps away from their homes to fish and hunt.

3.6.5 Previous Archaeological and Anthropological Work in the Area

Very little anthropological work was done in the Noatak and Kivalina areas until the 1950's. Robert Spencer was the first to discuss the Kivalina district from an anthropological perspective in the late 1950's. At that time he wrote that Kivalina "is a recent village founded at the turn of the century by a group of inland Eskimo who pushed to the sea" (Burch 1998). According to Burch (1998), he was correct about the founding of the town but mistaken about the people who founded it. As part of Project Chariot, Don Foote and his associates recorded information about the cultures of the people of the Noatak valley from 1959 to 1961 (Burch 1998). Ernest Burch (1998) conducted extensive anthropological and ethnographic work in Kivalina and the lower Noatak River areas, and reported many fall and spring settlements.

Several major archaeological projects took place in the region in the 1970's. The Alaska Division of Parks conducted an archaeological survey in the Kivalina area in the early 1970's. They reported finding no archaeological sites, but tested near several ice cellars (Bowers and Turney 1975). The Bureau of Land Management surveyed the middle Wulik and Kivalina rivers in 1979. They identified 36 sites with stone tool making debris and one settlement (Hall 1986). Many archaeological surveys have been conducted as part of the development of the Cominco Red Dog Mine. From 1982 to 1985, Edwin S. Hall & Associates surveyed the entire mine area and found many previously unrecorded sites (Hall 1986).

Two historic properties are recorded at Portsite. NOA-00074 is George Onalik's reindeer corral and camp. NOA-00307 is a grave and an ice cellar. Both sites are located along the side of the south Port Lagoon near the edge of the gravel pad.

NOA-00074 includes a cabin, tent sites, and a reindeer corral. The site is significant because of its association with George Onalik. Onalik eventually became president of the Kivalina Reindeer Company and worked closely with Chester Seveck. Onalik used the camp from at least 1923 to 1940. The cabin was sold in 1940 to George Onalik's brother, who then moved it to Kivalina. The posts from the corral were then sawn off near the ground and sold to people in Kivalina (Campbell 1994; Gerlach and Hall n.d.).

Edwin S. Hall & Associates first investigated NOA-00074 and NOA-00307 in 1982 (Hall 1986). At that time, an ice cellar (initially described as a semi-subterranean house) and grave were identified. The grave had a wooden headboard and no fence (Bowers and Gerlach 2002). The grave and ice cellar were enclosed within a wooden fence in the 1980s (Bowers and Gerlach 2002:3). In 1983, Herbert Onalik (George Onalik's son) pointed out the cabin site and reindeer corral (Hall 1986; Gerlach and Hall n.d.). He stated that the grave was Andrew McClellen's son and that he was buried before the Onalik family moved into the area (Bowers and Gerlach 2002). The cabin site, the reindeer corral, and other features were mapped in 1986 (Hall 1986; Bowers and Gerlach 2002).

In 1994, Chris Rabich Campbell (C.R.C. Cultural Resource Consultant for Cominco Red Dog Mine) and Georgeianne Reynolds (Corps archaeologist) visited NOA-00074. Campbell reported two fenced areas on the east shore of the lagoon (Campbell 1994). Based on her observations, the Onalik reindeer corral was in the shape of a butterfly with chutes and gates through the center. This part of the corral was between the two lagoons south of the port facility (Campbell 1994). A long line of posts extended from the corral along the barrier beach, which had once been wider. Campbell and Reynolds excavated two activity areas previously reported by Hall. One 7 by 9-meter excavation unit produced metal cans, burlap, oil-impregnated textiles, and wood fragments. The artifact collection from the other 6 by 7-meter excavation unit was not described (Campbell 1994).

Campbell and Reynolds surveyed and tested the peninsula between the two lagoons south of the port. The only cultural material they reported was corral posts in the southwest quarter of the peninsula and material eroding from along the seaward bank of the barrier beach south of the port (Campbell 1994). Campbell and Reynolds found no cultural material in test excavations on the mainland side of the lagoon or north of the port facility (Campbell 1994).

Based on their fieldwork, Campbell determined that the cabin site, associated activity area, and the complex of chutes and fences for reindeer herding were gone. The string of corral posts on the barrier bar, the remains of an historic midden, the grave, and the ice cellar are all that remain of the site (Campbell 1994). She concluded, "NOA-00074, an historic reindeer corral, does not appear to contain enough integrity to warrant placement on the National Register of Historic Places" (Campbell 1994). The grave, midden, and ice cellar were not evaluated as part of NOA-00074.

In August 1993, the National Park Service (NPS) and the Alaska State Historic Preservation Officer (SHPO) responded to proposed construction at DMT. They noted that NOA-00074 was never evaluated for the National Register of Historic Places. The SHPO noted that placing fill on the coastal side of the site may act to preserve the site, but that the erosion problem was being caused by the dock interrupting sediment movement. The SHPO and NPS also expressed concerns about how the change to near-shore sediment transport may adversely affect coastal sites southeast of the port (Ted Birkedal, Chief, Division of Cultural Resources, U.S. Department of the Interior, National Park Service Alaska Regional Office to Chief, Environmental Compliance, U.S. Army Corps of Engineers Alaska District, letter, 19

Aug. 1993; Judith E. Bittner, Alaska State Historic Preservation Officer to Robert Oja, Regulatory Branch, U.S. Army Corps of Engineers Alaska District, letter, 31 Aug. 1993). On October 7, 1993, the SHPO concurred with a finding of no adverse effect on NOA-00074 by the proposed action (Judith E. Bittner, Alaska State Historic Preservation Officer to Robert Oja, Regulatory Branch, U.S. Army Corps of Engineers Alaska District, letter, 7 Oct. 1993). This finding implies that either the site was not within the area of potential effect or that the site was found not eligible for the National Register of Historic Places. No record of these determinations was found.

In 2002, the grave and cellar, which had been previously included in NOA-00074, were recognized as a separate site – NOA-00307. This site is eligible for the National Register of Historic Places (Pete Bowers 2002 personal communication).

There are 220 cultural resource sites recorded to date in the *Napaaqtugmiut* and *Kivalliñigmiut* districts. Thirty-eight are settlement sites dating from all periods of occupation. There are 30 rock cairns and hunting blinds, 57 sites where only lithic artifacts were recovered, 18 sites dated exclusively to the historic period, 5 sites consisting mainly of cache pits, 15 sites consisting mainly of tent rings, 1 historic trail, 1 National Historic Landmark District, and 1 kayak. Burch (1998) reported 34 settlements that have yet to be relocated. In addition, there are 14 known paleontological sites. Based on the in-depth archaeological study of Cape Krusenstern National Monument, it is clear that there is a high potential for additional cultural resources in the Kivalina and Noatak regions (Hall 1986). While archaeologists have surveyed most areas in the vicinity of Portsite with a high or medium potential for cultural resources, there are some areas yet to be examined.