INTEGRATED
NATURAL
RESOURCES
MANAGEMENT
PLAN

2013

611th Air Support Group
Alaska Installations

SITE-SPECIFIC APPENDICES 3.0

U.S. AIR FORCE, 611th AIR SUPPORT GROUP, ALASKA
611th CIVIL ENGINEER SQUADRON, ENVIRONMENTAL FLIGHT

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN 2013

611th Air Support Group, Alaska Installations

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This appendix contains site-specific information for 35 611th Air Support Group installations in Alaska. Installations within this appendix are in the following order.

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○ Appendix 3.0– Barter	Barter Island Long Range Radar Site (LRRS)
○ Appendix 3.0– Lisburne	Cape Lisburne LRRS
○ Appendix 3.0– Newnham	Cape Newenham LRRS
○ Appendix 3.0– Romanzof	Cape Romanzof LRRS
○ Appendix 3.0– Cold	Cold Bay LRRS
○ Appendix 3.0– Yukon	Fort Yukon LRRS
○ Appendix 3.0– Indian	Indian Mountain LRRS
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Below is the Table of Contents for Eareckson AS. Other site-specific appendices have the same chapter and section headings but fewer tables, figures, and site-specific appendices (particularly Excess sites) than shown for Eareckson AS.

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There are lists of vascular plants, fish, mammals, and birds for each 611 ASG site. These lists have been combined for various sites in former Integrated Natural Resources Management Plans and various studies and surveys. This practice has been continued within these appendices, which significantly reduces the number of pages. The below table indicates which site-specific appendices include site-specific species tables.

611 ASG Site	Vascular Plant List	Fish List	Mammal List	Bird List
Eareckson AS	EAS – Table B1	EAS – Table B2	EAS – Table B3	EAS – Table B4
King Salmon Airport	KSA – Table A1	KSA – Table A2	KSA – Table A3	KSA – Table A4
Barter Island	Barter – Table A1	Barter – Table A2	Barter – Table A3	Barter – Table A4
Cape Lisburne	Lisburne – Table A1	Lisburne – Table A2	Lisburne – Table A3	Lisburne – Table A4
Cape Newenham	Newenham- Table A1	Newenham- Table A2	Newenham- Table A3	Newenham- Table A4
Cape Romanzof	Newenham- Table A1	Newenham- Table A2	Newenham- Table A3	Newenham- Table A4
Cold Bay	Newenham- Table A1	Newenham- Table A2	Newenham- Table A3	Newenham- Table A4
Fort Yukon	Yukon- Table A1	Yukon- Table A2	Yukon- Table A3	Yukon- Table A4
Indian Mountain	Yukon- Table A1	Yukon- Table A2	Yukon- Table A3	Yukon- Table A4
Kotzebue	Lisburne – Table A1	Lisburne – Table A2	Lisburne – Table A3	Lisburne – Table A4
Murphy Dome	Yukon- Table A1	Yukon- Table A2	Yukon- Table A3	Yukon- Table A4
Oliktok	Barter – Table A1	Barter – Table A2	Barter – Table A3	Barter – Table A4
Point Barrow	Barter – Table A1	Barter – Table A2	Barter – Table A3	Barter – Table A4
Sparrevohn	Yukon- Table A1	Yukon- Table A2	Yukon- Table A3	Yukon- Table A4
Tatalina	Yukon- Table A1	Yukon- Table A2	Yukon- Table A3	Yukon- Table A4
Tin City	Lisburne – Table A1	Lisburne – Table A2	Lisburne – Table A3	Lisburne – Table A4
Bullen Point	Bullen- Table A1	Barter – Table A2	Bullen- Table A2	Bullen- Table A3
Campion	Campion- Table A1	Campion- Table A2	Campion- Table A3	Campion- Table A4
Lake Louise	Campion- Table A1	Campion- Table A2	Campion- Table A3	Campion- Table A4
Point Lay	Lay- Table A1	Lay- Table A2	Lay- Table A3	Lay- Table A4
Point Lonely	Lay- Table A1	Lay- Table A2	Lay- Table A3	Lay- Table A4
Wainwright	Bullen- Table A1	Barter – Table A2	Bullen- Table A2	Bullen- Table A3
Anvil Mountain	Anvil- Table A1	Lay- Table A2	Lay- Table A3	Anvil- Table A2
Bear Creek	Campion- Table A1	Campion- Table A2	Campion- Table A3	Campion- Table A4
Beaver Creek	Campion- Table A1	Campion- Table A2	Campion- Table A3	Campion- Table A4
Bethel	Bethel- Table A1	Lay- Table A2	Lay- Table A3	Bethel- Table A2
Big Mountain	Bethel- Table A1	Lay- Table A2	Lay- Table A3	Bethel- Table A2
Driftwood Bay	Driftwood- Table A1	Campion- Table A2	Campion- Table A3	Driftwood- Table A2
Granite Mountain	Anvil- Table A1	Lay- Table A2	Lay- Table A3	Anvil- Table A2
Kalakaket Creek	Campion- Table A1	Campion- Table A2	Campion- Table A3	Campion- Table A4
Naknek	Bethel- Table A1	Lay- Table A2	Lay- Table A3	Bethel- Table A2

Nikolski	Driftwood- Table A1	Campion- Table A2	Campion- Table A3	Driftwood- Table A2
Nome	Anvil- Table A1	Lay- Table A2	Lay- Table A3	Anvil- Table A2
North River	Anvil- Table A1	Lay- Table A2	Lay- Table A3	Anvil- Table A2
Port Heiden	Driftwood- Table A1	Campion- Table A2	Campion- Table A3	Driftwood- Table A2

Appendix 3.0 - Eareckson. Eareckson Air Station, Shemya Island

3.0 Installation Overview

Figure 3.0 Aerial View of Eareckson Air Station, Shemya Island

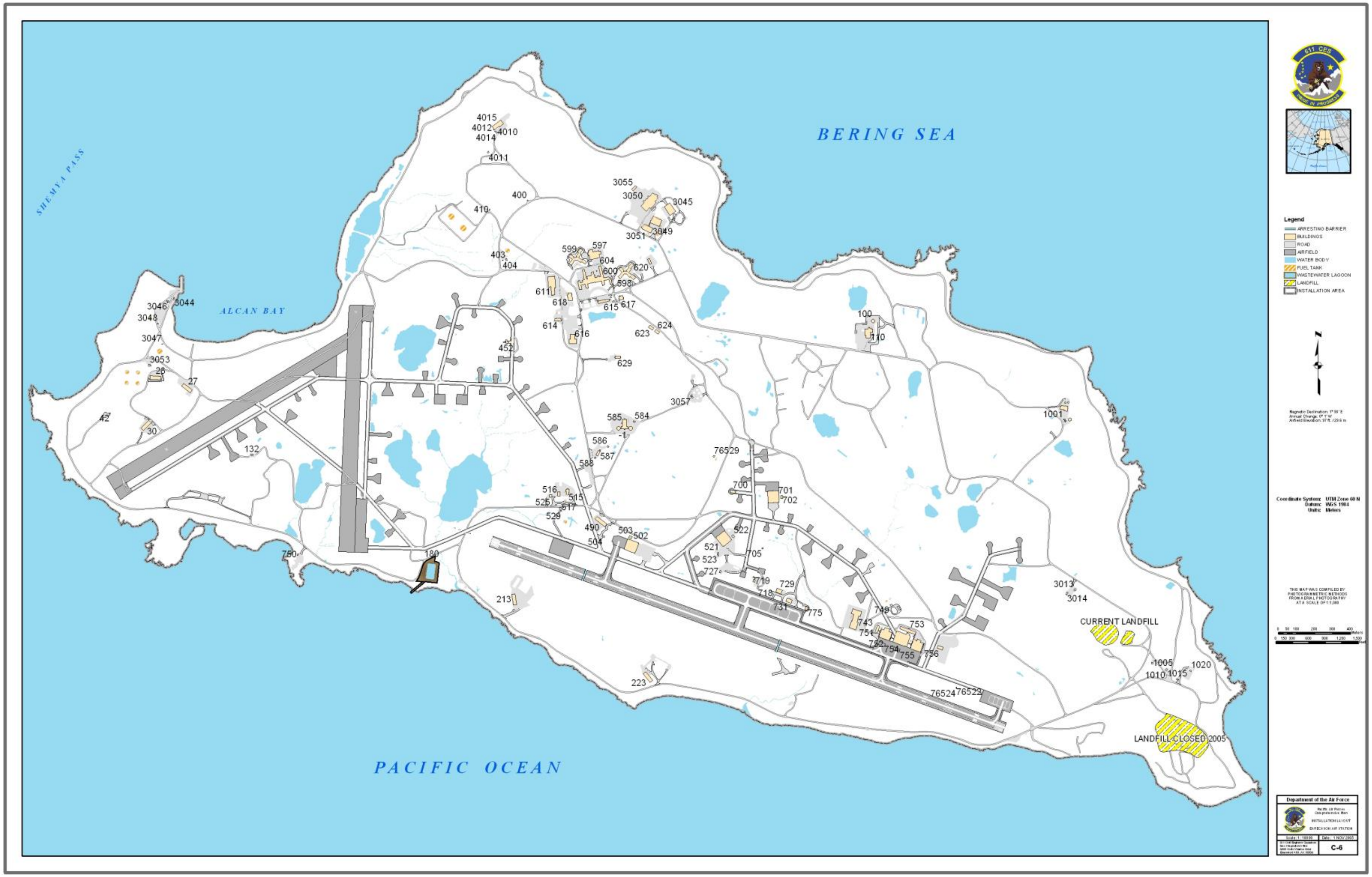
Eareckson Air Station (AS) occupies the entire Shemya Island, which is located 1,500 miles from Anchorage (INRMP Figure 3.1). Shemya Island is approximately 3.5 miles in length and 1.5 miles in width, 3,520 acres. Shemya Island is one of the Near Islands of the Aleutian Archipelago, located near the western tip of the Aleutian Chain. Shemya is the largest of the three Semichi Islands (Shemya, Alaid, and Nizki Islands) (Hostman 1988). Shemya Island was withdrawn as part of a wildlife refuge in 1913, and Congress included it in the Alaska Maritime NWR in the Alaska National Interest Lands Conservation Act (ANILCA) of 1980.

Figure 3.1 is a site map of Eareckson AS. Almost all roads have unpaved gravel surfaces. The north-facing (Bering Sea) side of the island has a rugged stony shoreline, steep sloping banks, and rocky cliffs. The southern (Pacific) side of the island is a sandy/gravely beach that is gently to moderately sloping (Hostman 1988).

3.2 Installation History

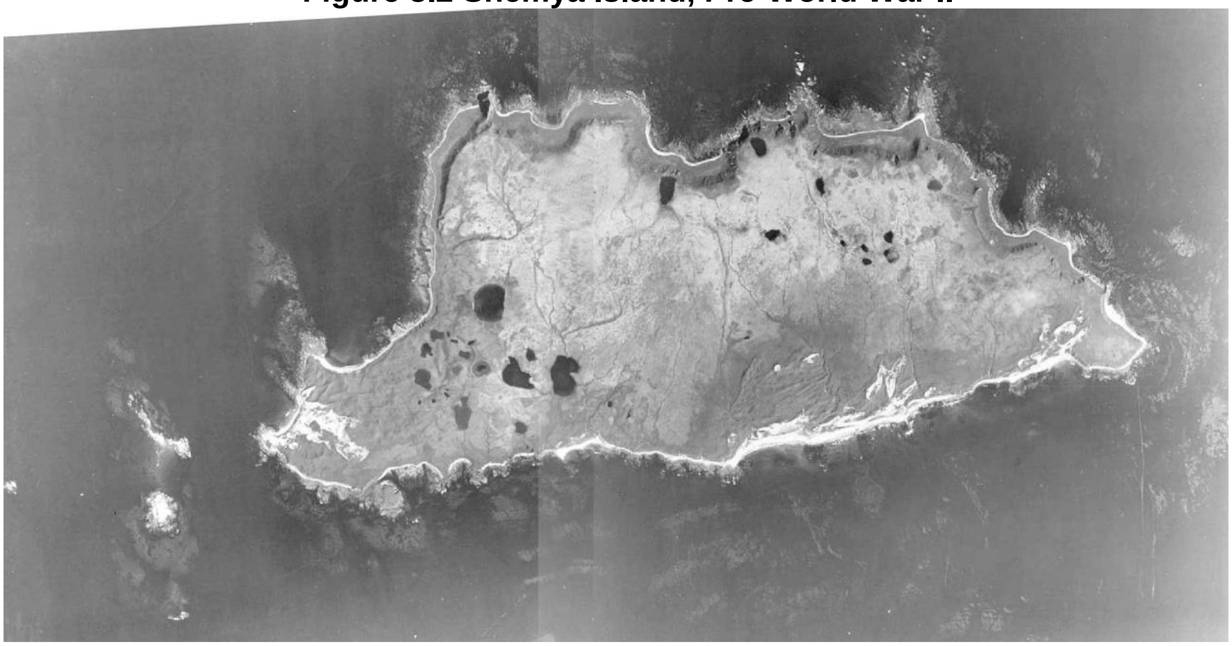
The installation (originally Shemya Air Force Base) was first established in May 1943 during the U.S. campaign to retake Attu Island, which had been occupied by Japanese troops since June 1942. In June-August 1943, runways for fighters and bombers, with hangars and other support facilities, were constructed on Shemya. The base was used for bombing raids on Japanese military targets in the northern

Figure 3.1 Eareckson Air Station, Shemya Island



Kurile Islands during 1943-1945 (Center for Environmental Management of Military Lands 2010a). Some 25,000 military personnel lived on the island during 1944 and 1945 (TRA/Farr & Dowl Engineering 1988). Figure 3.2 is undated but appears to show Shemya Island prior to World War II.

Figure 3.2 Shemya Island, Pre-World War II



The geographic location of Shemya Island provided for continued strategic military importance in the Cold War era. During the Korean Conflict (1950-1953), Shemya AFB was used as a refueling stop for support and supply aircraft en route to South Korea. In 1954 the base was deactivated, and during 1955-1957, base facilities were used for refueling commercial aircraft (Center for Environmental Management of Military Lands 2010a).

The base was reactivated in 1958 to support collection of intelligence data on Soviet ballistic missile tests. By 1962 both detection and tracking radars were used to monitor Soviet Intercontinental Ballistic Missiles tested on nearby Kamchatka and adjacent northern Pacific waters. In 1977 conventional radars were replaced with the Cobra Dane phased array system, which continued to track Soviet missiles and also performed space surveillance and early missile attack warning missions. Data on Soviet missile tests were also gathered by reconnaissance aircraft (Cobra Ball) operating from both Eielson AFB and Shemya AFB (Center for Environmental Management of Military Lands 2010a).

In 1985-1986 the U.S. Army constructed the Queen's Match facility on Shemya for conducting research related to the Strategic Defense Initiative (USAF undated). In 1993 the installation was renamed Eareckson Air Force Station in honor of Col. William O. Eareckson. The importance of the base declined with the end of the Cold War, and in 1995 Eareckson AS was drawn down and converted to contractor operations and maintenance (Center for Environmental Management of Military Lands 2010a).

In 1993 approximately 700 personnel were assigned to Eareckson AS, including about 400 USAF personnel and 300 contractor personnel and DoD civilian employees. During summer the population often increased by 200-400 people, mostly contractors providing installation restoration and construction-related support services (Hostman 1988). Although Eareckson AS was drawn down and converted to contractor operations and maintenance in 1995, it continues to support the mission of the 611 ASG.

3.3 Military Mission

The mission of Eareckson AS is support to provide weather divert and emergency runway, provide en-route refueling for military aircraft, provide support and sustainment for Ground-based Midcourse Defense (GMD), and support tenant organizations. A more recent addition to the Eareckson AS mission is the Missile Defense Agency, which is responsible for developing and testing the Ballistic Missile Defense System. An element of one phase of the Midcourse Defense Segment of their project is the GMD. The GMD is designed to protect all 50 states against limited ballistic missile attack by intercepting long-range ballistic missiles during the midcourse (ballistic) phase of their flight, before their reentry into the earth's atmosphere (Center for Environmental Management of Military Lands 2010a).

A Base Operational Support (BOS) contract is used to provide manning for Eareckson AS operation, maintenance, and support. There are no USAF military or civilian personnel permanently stationed at Eareckson AS, a major departure from pre-1995 drawdown. The 611 ASG maintains a contractor staff of about 125 (December 2011), including tenant units (e-mail communication from Kevin D. Hargis, Project Manager, Chugach McKinley Inc., Eareckson AS). There are 225 billeting spaces available for temporary duty personnel (personal communication, K. Hopkins 2006).

3.4 Surrounding Communities

Shemya Island has no communities other than the AS itself. The nearest community is the U.S. Coast Guard LORAN Station on Attu Island, approximately 28 miles away (20 personnel). Other important locations and approximate distances include:

- Kamchatka Peninsula, Russia (450 miles);
- Adak, AK (265 miles), 2006 population estimate 146, the next nearest civilian community, incorporated as a second class city, the former Naval AS;
- Atka, AK (375 miles), 2006 population estimate 73, the nearest chartered Native village and incorporated as a second class city;
- Unalaska/Dutch Harbor (largest Aleutian community) (664 miles), 2006 population estimate 3,940 is a first class city; and
- Elmendorf AFB/Anchorage, AK (1,500 miles).

3.5 Regional Land Use

Shemya Island's historic resources can be described through characterization of several periods: aboriginal pre-history, early Russian and European influence, early American influence, World War II, and post-war developments.

Very few archaeological resources have been recorded at Eareckson AS. There are 11 known prehistoric sites on Shemya Island (Center for Environmental Management of Military Lands 2010a). Two sites appear to have been completely destroyed; a third site is almost completely destroyed with only a small remnant identifying its location; and the remaining eight sites have been disturbed by past construction activity and/or vandalism (Lefevre, West, and Corbett 2001). The *Integrated Cultural Resources Management Plan (2004-2009), Eareckson Air Station, Alaska* (Center for Environmental Management of Military Lands 2010a) contains a summary of the prehistory and history of Shemya Island.

The Near Islands, including Shemya Island, appear to have been occupied by at least 2,500 years Before Present. The only known remnants of these activities are artifacts washed up on island beaches. At the time of initial contact with Europeans, the Near Islands were occupied by approximately 1,000 people who had developed a distinctive Attuan dialect and artifact style. Shemya Island prehistory cannot be isolated from the Near Islands as a whole (Hoffecker and Whorton 1999).

The second Kamchatka Expedition, commanded by Vitus Bering in 1741, is thought to have passed through the vicinity of Shemya Island. The expedition established the basis for Russian claims to the

Aleutian Islands, which prevailed until Alaska was purchased by the United States Government in 1867. Two Russian graves, along West Beach Road in the Alcan Cove vicinity, serve as a reminder of Russian influence within the region.

Fur trade, based primarily on the sea otter, was the predominant economic activity as early as 1824, with whaling and fishing also of significance within the region (Jacobs Engineering Group, Inc. 1998). Shemya Island was essentially undeveloped and uninhabited until World War II (TRA/Farr & Dowl Engineering 1988). Shemya became part of the Aleutian Islands NWR in 1913. The military has occupied Shemya Island from World War II to present (except 1954-1958) for activities that include bombing, photo reconnaissance, refueling and staging, and early warning detection and monitoring activities.

3.6 Local and Regional Natural Areas

Shemya Island is located within and is part of the Alaska Maritime National Wildlife Refuge. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (www.fws.gov/refuges/profiles January 2007).

4.0 PHYSICAL ENVIRONMENT

4.1 Climate

Shemya Island is dominated by a persistent low pressure system that stands out in global climatology as the "Aleutian low" region. Frequent storms track across the north Pacific into the Aleutian Islands. Aleutian low pressure cells are responsible for the relatively mild maritime climate of the Aleutian Islands. The highest temperature ever recorded on the island is 63°F, and the lowest is 7°F. The diurnal temperature variation rarely exceeds 10°F. The average annual precipitation is 31.3 inches, with maximum and minimum precipitation extremes of 44 inches and 15.8 inches, respectively. The average annual snowfall is 70 inches with an average 24-hour snowfall of three inches. Precipitation occurs more than 330 days per year.

All months of the year have recorded winds greater than 55 knots with an annual average of 17 knots. This persistent wind results in drifting snow and driving rain conditions. Summertime fogs are the most severe and preclude flying as often as one day in four. The persistent wind, fog, and salt spray are responsible for the highly corrosive and harsh conditions on the island (Hostman 1988).

4.2 Landforms

Shemya Island is generally characterized by rolling topography. The island is a flat-topped seamount or guyot. The topography gently slopes south-southwest to 20-25 feet above the Pacific Ocean. The island is rimmed with small sandy/gravely beaches and rugged bedrock crags. A small raised beach platform nearly encircles Shemya Island suggesting rising and falling sea levels. The maximum local relief of the island is 275 feet on the Bering Sea flank (Hostman 1988).

The surface is typical of hummocky glaciated terrain and tundra regions. Numerous small freshwater ponds are found on the island. Surface and subsurface drainage flows in the south-southwest direction. Interior drainage is poor, primarily as a result of tundra degradation, frost ponds, and open pits, resulting in standing water. The construction of the 10,000-foot airstrip has greatly modified the natural surface drainage of the island. Two distinct surface drainage systems divide the island in half. The watershed on the eastern half of the island is used for the installation water supply (Hostman 1988).

4.3 Geology and Soils

Regionally, Shemya Island is part of the Aleutian volcanic arc of the north Pacific Ocean. Tectonic and volcanic activities along the Aleutian arc are frequent and oftentimes violent. Eareckson AS has been the scene of at least two major earthquakes. A veneer of post or mid-Wisconsin (10,000 to 25,000 years ago) brecciated tuffs and other unconsolidated sediments cover the raised wavecut platform of Shemya Island. A thin layer of outwash sand and ground moraine cover the island. Coarse beach sands, gravels, and discontinuous lenses of till are in low areas, directly overlying the structurally southwestern-sloping bedrock. Bedrock is predominantly exposed in sea cliffs and two quarries near the central part of the island.

A matted accumulation of tundra peat is the predominant surficial deposit on the island. This highly saturated material is typical of tundra regions. This layer varies in thickness but is usually 2-5 feet deep overlaying loamy sands and gravel in the substrata. Depth to bedrock varies from zero to over 25 feet (Hostman 1988). Sand soils over bedrock tend to dominate south shore beaches. Most surficial materials on Shemya Island can retain and transmit water. Shemya Island has no permafrost.

4.4 Hydrology

4.4.1 General

All potential aquifers on Shemya Island are either thin, have low porosity, or have low permeability. Surface and groundwater discharges respond directly and rapidly to precipitation. During dry months stream flow comes from groundwater discharge. Much of the precipitation percolates through peat, gravel, and sand deposits and the surface-soil interface. Some water finds its way to fractures in the bedrock where it is stored. Remaining water is discharged by streams or springs on the southern coastline. A 1952 U.S. Army survey estimated surface water storage in lakes to be approximately 30 million gallons. The fresh water supply for the island is obtained from an infiltration gallery located on the northern side of the runway. There are 15 permanent small lakes on Shemya Island.

4.4.2 Flood Plains

Interior drainage of Eareckson AS is poor, primarily as a result of tundra degradation, frost ponds, and open pits, resulting in standing water. The shoreline drops precipitously 20 to 25 feet into a small raised beach platform that nearly encircles the island. There is no record of either rainfall-induced flooding or coastal flooding on Shemya Island. The coastline is sufficiently high and steep that 100-year storm waves would not overtop the beach crest. Lakes and interior streams have not been gauged. The 100-year flood level of the lakes should not exceed three feet above their normal level, due to their limited watersheds and normally wet conditions (U.S. Army Corps of Engineers 1998).

Floodplain maps are in Appendix A, taken from *Flood Plain Identification, Forward Operating Bases, Eareckson Air Station, Galena Airport, King Salmon Airport, Alaska* (U.S. Army Corps of Engineers 1998).

5.0 ECOSYSTEMS AND THE BIOTIC ENVIRONMENT

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Eareckson AS. Much information included in INRMP Chapter 5.0 that includes Eareckson AS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Shemya Island and the surrounding area. Appendix B contains lists of vascular plants (Table B1), fish (Table B2), mammals

(Table B3), and birds (Table B4) known to occur or potentially occurring in the Eareckson AS area. Threatened or Endangered Species that may occur at Eareckson AS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M127 Aleutian Oceanic Meadow-Heath Province
Description: Islands that chiefly make up this province are mountainous, containing more than 75 volcanoes. Slopes are steep all to the water's edge with shores rocky and craggy. The climate is similar to the arctic coastal plain although winters are less severe; temperatures range between 18 to 27F. Winds are severe, and smaller islands receive less precipitation than larger islands; annual precipitation ranges from 21 inches to more than 78 inches. In the Aleutian Province there are no trees; the vegetation is a few shrubs and in the lower elevations are a variety of tall grasses, flowering plants, and ferns. Dominant soils are Inceptisols; permafrost is absent.

5.2 Vegetation

The plant community of Shemya Island has been greatly influenced by extensive habitat alterations dating back to World War II (TRA/Farr & Dowl Engineering 1988). Existing communities include an almost continuous mat of mosses and lichens in which other plants, such as tufted hairgrass, are rooted. Grasses are common, and cotton grass may be predominant in poorly drained areas. At slightly higher locations with better drainage, dwarf shrubs, including crowberry, cloudberry, lapland cornel, and blueberry, are dominant. During summer, colorful flowers produced by forbs, such as buttercup, lousewort, monkshood, and violet, are scattered throughout this community.

The plant community of Shemya Island represents a disturbed ecosystem, and many dominant plants are recolonizers. Few trees remain on Shemya Island.

A separate major plant community identified on Shemya Island is the beach community. Plants of the beach community inhabit the rugged and rocky shoreline within bays, inlets, and coves of the island. Beach grass dominates this shoreline community, especially along the northern shore. Other plants that inhabit this area include beach pea, sea bluebell, seabeach sandwort, cow parsnip, cinquefoil, and various species of sedge. During summer, grasslands are often more than three feet high and usually very dense near sea level.

The USAF supported a study of natural revegetation of peat soils on Eareckson AS (Wright 1997) in cooperation with the ADNR. A list of species found on peat overfill was compiled as part of the study by the Alaska Plant Materials Center.

Woodward-Clyde (1995a) identified vascular plant species at Eareckson AS during site reconnaissance in 1993, and Wright (1997) compiled a species list during the peat soils revegetation study. Woodward-Clyde (1995a) prepared an ecological habitat map for Shemya Island. This map summarized areas of the island used by various groups of wildlife during certain times of the year. This map includes freshwater lakes.

Significant improvements in vegetation mapping at Eareckson AS were accomplished in 2005 (using 2003 digital aerial photography) with the preparation of a wildlife habitat map (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007b) (Frost *et al*. 2005a) and flora and fauna surveys.

The island (3,727 acres) is a volcanic flat-topped seamount that consists of well-drained to moderately well-drained soils and bedrock. The island is steepest on its northern side where steep vegetated bluffs drop abruptly to cobble beaches and rocky shorelines. The island gradually slopes to the south where moderate bluffs and sandy beaches occur (Frost *et al*. 2005a).

Roth and Macander (2009) updated this mapping and data analysis for Eareckson AS using 2008 Worldview-1 imagery. Habitat data revisions were related to altered disturbance regimes and recovery of vegetation. Table 5.2b shows changes in acreage between 2002 and 2008. Figure 5.2a shows these habitat classes for 2008. Figure 5.2b shows habitat changes between 2002 and 2008.

Table 5.2 Area of Habitat Classes and Differences between Years in Habitat Classes Mapped from 2002 and 2008 Imagery, Eareckson AS

Habitats Class	Acres 2002	Acres 2008	Acreage Change
Artificial Barrens	681	665	-16.3
Artificial Partially Vegetated	48	66	+17.5
Coastal Beach	113	111	-1.7
Coastal Brackish Water	12	12	0
Coastal Dry Leymus Meadow	131	130	-1.4
Coastal Dry Seral Herb Meadow	1	1	0
Coastal Moist Grass-Herb Meadow	81	81	0
Coastal Moist Umbel Meadow	27	27	0
Coastal Rock	197	197	0
Coastal Wet Graminoid-Herb Tundra	8	8	+0.3
Disturbed Moist Graminoid-Herb Meadow	878	867	-10.1
Lacustrine Water	72	72	0
Lowland Lacustrine Barrens	5	5	0
Lowland Wet Graminoid-Herb Meadow	58	58	0
Riverine Moist Grass-Herb Meadow	12	12	0
Tidal River	2	3	+0.8
Upland Barren Cliff	14	14	0
Upland Barren Rock & Scree	2	2	0
Upland Dry Grass-Herb Meadow	16	18	+2.6
Upland Dry Leymus Meadow	276	284	+8.2
Upland Dwarf Empetrum-Graminoid Scrub	627	622	-4.9
Upland Dwarf Ericaceous-Lichen Scrub	67	67	0
Upland Moist Grass-Herb Meadow	268	268	0
Upland Moist Umbel Meadow	117	119	+1.6
Upland Partially Vegetated Barrens	3	6	+3.3
Totals	**3,716**	**3,716**	**0**

Artificial habitats, including structures, roads, and regularly-manipulated vegetation, such as runway rights-of-way, comprise the island (731 acres; Figure 5.2 and Table 5.2). The predominant habitat mapped was Disturbed Moist Graminoid–Herb Meadow, which covers 23% of the island (867 acres). This habitat type occurs on altered ground surfaces where artificial mounds and pits are common, particularly

Figure 5.2a Eareckson Air Station Wildlife Habitat Map, 2008

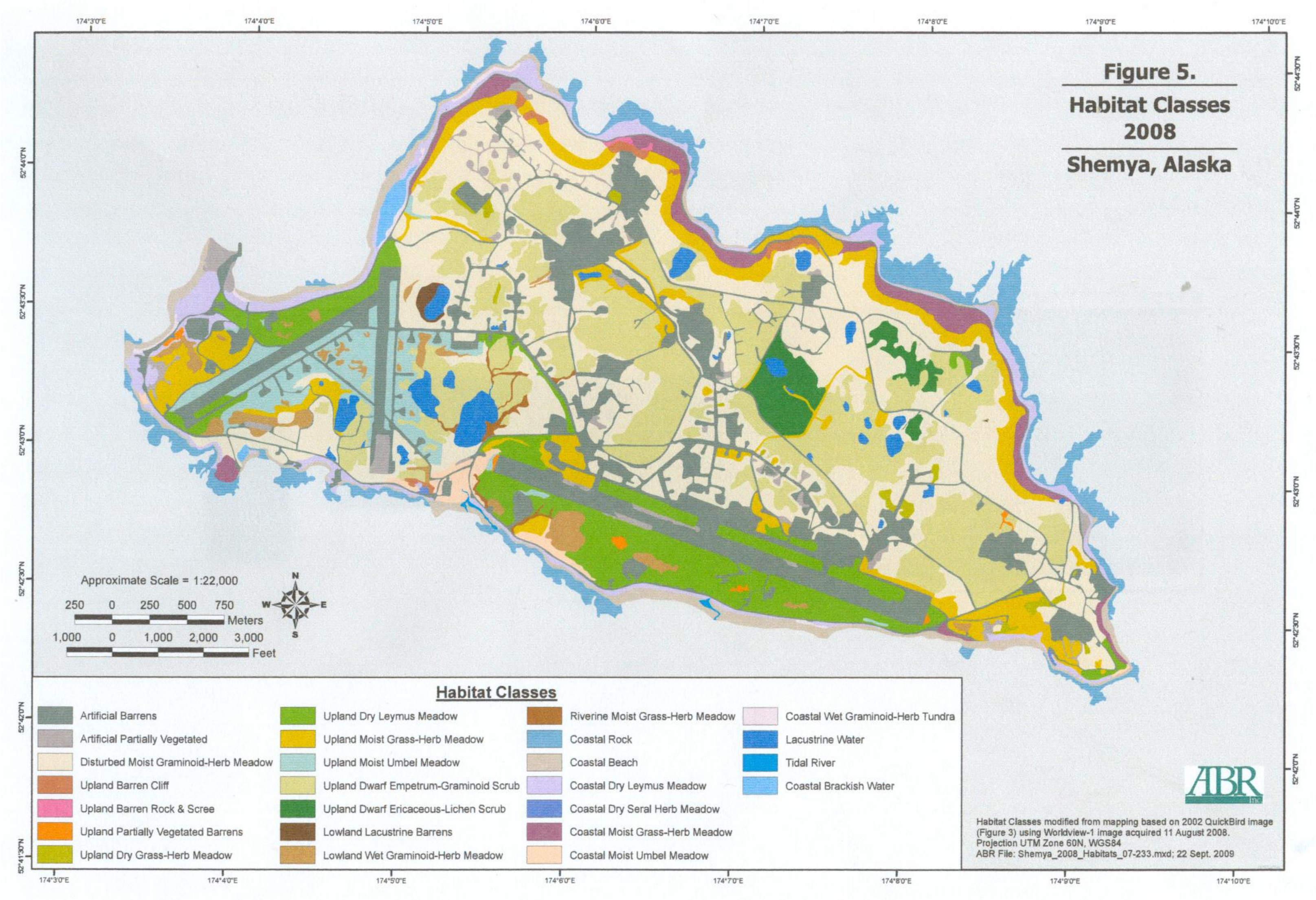


Figure 5.2b Eareckson Air Station Habitat Class Changes, 2002-2008

prevalent among demobilized bunker emplacements and along roadsides. The presence of intermixed wet and moist microsites (on pits and mounds, respectively) in this habitat is reflected in different plant communities occurring in this type (Frost *et al*. 2005a).

The most common undisturbed wildlife habitat at Eareckson AS is Upland Dwarf Empetrum–Graminoid Scrub (622 acres; Figure 5.2 and Table 5.2). This habitat is commonly used by Aleutian Cackling Geese for foraging. Other common habitats at Eareckson AS include Upland Dry Leymus Meadow, Upland Moist Grass–Herb Meadow, and Coastal Rock. Although not found extensively on the island (147.0 acres), Coastal and Upland Moist Umbel Meadow types appear to be favored habitats for passerines, particularly foraging migrants and resident birds, such as Asiatic Arctic Warblers, Brambling, Lapland Longspurs, and Song Sparrows (Frost *et al*. 2005a).

Several water bodies occur on Shemya Island (Figure 5.2), but most are deep lakes with steep shorelines that provide little wetland habitat. Waterfowl and gulls use open water on these lakes for loafing, and dabbling ducks forage in areas where aquatic vegetation is present along shorelines. Shorebirds, including Common Snipe, Long-billed Dowitchers, and various sandpiper species, use the few water bodies with shallow shorelines, such as Upper Lake, and Lowland Wet Graminoid–Herb Meadow habitats scattered across the island (Frost *et al*. 2005a).

Although coastal habitats, such as Coastal Beach, are not extensive at Eareckson AS, they are commonly used by species, such as Glaucous-winged Gulls, Ruddy Turnstones, and other migrating shorebirds, particularly at the mouths of the Tidal Rivers along the southern shore of the island. Intertidal areas and Coastal Rock surrounding Shemya Island are commonly used by Glaucous-winged Gulls, Common Eiders, Harlequin Ducks, and Pelagic and Red-faced Cormorants. Additionally, Peregrine Falcons, Common Ravens, Glaucous-winged Gulls, and migrating raptors use many of the bluff habitats surrounding the island, such as Upland Barren Cliff and Upland Dry Grass–Herb Meadow, for lift when soaring and hunting (Frost *et al*. 2005a).

5.3 Fish and Wildlife

Numerous surveys and studies have been accomplished at Eareckson AS. Table 5.3 lists wildlife monitoring efforts. Most reports are on file in the 611 ASG Natural Resources Program Manager's office.

Table 5.3 Wildlife Monitoring Studies at Eareckson AS

Study Name	Author	Purpose	Years
Migrant Birds at Shemya Island, Aleutian Islands, Alaska.	D.D. Gibson (1981)	Survey	uncertain
Winter Wildlife Survey at Eareckson Air Station, Shemya Island, Alaska 1988-2002	G. Vernon Byrd and Lisa Scharf (2003)	Survey	1988-2002
Trip Report: Winter Wildlife Survey, Shemya Island, Alaska 9-15 Dec 1993	Leah Lipinski and Greg Thomson (1993)	Survey	1993
Trip Report: Winter Wildlife Survey, Shemya Island, Alaska 11-18 Feb 1994	Leah Lipinski and Greg Thomson (1994)	Survey	1994
Winter Wildlife Survey at Eareckson Air Station, Shemya Island, Alaska Winter 1994/1995	Joseph P Meehan, Mark A. Krom, Jeffrey C. Williams and Lisa Scharf (1996)	Survey	1994/1995
Winter Wildlife Survey at Eareckson Air Station, Shemya Island, Alaska Winter 1995/1996	Joseph P Meehan and Mark A. Krom (1997)	Survey	1995/1996
Winter Wildlife Survey at Eareckson Air Station, Shemya Island, Alaska Winter 1996/1997	Joseph P Meehan (1997a)	Survey	1996/1997

Study Name	Author	Purpose	Years
Neotropical and Seabird Habitat Enhancement by Rat Eradication at Eareckson AS, AK	Joseph P. Meehan and G. Vernon Byrd (1996)	Rat Eradication	1995
Harlequin Duck Diet Contamination, Winter Feeding Ecology and Body Condition at Eareckson AS, Shemya Island, AK	Julian B. Fischer (1998)	Contaminant	1996/1997
Birds Observed at Shemya Island, Aleutian Islands, 27 Apr-11 June, 1999	D.D. Gibson, G. Vernon Byrd, and C.L Pruett (1999)	Survey	1999
Wildlife Hazard Assessment for Eareckson AS, Shemya Island, AK 1999 Interim Report	Jason M. Wood, Corey Rossi, David Sinnett and Mike Linnell (1999)	BASH	1999
Birds and Mammals Observed on Shemya Island, Alaska, Early Summer 1999, 26 June-27 July	Michael T. Schwitters (1999)	BASH	1999
Wildlife Hazard Assessment for Eareckson AS, Shemya Island, AK 2000 Interim Report	Michael T. Schwitters, Corey Rossi, David Sinnett and Mike Linnell (2001)	BASH	1999-2000
Bird Species Observed on Shemya Island, Alaska, 25 April-26 May 2000	Michael T. Schwitters (2000)	BASH	2000
Bird Species Seen on Shemya Island, Alaska, 25 August-17 October 2000	Michael Schwitters and Constance Schwitters (2000)	BASH	2000
Report of Observations of Wildlife at Eareckson Air Station, December 8-19, 2000	Howard, B. (2000)	Survey	2000
Wildlife Hazard Assessment for Eareckson AS, Shemya Island, AK 1999-2001 Final Report	Michael T. Schwitters, Corey Rossi, David Sinnett and Mike Linnell (2002)	BASH	1999-2001
Bird Species Seen on Shemya Island, Alaska, 24 April-12 June 2001	Michael Schwitters and D. Gibson (2001)	BASH	2001
Bird Species Observed Fall 2001, Shemya Island, Alaska, 16 August-18 October 2001	Michael Schwitters and Constance Schwitters (2001)	BASH	2001
Report of Observations of Wildlife at Eareckson Air Station, January 9-23, 2001	Howard, B. (2001)	Survey	2001
Experimental Wildlife Control, Spring 2002, Eareckson AS, Shemya Island, AK,	Michael Schwitters and Constance Schwitters (2002a)	BASH	2002
Experimental Wildlife Control, Fall 2002, Eareckson AS, Shemya Island, AK	Michael T. Schwitters and Corey Rossi (2002)	BASH	2002
Bird Species Seen, Shemya Island, Alaska, 9 April-11 June 2002	Michael Schwitters and Constance Schwitters (2002b)	BASH	2002
Bird Species Seen, Shemya Island, Alaska, 20 August-16 October 2002	Michael Schwitters (2002)	BASH	2002
Birds Observed, Shemya Island, Alaska, 28 May-7 June 2004	Michael Schwitters (2004)	BASH	2004
Wildlife Observations and Wildlife Habitat Mapping for Eareckson Air Station	Gerald V. Frost, Jennifer H. Boisvert, and Charles T. Schick (2005a)	Survey and Mapping	2005
Operational Field Evaluation of	Michael T. Schwitters, Corey L. Rossi and	BASH	2005

Study Name	Author	Purpose	Years
Alternative Wildlife Deterrent Methods, 2005 Report, Eareckson AS, Shemya Island, AK	Terry L. Smith (2005)		
Wildlife Observed at Shemya Island, Alaska, 15 April-14 June 2005	Michael T. Schwitters and Constance Schwitters (2005a)	Survey	2005
Wildlife Observed at Shemya Island, Alaska, Fall 2005, 15 August – 21 October 2005	Michael T. Schwitters and Constance Schwitters (2005b)	Survey	2005
Illustrated List of Wildlife Species Observed, 19 Apr – 9 Jun 2006	Michael T. Schwitters and Larry E. Schwitters (2006)	Survey	2006
Illustrated List of Wildlife Species Observed, 16 Aug – 20 Oct 2006	Michael T. Schwitters and Robert Martinka (2006)	Survey	2006
Shemya Island's Arctic Foxes: An Initial Assessment of Fox Population Status and Health, Draft Final Report, October 2006	Dr. Paula A. White and Dr. Terry R. Spraker (2006)	BASH	2006
Operational Field Evaluation of Alternative Wildlife Deterrent Methods, 2006 Report, Eareckson AS, Shemya Island, AK	Michael T. Schwitters, Corey L. Rossi and David Sinnett (2006)	BASH	2006
Aleutian Cackling Goose Surveys and Habitat Mapping in the Near Islands, Alaska, 2006	Gerald v. Frost, Matthew J. Macander, Alexander K. Prichard, and Jennifer H. Boisvert (2008)	Suvvey and Mapping	2006
Illustrated List of Wildlife Species Observed, 11 Apr – 11 June 2007	Michael T. Schwitters and Constance Schwitters (2007)	Survey	2007
Illustrated List of Wildlife Species Observed, 10 Aug – 14 Oct 2007	Michael T. Schwitters (2007)	Survey	2007
Bird Species Found at Shemya Island, Alaska, 1999-2007	Michael T. Schwitters (2008)	Survey	1999-2007
Aleutian Cackling Goose Surveys and Habitat Mapping in the Near Islands, Alaska, 2008-2009	Gerald V. Frost, Matthew J. Macander, Alexander K. Prichard, R.H. Day, P.F. Miller, and K.L. Beattie (2010)	Suvvey and Mapping	2008-2009
Observations of Arctic Foxes (Alopex lagopus) on Shemya Island, Alaska, Fall 2010 (27 August – 15 October 2010)	Michael T. Schwitters (2010a)	Survey	2010
2010. Wildlife of Shemya Island, Alaska, Spring 2010	Dennis L. Shirley and Michael T. Schwitters	Survey	2010
Species Observed Shemya Island, Alaska, Fall 2010, 27 August - 15 October 2010	Michael T. Schwitters (2010b)	Survey	2010

5.3.1 Fish

Fishery resources on and surrounding Shemya Island include marine, freshwater, and anadromous fishes. Freshwater fish are not a significant resource on Shemya Island.

Principal marine fishes and invertebrates of the Aleutian Islands include halibut, Pacific Ocean perch, sculpin, flounder, Pacific cod, sable fish, yellowfin sole, walleye pollock, sandlance, Pacific herring, tanner crab, and king crab. Jacobs Engineering Group, Inc. (1993) confirmed that tanner crab occur in coastal waters around Shemya Island.

Anadromous fishes of the Near Islands primarily include pink and chum salmon, although sockeye and coho salmon occur in some areas. Although Shemya Island has no significant salmon runs, significant numbers of pink salmon spawn on nearby Agattu and Attu islands. A few sockeye, coho, and chum salmon also spawn on these islands. Dolly Varden/Arctic char occur in waters surrounding Shemya Island and in one small stream in the vicinity of Lower Lake. Rainbow trout and coho salmon were introduced in a few lakes on Shemya Island for sport fishing (Jacobs Engineering Group, Inc. 1993).

Shirley and Schwitters (2010) netted three-spined sickleback (*Gasterosteus aculeatus*) in June and Myrtle lakes. They were also observed in small schools along the shorelines of Headquarters, Upper, Middle, and Lower lakes.

5.3.2 Mammals

There are no large terrestrial mammals on Shemya Island, but three species of non-native mammals have been introduced. The blue phase Arctic fox (*Alopex lagopus*), introduced to Shemya in 1911 (Bailey 1993), is the largest mammal on the island. Introduced rodents comprise the remainder of the terrestrial mammal population. It was speculated that the Norway rat (*Rattus norvegicus*) was inadvertently introduced to Eareckson AS during World War II along with cargo and supplies from freighters (Jacobs Engineering Group, Inc. 1993). Later evidence (Meehan and Byrd 1996) suggests that these may have been ship (or roof) rats. Introduced roof rats (*Rattus rattus*) are now established though in low numbers on Shemya Island. It appears the population has been curtailed by trapping and fox predation (Schwitters and C. Schwitters 2005, Schwitters and L.E. Schwitters 2006; Schwitters *et al*. 2005; Schwitters and Martinka 2006).

The third introduced and now established species is deer mice (*Peromyscus miniculatus*). The Arctic fox is considered an asset to Eareckson AS because foxes keep bird nesting populations in check. For example, foxes prey upon gull and geese nests, which, in turn, reduces the potential for BASH at Eareckson AS.

Several marine mammals occupy coastal waters surrounding Shemya Island. including the threatened sea otter, harbor seal, and endangered northern or Steller sea lion, and a few whale species. The northern or Steller sea lion is the most abundant marine mammal in the area, and haul-out occurs on off-shore islands northeast of Shemya Island. They use both clear and turbid waters at depths of less than 180 feet.

The walrus occurs in larger populations on the lower Alaska Peninsula than in the Aleutian Islands because they follow the edge of the winter ice pack, which only occasionally reaches the Aleutian Islands. They have been reported infrequently from Amak Island, False Pass, Unimak Island, Amchitka Island, and even Attu and Shemya Islands. Right and humpback whales are seasonal visitors to waters surrounding Shemya Island.

Alaska Maritime NWR staff initiated a winter survey at Shemya Island in 1988 to monitor avian and marine mammal populations in the western Aleutian Islands. Surveys were conducted sporadically through 1990. 611 ASG provided funding to continue the surveys during winters of 1995/96 and 1996/97. The most recent of these surveys occurred from 1999 to 2002. Byrd and Scharf (2003) summarized study observations for each winter since 1988 for which data were available.

During the ABR, Inc. 2005 field visit, Arctic fox and harbor seal, as well as the carcasses of a sperm whale and a Stejneger's beaked whale that had washed ashore were recorded. Two carcasses of Stejneger's beaked whales were reported in shallow waters adjacent to the island during 2005 (Schwitters *et al*. 2005).

Harbor Seal. Peak counts of more than 130 animals occurred in four winters, but most annual peaks were well below 100 animals. Highs of 140 harbor seals were observed in winter 1993/94 and winter 1996/97. Counts suggested a decline between 1994 and 2001. Seals were observed in nearshore waters around the entire island and were often hauled out on offshore rocks on the northeastern side during low tide (Byrd and Scharf 2003).

Arctic Fox. Foxes were frequently seen around the housing area and occasionally along the coastal road, but their numbers appeared to decline following the USAF drawdown, particularly around the housing area. During 1999-2002 surveys, peak counts recorded along the coastline of the island found single digit numbers for foxes (Byrd and Scharf 2003). During summer 2002 the population of foxes was estimated to be 30 or more (Schwitters and Rossi 2002). The fox population was estimated at 45 during 2006 (White and Spraker 2006).

Killer Whale. Killer whales were last observed on 4 December 1995 and 4 March 1996. They were not observed during 1999-2002 surveys (Byrd and Scharf 2003).

5.3.3 Birds

Shemya Island is year-round habitat for seabirds, waterfowl, and raptors. At least 187 species of birds have been observed at Shemya at one or more seasons of the year (Byrd and Scharf 2003). A major seabird colony is located on adjacent Nizki Island. Most islets and rocks surrounding Shemya Island support breeding bird colonies for pelagic seabirds. Neritic seabirds are those which use the belt of relatively shallow coastal waters, while pelagic seabirds live mainly on the open sea. Asiatic species have also been identified near Shemya Island during migrations. The north shore bluffs, vegetated with thistle and cow parsnip, provide important resting habitat for migrating Asiatic songbirds.

The western Aleutian Islands, of which Shemya Island is a part, are along the migratory pathways or are nesting grounds of many North American shorebirds and waterfowl. Rocky cliffs of Shemya Island provide ideal habitat for seabird colonies and roost sites for the Peale's Peregrine Falcon. Pelagic and Red-faced Cormorants and Tufted Puffins nest on offshore islets on the northern side of Shemya, but seabirds have been mostly extirpated from the main island by introduced foxes and rats. The island's tundra supports nesting habitat for waterfowl, including the endemic Aleutian Green-winged Teal and Aleutian Rock Sandpiper, but these too have been reduced by foxes and rats (Jacobs Engineering Group, Inc. 1993).

Glaucous-winged Gulls are found throughout the island, feeding along the coast and at the dump and sewage outlets or roosting on beaches and offshore rocks. The population of Glaucous-winged Gulls declined significantly between 1988 and 2001 (Byrd and Scharf 2003). Large numbers of gulls rest on runways in the fall after the young fledge from offshore islet colonies. Ruddy Turnstones use the northern shoreline during fall migration (Jacobs Engineering Group, Inc. 1993).

Shemya Island does not support as large a population of waterfowl as could be expected, given the available habitat on the island. Introduced foxes and rats probably prevent more waterfowl from breeding on the island. During winter a variety of waterfowl feed extensively on tidal benches and in nearshore waters. Waterfowl which may occur on Shemya Island include the Aleutian Cackling Goose, Emperor Goose, Steller's Eider (a threatened species), Whooper Swan, Green-winged Teal, Mallard, Northern Pintail, Greater Scaup, Common Goldeneye, Harlequin Duck, Common Eider, White-winged and Black Scoter, and Common and Red-breasted Merganser. The Upper, Middle, and Lower Lakes complex serves as a migration feeding and resting area for waterfowl. Emperor geese congregate on the sewage lagoon, east of the runway along the coastal shoreline. Numerous Harlequin Ducks use salt water surrounding Shemya. Common Eiders are also seen in the waters surrounding Shemya Island (Jacobs Engineering Group, Inc. 1993). Schwitters and L.E. Schwitters (2006) noted that a drake Northern Pintail was collected for the University of Alaska Fairbanks museum on May 1, 2006 that had been banded at a wildlife refuge near Tokyo, Japan on 2 February, 2006.

Winter wildlife surveys, including avifauna, were conducted at Eareckson AS from 1988 through 2002 with exception of winter 1989/99. Data from these surveys are summarized by Byrd and Scharf (2003). Thirty-three bird species were observed during the ABR, Inc. fall 2005 site visit, including the Northern

Shoveler, Eurasian Widgeon, Harlequin Duck, Pelagic and Red-faced Cormorant, Aleutian Cackling Goose, Eurasian Kestrel, Eurasian Hobby, Pearle's Peregrine Falcon, Long-billed Dowitcher, Black-legged Kittiwake, Common Murre, Asiatic Arctic Warbler, and Pectoral, Sharp-tailed, and Rock Sandpiper. There are many surveys done over the years (Table 5.3, above).

The Aleutian Cackling Goose (formerly the Aleutian Canada Goose) uses Shemya Island throughout the spring (typically mid-April to early-June) and fall (typically mid-August to early-October) for non-breeding activities, primarily feeding. Aleutian Cackling geese do not often use the island's lakes; instead when they were not feeding in upland crowberry habitats, they could only be found feeding and loafing in habitats that were quite open, with low vegetation, such as runway aprons, the clover patch, the lawn on front of Building 600, and even the island's roads (Schwitters *et al*. 2005).

Geese use Shemya Island as a feeding, staging, and resting area as they conclude spring migration, prior to nesting on adjacent islands and then after nesting and molting is complete during the period prior to fall migration (Schwitters and Martinka 2006). The Aleutian Cackling Goose does not nest on Shemya Island, and there was no expectation of nesting. Therefore ,no recovery plan actions were accomplished on the island during the period the bird was listed as endangered and threatened. The USFWS considered Shemya Island not suitable for restoring breeding populations due to human, rodent, and blue phase Arctic fox habitation. Observations found prior to initiation of hazing indicate that Aleutian Cackling geese rest on the Eareckson AS runway (Schwitters *et al*. 2005), necessitating hazing measures that were approved after Section 7 consultation under the Endangered Species Act. In the absence of aggressive hazing to protect aircraft, Aleutian Cackling Geese present a substantial strike hazard at Eareckson AS (Schwitters *et al*. 2005).

After a listing change from endangered to threatened, approximately 200 geese were seen on Shemya Island in September 1995 by biologists Joe Meehan (USFWS) and Gene Augustine (USAF). The following population information is taken from Aleutian Cackling Geese surveys listed in Table 5.3, above.

- Peak numbers using the island in spring and fall 1999 through 2001 doubled those seen in 1995 and gradually tripled, exceeding 600, as observed by Wildlife Services (Schwitters *et al*. 2002).
- Aleutian Cackling Goose use of Shemya Island continued to increase to over 1,000 in 2003 and 2004 (personal communication, G. Augustine 2006) and in spring 2005 (Schwitters *et al.* 2006).
- Aleutian Cackling Goose use of Shemya Island during 2005 was less than the average from 1999-2002 surveys. However, the number of Aleutian Cackling geese using Shemya Island (during the spring) was reported as significantly increased, perhaps doubled, since 2002. In addition, the numbers were about 100 percent larger that the average of the spring counts from 1999 through 2002 (Schwitters and C. Schwitters 2005). This obviously greatly increased the BASH risk on Shemya Island.
- An increase in the Cackling Goose population was noted on Shemya Island during spring 2006 although the number counted during surveys was less than in 2005 but about the same as numbers counted earlier in the decade (Schwitters and L.E. Schwitters 2006). During fall 2006 lower numbers of geese were recorded, which may have been due to a poor crop of crowberry being quickly consumed leaving no reason for geese to make the flight to Shemya Island (Schwitters and Martinka 2006).
- Frost *et al*. (2008) recorded 117 flocks with 1,586 geese in 11 habitat types during 2006 spring surveys and 104 flocks with 1,086 geese within 14 habitat types during 2006 fall surveys.
- In spring 2010 Wildlife Services' personnel observed record numbers of geese during evening surveys, with >800 often counted; 2010 fall counts were low, probably due to the use of a full-time hazer during 2008-2010 fall seasons. Low fall counts may have also been due to unmowed areas along the runway during 2010 (reported in Frost *et al*. 2010).

The population of the Aleutian Cackling Goose was determined recovered in North America and was delisted on March 20, 2001 (USFWS 2011), primarily as a result of four activities: the removal of introduced Arctic and red fox from nesting islands; the release of captive-reared and translocated family groups of geese; protection throughout its range and protection and management of migration and wintering habitat (Federal Register, Vol. 66, No. 54, March 20, 2001). By 2001 the population had rebounded to well over 30,000 (http://web1.audubon.org). The current population is such that Aleutian Cackling geese are hunted in California and Oregon; the area where geese from the Aleutian Islands migrate to for winter. Depending on what area is hunted in the Pacific Northwest, daily bag limits for Aleutian Cackling geese range from 1 to 4 (www.dfg.ca.gov and www.dfg.state.or.us). Hunting began in 2001 in California, Alaska regulations first allowed hunting of Aleutian Cackling geese in fall of 2005 with other dark geese (Tom Rothe, ADFG, 11 Jul 07, personal communication, G. Augustine).

The Harlequin Duck and Marbled Murrelet are former Category 2 candidate species. Harlequin Ducks are common visitors, and two Marbled Murrelet were observed in winter 1994/95 and winter 1996/97 near the shores of Shemya Island (Byrd and Scharf 2003). The Red-legged Kittiwake is a formerly listed Category 2 species. The Red-legged Kittiwake has an established breeding colony on Buildir Island, which is about 50 miles east of Shemya Island. This species may temporarily occur on Shemya Island enroute to Buildir Island.

5.4 Threatened and Endangered Species

Thirteen threatened, endangered, or candidate faunal species potentially occur on Shemya Island or in adjacent waters. None are permanent residents of Shemya Island. No threatened or endangered flora species have been identified at Shemya Island. The following subsections identify threatened and endangered species of concern and where known, habitat types they utilize on Shemya.

Fish. No threatened or endangered fish species have been identified on Shemya Island or its surrounding waters.

Birds. The Short-tailed Albatross is listed as endangered (USFWS 2011) The preferred habitat of the Short-tailed Albatross is offshore marine waters. Its presence on Shemya Island is unlikely, but it occurs within three miles of Shemya Island. There are no management requirements or issues associated with this species at Eareckson AS.

The Spectacled Eider is listed as threatened (USFWS 2011). The Alaska Natural Heritage Program confirms that the winter range for the Spectacled Eider does not include Shemya Island (S.Wilber, ANHP, 20 Aug. 98 personal communication with G. Augustine), and the recovery plan for the Eider (USFWS 1996) shows the major wintering area is north in the Bering Sea between St Lawrence and St Matthew islands. However, there are records of observations of an individual Spectacled Eider in waters around Attu from May 1993 - June 2002 (G.V. Byrd 2007, review comments on draft INRMP (Gene Stout and Associates and Blythe and Trousil, Inc. 2007b).

The Steller's Eider is listed as threatened (USFWS 2011). The molting and winter range for the Steller's Eider does not include Shemya Island (Alaska.fws.gov/fisheries/endangered/consultation_guide.htm). Steller's Eiders were observed in 6 of 12 winters at Eareckson AS (Byrd and Scharf 2003). They spend most of the year in shallow, near-shore marine waters, and molting and wintering flocks congregate on exposed shoals, in protected lagoons and bays, and along rocky headlands and islets (USFWS 2011).
The Kittlitz's Murrelet is listed as a candidate species (USFWS 2011). Two Kittlitz's Murrelets were observed during winter surveys at Eareckson AS (Byrd and Scharf 2003). This species is one of the least known seabirds; its winter range even less well known, but the small seabirds appear to scatter in mid-shelf waters offshore, and occasionally near shore in a few Southcoastal Alaska locations (Kuletz 2004).

The Yellow-billed Loon, a candidate species, is also confirmed for Eareckson AS.

Terrestrial Mammals. No threatened or endangered terrestrial mammal species have been identified on Shemya Island.

Marine Mammals. Marine mammals in waters around Shemya are protected under federal laws, as well as by international treaties and agreements. They are protected from take, harassment, etc., and their habitat is protected from encroachment, damage, or destruction. The NMFS has major responsibilities for listing such species under the Endangered Species Act. The exception is the northern sea otter, which is managed by the USFWS.

Northern Sea Otter. Sea otters are a natural part of the marine ecosystem in coastal waters of Alaska and the Aleutian Islands. Between 1742 and 1799 the Russians virtually eliminated the population for their pelts. An international convention in 1911 prohibited the harvesting of sea otters and regulated fur seal hunting. All sea otter hunting (including subsistence hunting) was prohibited after 1960, and populations began increasing in many areas. Sea otters are found in all coastal waters surrounding Shemya Island. They favor the southwest coastline because of the presence of kelp beds and suitable habitat for resting and pupping. Sea otters generally live in clear coastal waters less than 240 feet deep. They serve as a key species in the coastal ecosystem. Sea otters limit epibenthic invertebrates by eating large quantities of animals each day, in part to maintain their normal body temperature. They are especially fond of sea urchins (USAF undated).

The northern sea otter was listed as threatened on August 9, 2005 in its range from the Aleutian Islands to Cook Inlet (USFWS 2011). Significant declines in otter populations were recorded between 1986 and 2001 (70% decline in the Aleutian Islands from 1992-2000). The number of sea otters observed during winter surveys at Shemya Island varied dramatically over the 14-year span of the surveys. Sea otter numbers increased significantly between 1988 and 1992 (peak number counted was 124 animals in winter 1992/93), but the sharp increase was followed by a significant decline. During winter surveys in 1999/00 and 2000/01, peak counts recorded only two otters, and in winter 2001/02 only three otters were recorded. Otters fed primarily in rocky areas along the northern shoreline and were often observed hauled out on offshore rocks and tidal benches in this area (Byrd and Scharf 2003).

Whales. Bowhead, North Pacific right, sperm, humpback, blue, and fin whales are seasonal visitors to waters surrounding Shemya Island. These species are designated as endangered (USFWS 2011). Bowhead whales and humpback whales pass by the shore during migrations in May and October (S. Wilbur, Alaska Natural Heritage Program, 20 Aug. 1998 personal communication, G. Augustine). North Pacific right whales and sperm whales use the area from April to September. The humpback whale uses the area surrounding Shemya for feeding and as a migration corridor from May to October. Blue whales and fin whales feed in the area during summer.

Steller Sea Lion. The Steller sea lion is listed as endangered west of 144º longitude (USFWS 2011), which includes Shemya Island. Steller sea lions generally live in clear waters less than 300 feet deep, and they occasionally ascend rivers for brief periods of time. Two sea lion rookeries and/or haul-out grounds are on the northern and northwestern ends of Shemya Island. As many as 120 sea lions were counted during the 1988/89 winter, but numbers have significantly declined since then. By 1999 peak counts were less than 10 animals (Byrd and Scharf 2003). During a 2002 survey 52 sea lions were counted, and during a summer 2004 photogrammetric census of Steller sea lions 17 animals comprising 13 juveniles, three adult females, and one bull were documented on one rock off-shore the northeastern side of Shemya Island (Stinchcomb 2004).

5.5 Wetlands

Wetlands at Eareckson AS are associated primarily with palustrine and marine intertidal features and to a lesser degree with lacustrine and riverine habitats. The most common wetland types on Shemya Island, away from the immediate coast, are seasonally flooded or saturated persistent palustrine emergents and saturated emergent palustrine scrub shrub types. Along the coast, regularly and irregularly flooded unconsolidated and rocky shores are common. Many wetlands at Eareckson AS have evidence of past and/or current human disturbance, which primarily include such activities as excavation, diking, or water impoundments. Common woody shrub species found in Eareckson AS wetlands include *Empitrum nigrum*, *Cornus suecica*, and *Vaccinium uliginosum.* Common emergent plant species occurring in wet, saturated, palustrine areas include *Carex lyngbyaei*, *C. macrochaeta*, *Juncus haenkei*, *Equisetum arvense*, and *Epilobium ciliatum.* Species commonly found in better-drained, but still saturated or seasonally flooded wetlands, include *Calamagrostis nutkaensis*, *C. canadensis*, *Poa macrocalyx*, *Leymus mollis*, *Heracleum lanatum*, *Lupinus nootkatensis*, *Lathyrus japonicus*, *Angelica lucida*, and *Cirsium kamtschaticu* (Frost *et al*. 2005a).

A U.S. Army Corps of Engineers wetland jurisdictional delineation was completed in 1986 and was included the draft 1995 Natural Resources Plan (Woodward-Clyde 1995a). Most of Shemya Island fell within a wetland classification. The delineation was jurisdictional and provided little information about relative habitat values. The USFWS performed a habitat survey and wetlands mapping project to better define wetland values.

This was further enhanced by the 2002 and 2008 habitat mapping projects (Frost *et al*. 2005a and Roth and Macander 2009, respectively. Table 5.2 summarizes wetland acreages on Eareckson AS. These sources are used to facilitate decisions regarding facility siting. Eareckson AS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2000-2005, which has been updated with 2011 NWI mapping 1,794.36 acres). Figure 5.5 shows wetlands on Eareckson AS from this 2011 data.

5.6 Other Natural Resources Information

There are no organized outdoor recreation opportunities at Eareckson AS. Since the 1995 drawdown and removal of active military personnel, official recreation requirements ended; non-appropriated funds are not available for morale, welfare, and recreation.

Unorganized outdoor recreation opportunities available at Eareckson AS include jogging, hiking or biking on the road system, wildlife viewing, photography, beachcombing, bonfires, and fishing. Numerous small lakes that dot the island offer several outdoor recreation opportunities. The island offers a great variety of flora and fauna that are unique to the Aleutian Islands. Several attractive beach areas and impressive views and wildlife viewing opportunities are available from rocky headlands that rise above surrounding ocean waters. Prior to drawdown, an informal system of jogging and bicycling trail routes was identified along the installation road system.

Figure 5.5 Eareckson Air Station Wetlands, 2011

Interest in the development of an outdoor skeet range in the gravel pit area and an indoor archery or air rifle range within one of the existing storage buildings was expressed in Woodward-Clyde (1995a). However, the Project Office considers archery items weapons, and given security concerns, it is not likely that archery equipment would be allowed either as personal owned or owned as part of a recreation program on the island (electronic communication, K. Hopkins with G. Augustine 2007). Also, due to the drawdown and reduced budgets, development of such recreation is not feasible.

Personal weapons and hunting has not been permitted on Eareckson AS due to security requirements for at least the past 15 years. This prohibition has precedence over the personal weapons policy described in INRMP Section 7.11, *Outdoor Recreation and Related Land Use*. Because of the policy, only activitiesthat do not require weapons (*e.g.*, fishing, berry picking) can now occur. Security and airfield personnel are permitted to use firearms and other weapons for wildlife hazing and deterrence.

Woodward-Clyde (1995a) indicated that fishing is a primary source of recreation at Eareckson AS. Most saltwater fishing occurs off the dock because it affords easy access that permits fishermen to reach substantial depths to catch a variety of marine fish. Other fishing opportunities include freshwater fishing in various lakes.

Anticipated future demands for natural resources by contractor personnel at Eareckson AS are continued fishing and other outdoor recreation activities. The use of natural resources is expected to remain relatively constant at low levels.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Eareckson AS occupies the entire Shemya Island. The major land use is by military support facilities, including buildings; roads; a runway; petroleum, oils, and lubricants tank farms; training areas; and waste disposal areas.

Shemya Island is also managed as part of the Aleutian Islands Unit of the Alaska Maritime NWR by the USFWS. The island remains part of the NWR though in 2001 the Defense Appropriations Act (Public Law 106-259, Section 302) transferred primary jurisdiction of Shemya Island from the USFWS to the USAF 611 ASG. If DoD missions on the island were no longer required, jurisdiction would return to the USFWS. However, the military department exercising primary jurisdiction, custody, and control over Shemya Island shall:

- work with the USFWS to protect and conserve the wildlife and habitat on the island, and
- grant access to Shemya Island and its appurtenant waters to the USFWS for the purpose of management of the Alaska Maritime NWR.

The Shemya AFB Comprehensive Plan (TRA/FARR & Dowl Engineering 1988) identified the following land use categories: airfield, operations and maintenance, industrial, administrative, community, housing, outdoor recreation, open space, and water. The three spatially-dominant land use categories are open space, industrial/residential, and airfield (CH2M Hill 1990).

Open Space. Approximately 2,750 acres, roughly three-quarters of Shemya Island's land area, are devoted to open space. This open space can be categorized as follows (CH2M Hill 1990):

- Safety Areas: Substantial areas of the island are subject to safety restrictions for explosive safety and airfield approach/departure zones. Activity immediately northwest of Cobra Dane is also restricted for safety reasons.
- Buffer Areas: Spatial separation is required between uses that might otherwise conflict due to

security concerns, noise, traffic, blocking of views, or other factors.

- Environmental Protection: The watershed serving the collection gallery and portions of the island characterized by steep bluffs, unstable soil, important habitat values (such as the Upper-Middle-Lower Lakes system), or subject to coastal flooding are being retained as open spaces to preserve their functions and values.
- Reserve: Areas currently not intensively used or within categories noted above with potential for meeting other demands in the future are reserved. These include areas that formerly supported facilities that have been abandoned.

Industrial/Residential. Industrial/Residential land use is one of the broadest land-use categories, supporting facilities that range from supply warehouses to utilities to maintenance shops. Industrial category uses are dispersed throughout almost all areas of Eareckson AS, at least partially as a result of earlier development patterns and the tendency to reuse existing structures (CH2M Hill 1990).

Airfield. The airfield is an open area, unfortunately where birds have been found to rest and forage. This openness allows certain birds to feel secure and easily detect the Arctic fox. Generally, during late April to mid-June and mid-August through mid to late October, Aleutian Cackling Geese visiting Shemya Island have increased in numbers, causing an increased BASH condition.

Ravens and Glaucous-winged Gulls have had an increasing presence in summer. Three gull fatalities occurred in June 1997 without human injury or loss to a C-130 aircraft. However, a landing gear light was destroyed on a C-130 aircraft in November 1998 when an unidentified bird was struck. An unidentified gull was struck in May 1999 by a Boeing 727 without human injury or damage to the aircraft (Schwitters *et al*. 2002).

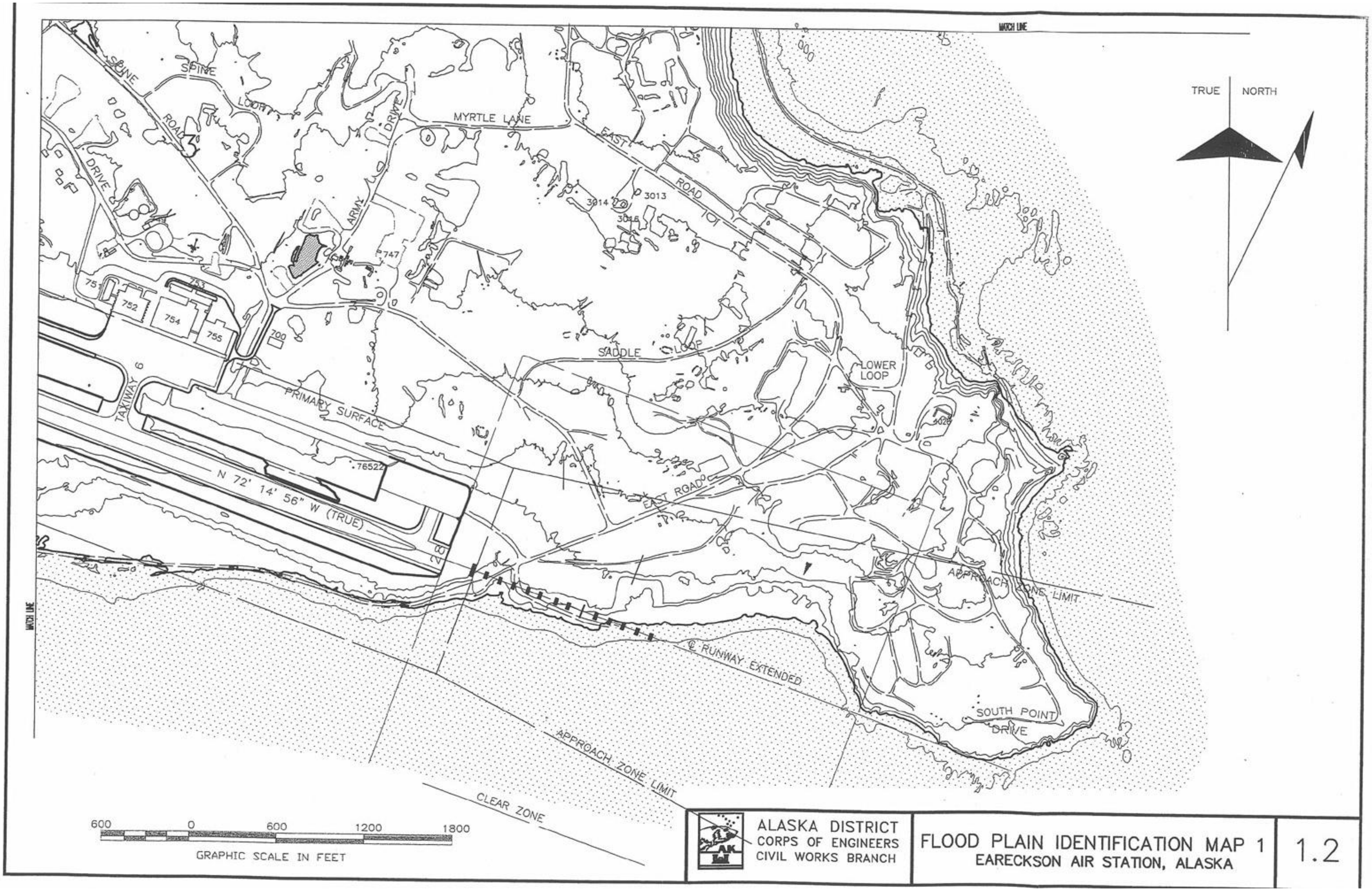
The airfield contains runways, taxiways, aprons, various navigational aids, and areas between these active features. Most structural features, including Air Combat Command facilities, are congregated along the northern edge of the airfield. It is a relatively well-defined focal point of installation aviation activity that dominates land use in the south-central part of the island. The airfield's generally good condition, the major investment it represents, and the lack of major anticipated changes in operational requirements make it a stable use. The airfield's configuration, combined with erodible soils and southern slope, limit potential land uses in the vicinity of the runways, as do safety clearances in approach/departure areas extending from both ends of Runway 10-28 (CH2M Hill 1990).

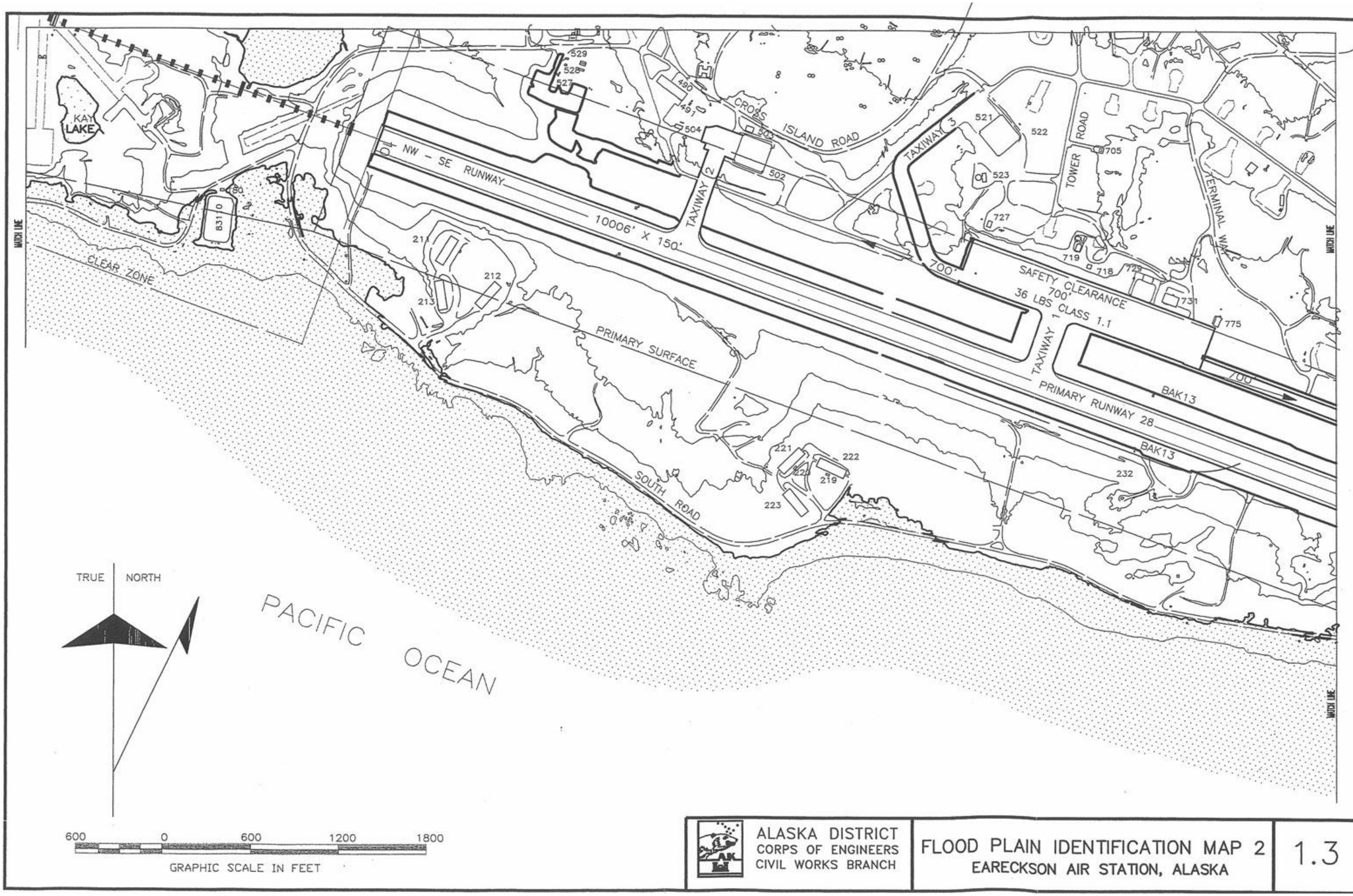
Most management issues related to land use identified by Woodward-Clyde (1995a) are still applicable, including revegetation of disturbed sites including demolition sites, preservation of wetlands, surface water quality, and protection of watershed areas from disturbance and potential contamination.

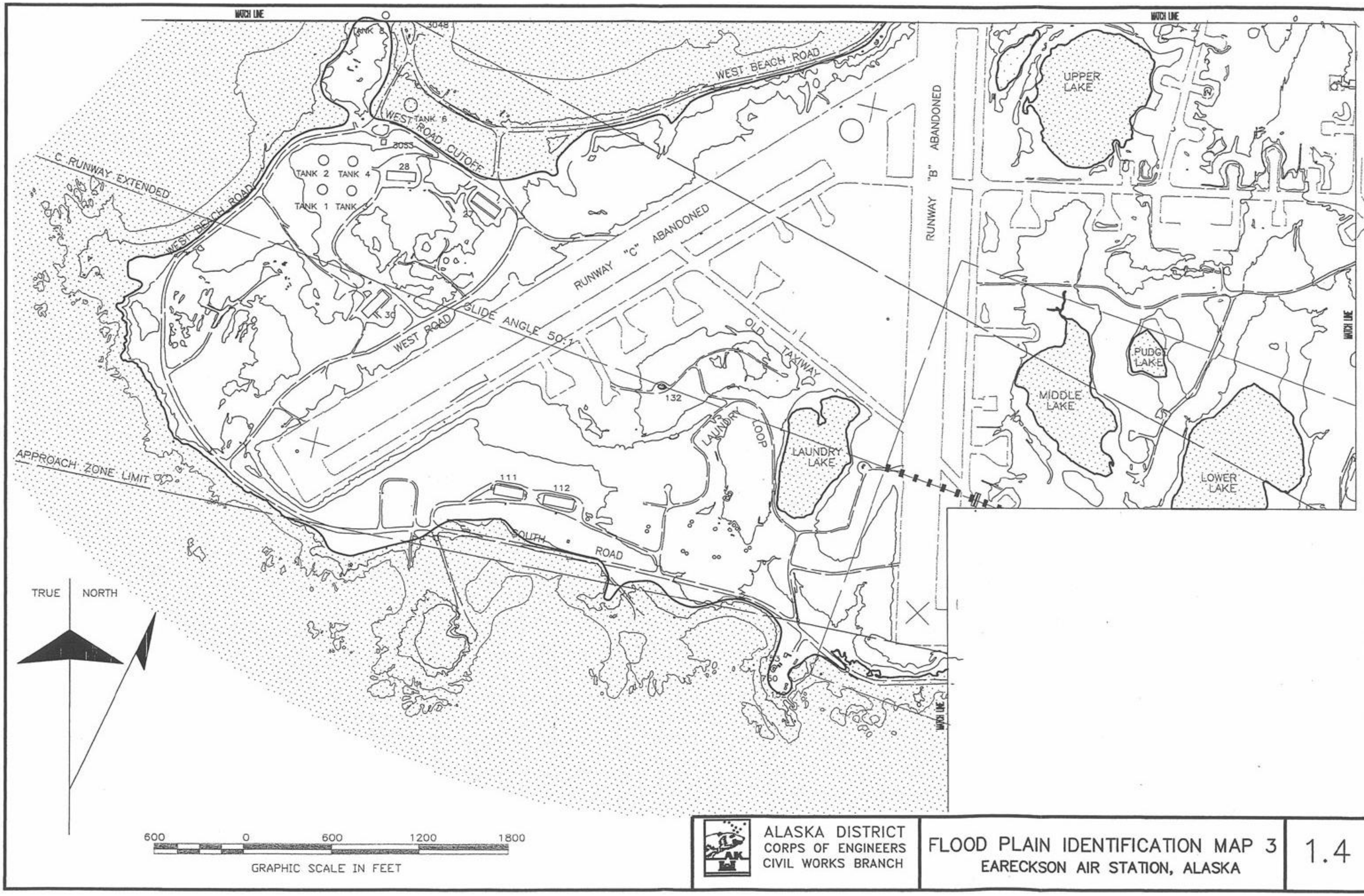
The issue of stabilization of sand dunes located in the airfield's lateral clear zone between the south side of the active airfield (Runway 10-28) and South Beach Road has occurred in the past 15years. However, protection of sand dunes from disturbance between the shoreline and South Beach Road was not accomplished. Approximately 1,000 feet of the fore-dunes and the predominant beach wildrye grasses were removed and used to cover the closed sanitary landfill, exposing the road to drifting sand and erosion since 2003. In addition, increased open space or conversion to other land uses has surfaced as a land use issue as a result of demolition activities.

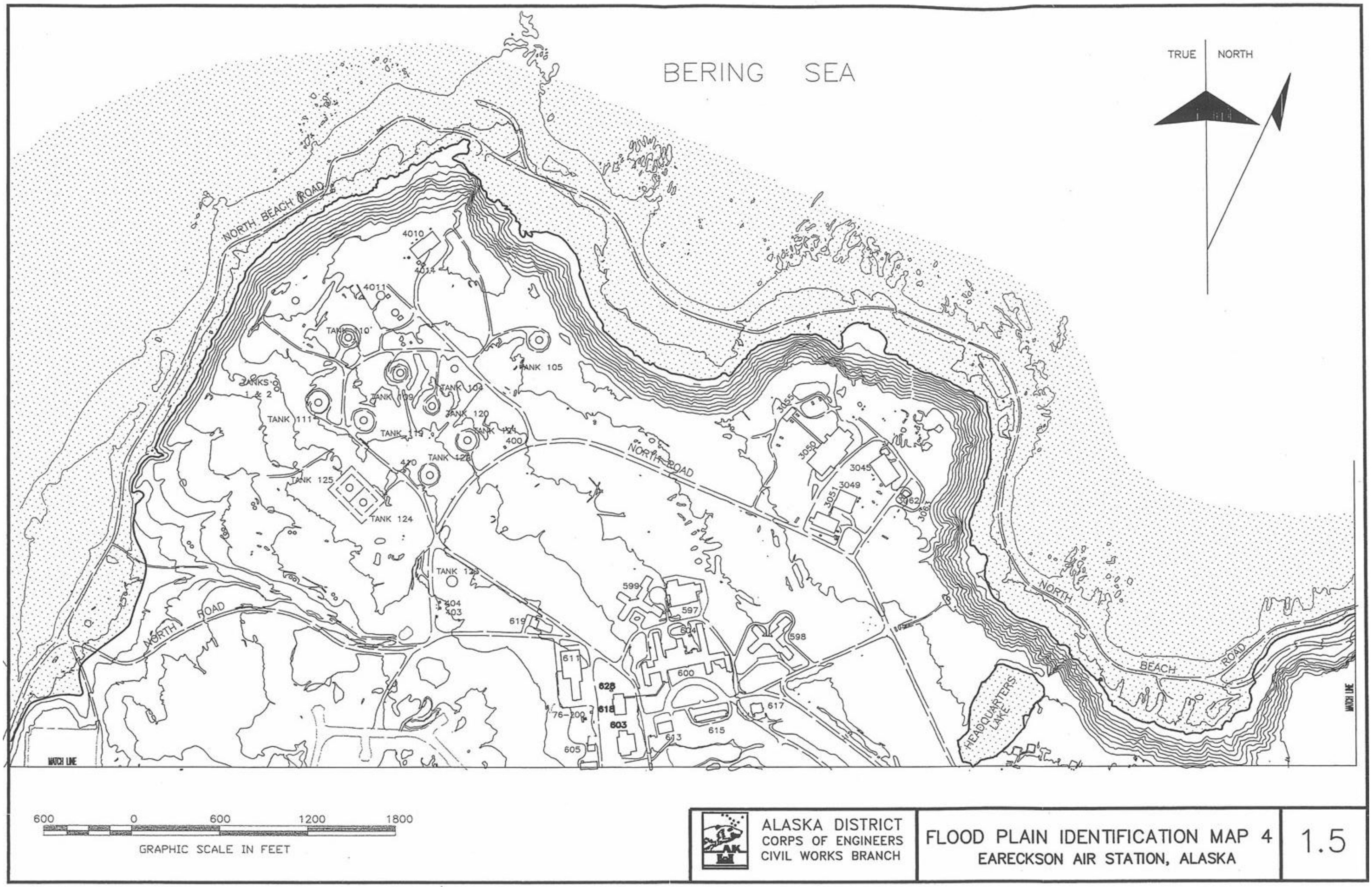
APPENDIX A: Flood Plains of Shemya Island

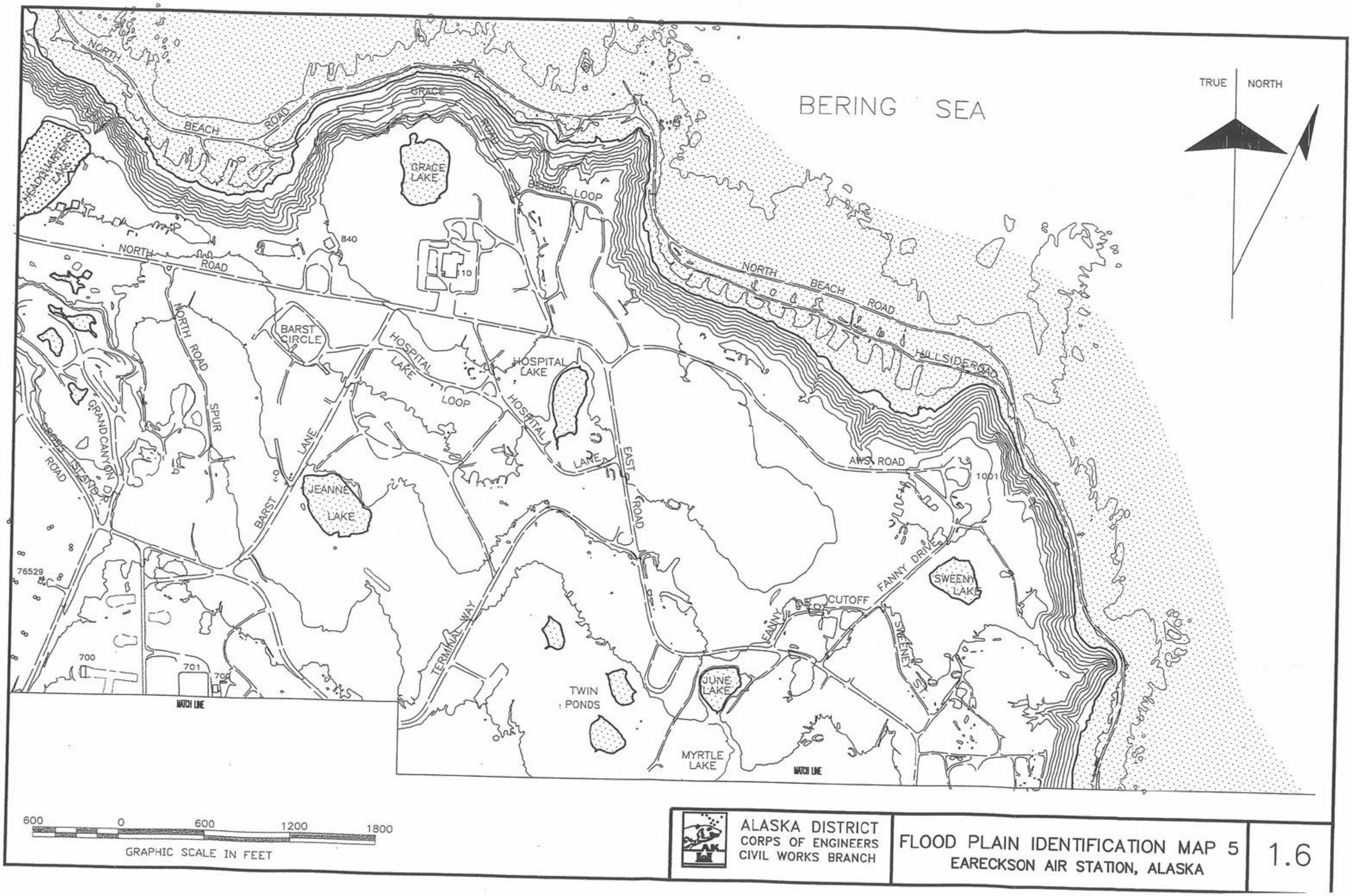
Maps in this appendix are taken from *Flood Plain Identification, Forward Operating Bases, Eareckson Air Station, Galena Airport, King Salmon Airport, Alaska* (U.S. Army Corp of Engineers 1998).


MATCH LINE
TRUE NORTH
SPINE ROAD
SPINE LOOP
MYRTLE LANE
DRIVE
ARMY DRIVE
EAST ROAD
3014
3013
3016
747
751
753
752
754
755
700
SADDLE LOOP
LOWER LOOP
TAXIWAY 6
PRIMARY SURFACE
76522
N 72' 14' 56" W (TRUE)
EAST ROAD
APPROACH ZONE LIMIT
RUNWAY EXTENDED
SOUTH POINT DRIVE
APPROACH ZONE LIMIT
CLEAR ZONE
600 0 600 1200 1800
GRAPHIC SCALE IN FEET
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH
FLOOD PLAIN IDENTIFICATION MAP 1
EARECKSON AIR STATION, ALASKA
1.2


KAY LAKE
NW - SE RUNWAY
10006' X 150'
CROSS ISLAND ROAD
TAXIWAY 2
TAXIWAY 3
TAXIWAY 1
TOWER ROAD
TERMINAL WAY
SAFETY CLEARANCE
700'
36 LBS CLASS 1.1
CLEAR ZONE
PRIMARY SURFACE
PRIMARY RUNWAY 28
BAK13
SOUTH ROAD
PACIFIC OCEAN
TRUE NORTH
600 0 600 1200 1800
GRAPHIC SCALE IN FEET
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH
FLOOD PLAIN IDENTIFICATION MAP 2
EARECKSON AIR STATION, ALASKA
1.3


MATCH LINE
TANK 8
3048
WEST BEACH ROAD
TANK 6
WEST ROAD CUTOFF
3053
28
TANK 2
TANK 4
TANK 1
TANK 3
27
30
C RUNWAY EXTENDED
WEST BEACH ROAD
RUNWAY "C" ABANDONED
WEST ROAD
GLIDE ANGLE 50:1
OLD TAXIWAY
132
LAUNDRY LOOP
LAUNDRY LAKE
111
112
SOUTH ROAD
APPROACH ZONE LIMIT
RUNWAY "B" ABANDONED
UPPER LAKE
PUDGY LAKE
MIDDLE LAKE
LOWER LAKE
TRUE
NORTH
600
0
600
1200
1800
GRAPHIC SCALE IN FEET
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH
FLOOD PLAIN IDENTIFICATION MAP 3
EARECKSON AIR STATION, ALASKA
1.4


BERING SEA
TRUE NORTH
NORTH BEACH ROAD
NORTH ROAD
TANK 105
TANK 111
TANK 125
TANK 124
TANK 122
TANK 120
TANK 123
TANKS 1 & 2
4010
4011
400
410
404
403
3055
3050
3045
3049
3051
3062
599
597
598
604
600
611
619
628
618
603
605
613
615
617
76-200
HEADQUARTERS LAKE
BEACH ROAD
MATCH LINE
600 0 600 1200 1800
GRAPHIC SCALE IN FEET
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH
FLOOD PLAIN IDENTIFICATION MAP 4
EARECKSON AIR STATION, ALASKA
1.5


BERING SEA
TRUE NORTH
NORTH BEACH ROAD
GRACE ROAD
HEADQUARTERS LAKE
GRACE LAKE
BERING LOOP
840
110
NORTH ROAD
NORTH BEACH ROAD
HILLSIDE ROAD
BARST CIRCLE
HOSPITAL LAKE LOOP
HOSPITAL LAKE
HOSPITAL LANE
NORTH ROAD SPUR
GRAND CANYON DR.
ROAD
BARST LANE
JEANNE LAKE
EAST ROAD
AWS ROAD
1001
FANNY DRIVE
SWEENY LAKE
CUTOFF
SWEENEY
76529
TERMINAL WAY
TWIN PONDS
JUNE LAKE
MYRTLE LAKE
700
701
MATCH LINE
GRAPHIC SCALE IN FEET
600 0 600 1200 1800
ALASKA DISTRICT
CORPS OF ENGINEERS
CIVIL WORKS BRANCH
FLOOD PLAIN IDENTIFICATION MAP 5
EARECKSON AIR STATION, ALASKA
1.6

APPENDIX B: Natural Resources of Eareckson Air Station

Table B1: Vascular Plant Species Observed or Potentially Occurring on or near Eareckson Air Station

Common Name	Scientific Name	Observed	Reference
Trees and Shrubs			
Alaska cassiope	*Cassiope lycopodiodes*		2
Lapland cornel	*Cornus suecica*	X	2, 4
Crowberry	*Empetrum nigrum*	X	2, 4, 7, 8
Twin-flower	*Linnaea borealis*	X	2, 3, 4
Alpine-azalea	*Loiseleuria procumbens*	X	2, 7
Aleutian Mtn.-heath	*Phyllodoce aleutica*		2
Sitka Spruce	*Picea sitchensis*	X	Introduced, 7, 8
Kamchatka rhododendron	*Rhododendron camtschaticum*	X	1, 2, 4, 7
Nagoonberry	*Rubus arcticus*	X	2
Cloudberry	*Rubus chamaemorus*	X	1, 2, 3, 4
Arctic willow	*Salix arctica*	X	1, 2, 7
Ovalleaf willow	*Salix cyclophylla*		1, 2
Netleaf willow	*Salix reticulata*		1, 2
Siberian Mtn. ash	*Sorbus sambucifolia*		1, 2
Early blueberry	*Vaccinium ovalifolium*	X	2, 3, 4
Bog blueberry	*Vaccinium uliginosum*	X	2, 3, 4, 7, 8
Mountain cranberry	*Vaccinium vitis-idaea*	X	2, 3, 4, 7, 8
Herbaceous Plants			
Yarrow	*Achillea borealis*	X	1, 4, 5, 8
	Achillea millefolium borealis	X	7
Monkshood	*Aconitium maximum*	X	1, 3, 4, 7
	Agrostis alaskana	X	8
	Agrostis borealis	X	8
Spike bentgrass	*Agrostis exarata*	X	1, 5, 7
Northern bentgrass	*Agrostis mertensii*	X	1, 7
Rough bentgrass	*Agrostis scabra*	X	1, 7

Common Name	Scientific Name	Observed	Reference
Victory onion	*Allium victorialis*		1
Shortawn foxtail	*Alopecurus aequalis*	X	1, 7, 8
Boreal foxtail	*Alopecurus alpinus*	X	1
Meadow foxtail	*Alopecurus pratensis*	X	1, 7, 8
Round-leaf orchid	*Amerochis rotundifolia*		1
Pearly everlasting	*Anaphalis margaritacea*	X	1, 3, 4, 5, 7
Pasque flower	*Anemone drummondii*	X	1, 3, 4
Narcissus-flower anemone	*Anemone narcissiflora*	X	1, 3, 4, 7, 8
Yellow anemone	*Anemone richardsonii*	X	1, 3, 4, 7, 8
Wild celery	*Angelica lucida*	X	1, 3, 4, 5, 7, 8
Pink pussytoes	*Antennaria dioica*		17
Lyre-leaf rockcress	*Arabis lyrata*	X	1, 3, 4, 7
	Arabis lyrata kamchatica	X	8
Pendent grass	*Arctophila fulva*	X	1, 3, 4
Pacific silverweed	*Argentina egedii*		1
Alpine arnica	*Arnica alpina*	X	1, 3, 4
Tall meadow arnica	*Arnica chamissonis*	X	1, 3, 4
Unalaska arnica (mugwort)	*Arnica unalaschensis*	X	1, 5, 7
	Artemisia arctica	X	8
Oldwoman	*Artemisia stelleriana*	X	1, 7, 8
Common wormwood	*Artemisia tilesii*	X	1, 3, 4, 7, 8
	Artemisia unalaskensis	X	8
Arctic wormwood	*Artemisia vulgaris*	X	1, 4, 7
Bride’s feathers	*Aruncus dioicus*	X	1, 7
Lady fern	*Athyrium filix-femina*	X	1, 4, 7
Winter cress	*Barbarea orthoceras*	X	1, 7, 8
Moonwort	*Botrychium lunaria*		1
Leathery grape fern	*Botrychium multifidum*		1
Canola	*Brassica juncea*	X	1, 4, 7, 8

Common Name	Scientific Name	Observed	Reference
Turnip	*Brassica napus*		1
Aleutian brome	*Bromus aleutensis*	X	1, 7, 8
Bluejoint	*Calamagrostis canadensis*	X	1, 3, 4, 5, 7, 8
Pacific reedgrass	*Calamagrostis nutkaensis*	X	1, 3, 4, 7, 8
Hairyflower bellflower	*Campanula chamissonis*		1
Mountain harebell	*Campanula lasiocarpa*		1, 3
Shepherd's purse	*Capsella bursa-pastoris*		1
Alpine bittercress	*Cardamine bellidifolia*		1
Umbel bittercress	*Cardamine oligosperma*	X	1, 7
	Cardamine umballeta	X	8
Sedge	*Carex anthoxanthea*	X	1, 6
Sedge	*Carex glareosa*	X	1, 6, 7, 8
Sedge	*Carex kelloggii*	X	7, 8
Sedge	*Carex lenticularis*	X	1, 6
Sedge	*Carex lyngbyaei*	X	1, 4, 6, 7, 8
Sedge	*Carex macrochaeata*	X	1, 4, 5, 6, 7, 8
Sedge	*Carex pluriflora*	X	1, 3, 4, 5, 6, 7, 8
Sedge	*Carex saxatilis*	X	1, 3, 4, 6, 7
Coastal paintbrush	*Castilleja unalaschcensis*		1
Fischer's chickweed	*Cerastium fischerianum*	X	1, 4
Bering Sea chickweed	*Cerastrium beeringianum*	X	1, 3, 4, 7
Fireweed	*Chamerion angustifolium*		1
Dwarf fireweed	*Chamerion latifolium*	X	1, 3, 4, 7
Arctic daisy	*Chrysanthemum arcticum*	X	1, 4, 7, 8
Water carpet	*Chrysoplenium wrightii*		1
Kamchatcka thistle	*Cirsium kamtschaticum*	X	1, 7, 8
Siberian springbeauty	*Claytonia sibirica*	X	1, 4, 7
Frog orchid	*Coeloglossum viride*		1
Scurvy grass	*Cochlearia officinalis*	X	1, 3, 4, 7. 8

Common Name	Scientific Name	Observed	Reference
Purple marshlocks	*Comarum palustris*	X	1, 4, 7
Hemlock parsley	*Conioselinum chinense*	X	5, 7
Goldthread	*Coptis trifolia*	X	1, 7
	Cornus suecica	X	7, 8
Parsley fern	*Cryptogramma crispa*		1
Pink lady's slipper	*Cypripedium guttatum*		1
Fragile fern	*Cystopteris fragilis*	X	1, 7, 8
keyflower	*Dactylorhiza aristata*	X	1, 4, 7
Bering's tufted hairgrass	*Deschampsia beringensis*	X	1, 4, 7
Tufted hairgrass	*Deschampsia caespitosa*	X	1, 5, 7
Aleutian draba	*Draba aleutica*		1
Boreal draba	*Draba borealis*	X	1, 7
North Pacific draba	*Draba hyperborea*		1
Long leaved sundew	*Drosera rotundifolia*		1
Dryopteris fern	*Dryopteris dilatata*		1
Fringed willowherb	*Epilobium ciliatum*	X	1, 4, 5, 7, 8
Hornemann's willowherb	*Epilobium hornemannii*	X	1, 4, 7
	Epilobium latifolium	X	8
Field horsetail	*Equisetum arvense*	X	1, 4, 5, 7, 8
Arctic alpine fleabane	*Erigeron humilis*		1
Subalpine fleabane	*Erigeron peregrinus*	X	1, 3, 4, 7
Red cottongrass	*Eriophorum russeolum*	X	1, 3, 5,7
Subalpine eyebright	*Euphrasia mollis*	X	1, 7, 8
Fescue grass	*Festuca* sp.	X	1, 3, 4
Red fescue	*Festuca rubra*	X	5, 7, 8
Chocolate lily	*Fritillaria camschatcensis*	X	1, 4, 7
Stickywilly	*Galium aparine*	X	1, 5, 7
Boreal bedstraw	*Galium kamtschaticum*		1
Common marsh bedstraw	*Galium palustre*		1

Common Name	Scientific Name	Observed	Reference
Threepetal bedstraw	*Galium trifidum*	X	1
	Galium trifidum colunbianum	X	7
Whitish gentian	*Gentiana aleutica*		1, 7, 8
Autumn dwarf gentian	*Gentiana amarella*	X	1, 7
	Gentiana propinqua propinqua	X	8
Woolly geranium	*Geranium erianthum*	X	1, 4, 5, 7, 8
Calthaleaf avens	*Geum calthifolium*	X	1, 7, 8
Largeleaf avens	*Geum macrophyllum*	X	1
	Geum macrophyllum macrophyllum	X	7
Ross's avens	*Geum rossi*		1
Oakfern	*Gymnocarpium dryopteris*		1
Cow parsnip	*Heracleum lanatum*	X	1, 3, 4, 5, 7, 8
Vanilla grass	*Hierochloe odarata*	X	1, 3, 4, 7, 8
Mare's tail	*Hippuris vulgaris*	X	1, 7
Sandwort	*Honckenya peploides*	X	1, 3, 4, 7, 8
Wild iris	*Iris setosa*		1
Quillwort	*Isoetes muricata*		1
	Juncus arcticus sitchensis	X	8
Toad rush	*Juncus bufonius*	X	1, 7, 8
Swordleaf rush	*Juncus ensifolius*	X	1, 5, 7
Falcate rush	*Juncus falcatus*	X	1, 5, 7
Haenke's rush	*Juncus haenkei*	X	1, 4, 5, 7
Merten's rush	*Juncus mertensianus*	X	1, 5, 7
Island purslane	*Koenigia islandica*		1
Weaselsnout	*Lagotis glauca*		1
Beach pea	*Lathyrus japonicus*	X	1, 4, 7
	Lathyrus maritimus maritimus	X	8
Marsh pea	*Lathyrus palustris*		1
Beach wildrye	*Leymus mollis*	X	5, 7, 8
Beach lovage	*Ligusticum scoticum*	X	1, 5, 7

Common Name	Scientific Name	Observed	Reference
	Ligusticum scoticum hultenii	X	8
	Linnaea borealis	X	7
Heartleaf twayblade	*Listera cordata*	X	1, 7
Perennial ryegrass	*Lolium perenne*		1
Nootka lupine	*Lupinus nootkatensis*	X	1, 4, 7, 8
Wideleaf arctic woodrush	*Luzula arctica*	X	1, 5
Curved woodrush	*Luzula arcuata*	X	1
	Luzula arcuata unalaschensis	X	7
	Luzula confusia	X	8
Common woodrush	*Luzula multiflora*	X	1, 4, 7, 8
Smallflowered woodrush	*Luzula parviflora*	X	1, 7
	Luzula piperi	X	7
Wahlenberg's woodrush	*Luzula wahlenbergii*	X	1, 3, 4
Alpine clubmoss	*Lycopodium alpinum*		1
Stiff clubmoss	*Lycopodium annotinum*	X	1, 3, 4, 7
Common clubmoss	*Lycopodium clavatum*	X	1, 7
Fir clubmoss	*Lycopodium selago*	X	1, 3, 4, 7
Adder's mouth	*Malaxis monophylla*		1
False lily-of-the-valley	*Maianthemum dilatatum*	X	1, 7
Oysterleaf	*Mertensia maritima*	X	1, 4, 7, 8
Wild snapdragon	*Mimulus guttatus*		1
Grove sandwort	*Moehringia lateriflora*		1
Water minerslettuce	*Montia chamissoi*		1, 5
Annual water minerslettuce	*Montia fontana*		1
Eurasian water-milfoil	*Myriophyllum spicatum*		1
Yellow pond lily	*Nuphar polysepalum*		1
	Oxygraphis glacialis		8
Alaska poppy	*Papaver alaskanum*		1
Eared Indian plantain	*Parasenecia auriculata*	X	1, 3, 4, 5, 7

Common Name	Scientific Name	Observed	Reference
Grass of Parnassus	*Parnassia palustris*	X	1, 7, 8
Wooly lousewort	*Pedicularis chamissonis*	X	1, 4, 7
Whorled lousewort	*Pedicularis verticillata*		1
Alpine timothy	*Phleum commutatum* var. *americanum*	X	1, 4, 5, 7, 8
Common butterwort	*Pinguicula vulgaris*		1, 7
Seashore plantain	*Plantago macrocarpa*	X	1, 7, 8
Common plantain	*Plantago major*	X	1, 3, 4, 7, 8
Choriso bog orchid	*Platanthera chorisiana*		1
Kamchatka bog orchid	*Platanthera convallariaefolia*	X	1, 7
White bog orchid	*Platanthera dilitata*	X	1, 4, 7, 8
Aleutian bog orchid	*Platanthera tipuloides*		1, 7
Alpine bluegrass	*Poa alpina*		1
Arctic bluegrass	*Poa arctica*	X	5, 7, 8
Spear bluegrass	*Poa eminens*	X	1, 5, 7, 8
Largeglume bluegrass	*Poa macrocalyx*	X	1, 4, 5, 7, 8
	Poa pratensis	X	Introduced, 7, 8
Alpine meadow bistort	*Polygonum viviparum*	X	1, 3, 4, 5, 8
Braun's fern	*Polystichum braunii*		1
Arctic cinquefoil	*Potentilla nana*		1
	Potentilla palustris	X	8
Villous cinquefoil	*Potentilla villosa*	X	1, 7, 8
Wedge-leaved primrose	*Primula cuneifolia*		1
Self-heal	*Prunella vulgaris*		1
Alkaligrass	*Puccinellia* sp.	X	1
Tundra alkaligrass	*Puccinellia tenella*	X	1, 7
	Puccinellia langeana	X	8
Wintergreen	*Pyrola minor*		1
Tall buttercup	*Ranunculus acris*	X	1, 4, 7
Eschscholtz buttercup	*Ranunculus eschscholtzii*		1
Greater creeping spearwort	*Ranunculus flammula*	X	1, 7, 8

Common Name	Scientific Name	Observed	Reference
	Ranunculus grandis	X	8
Western buttercup	*Ranunculus occidentalis*	X	1, 4, 7
Woodland buttercup	*Ranunculus uncinatus*	X	1, 4
Yellow rattle	*Rhinanthus minor*	X	1, 8
	Rhinanthus minor borealis	X	7
	Rubus arcticus	X	7, 8
	Rubus chamaemorus	X	7, 8
Common sheep sorrel	*Rumex acetosella*	X	1, 3, 4
Western dock	*Rumex fenestratus*	X	1
Pearl wort	*Sagina intermedia*	X	1, 3, 4, 8
Stickystem pearlwort	*Sagina maxima*	X	1, 7, 8
	Sagina nivalis	X	7
	Sagina saginoides	X	8
Aleut saxifrage	*Saxifraga aleutica*		1
Bract saxifrage	*Saxifraga bracteata*		1
Spotted saxifrage	*Saxifraga bronchialis*		1
Heart-leaf saxifrage	*Saxifraga nelsoniana*	X	1, 7
Purple mountain saxifrage	*Saxifraga oppositifolia*		1
Spike moss	*Selaginella selaginoides*		1
Seaside ragwort	*Senecio pseudoarnica*	X	1, 3, 4, 7, 8
Creeping sibbaldia	*Sibbaldia procumbens*	X	1, 7, 8
Goldenrod	*Solidago multiradiata*		1
Narrowleaf bur-reed	*Sparganium angustifolium*		1
Boreal chickweed	*Stellaria borealis*	X	1, 7, 8
Curled starwort	*Stellaria crispa*		1
Saltmarsh starwort	*Stellaria humifusa*		1
Common chickweed	*Stellaria media*		1
Circumpolar starwort	*Stellaria ruscifolia*		1
Sitka starwort	*Stellaria sitchana*	X	1, 3, 4, 7,8
Twistedstalk	*Streptopus amplexifolius*	X	1, 7

Common Name	Scientific Name	Observed	Reference
Awlwort	*Subularia aquatica*	X	1, 3, 4, 7, 8
Common dandelion	*Taraxacum ceratophorum*	X	1, 4
Common dandelion	*Taraxacum officinale*	X	1, 4, 8
	Taraxacum officinale ceratophorum	X	7
Queen’s-veil maiden fern	*Thelypteris quelpaertensis*		1
Long beechfern	*Thelypteris connectilis*		1
False asphodel	*Tofieldia coccinea*	X	1, 7
Trichophorum	*Trichophorum caespitosum*		1
Arctic starflower	*Trientalis europaea*	X	1
	Trientalis europaea arctica	X	7
White clover	*Trifolium repens*	X	1, 7, 8
Spike trisetum	*Trisetum spicatum*	X	1, 5, 7, 8
Mountain hairgrass	*Vahlodea atropurpurea*	X	1, 7, 8
False hellebore	*Veratrum album*		1
American speedwell	*Veronica americana*	X	1, 4
Largeflower speedwell	*Veronica grandiflora*		1, 7
Thymeleaf speedwell	*Veronica serpyllifollia*	X	1, 7
Alpine speedwell	*Veronica stelleri*		1, 7
Alaska violet	*Viola langsdorffii*	X	1, 3, 4, 7
Lichens			
	Cladina portentosa pacifica	X	8
	Cetraria islandica	X	8
	Cladina sp.	X	8
	Cladonia sp.	X	8
	Stereocaulon sp.	X	8
	Thammolia vermicularis	X	8
Bryophytes			
	Hylocomium splendens	X	8
	Pleurozium schreberi	X	8

Common Name	Scientific Name	Observed	Reference
	Ptilidium ciliare	X	8
	Ptilidium crista-castrensis	X	8
	Racomitrium lanuginosum	X	8
	Rhytidiadelphus loreus	X	8
	Sphagnum sp.	X	8
	Sphagnum squarrosum	X	8

Reference:
1 - Hulten 1968
2 - Viereck and Little 1972
3 - Virginia Moran 1993
4 - Woodward-Clyde 1995a
5 - Wright 1997
6 - Tande and Lipkin 2003
7 - Frost *et al*. 2008
8 - Frost *et al*. 2010

Note:
Observed includes species collected and identified during 28 July-2 August 1993 field visit (Woodward-Clyde 1995a); by Wright (1992-96); or by ABR, Inc. - Environmental Research & Services (Boisvert and Frost) during 15-19 September 2005 field visit.
Species listed alphabetically by scientific name. Current nomenclature is taken from the Biota of North America Program database (http://www.invasivespecies.org/Bonap/index.html).

Table B2: Fish Species Found on or around Shemya Island

Common Name	Scientific Name
Sockeye salmon	*Oncorhynchus nerka*
Chinook king salmon	*Oncorhynchus tshawitscha*
Coho salmon	*Oncorhynchus kisutch*
Chum salmon	*Onchorhynchus keta*
Pink salmon	*Oncorhynchus gorbuscha*
Arctic char	*Salvelinus alpinus*
Dolly varden	*Salvelinus malma*
Arctic grayling	*Thymallus arcticus*
Alaska blackfish	*Dallia pectoralis*
Trout-perch	*Percopsis omniscomaycus*
Pacific ocean perch	*Sebastes alutus*
Slimy sculpin	*Cottus cognatus*
Irish lord	*Hemilepidotus* sp.
Halibut	*Hippoglossus stenolepis*
Flounder	*Hippoglossoides robustus*
Pacific cod	*Gadus macrocephalus*
Sable fish	*Anoplopoma fimbria*
Yellow fin sole	*Pleuronectes asper*
Walleye Pollock	*Pollachius virens*
Sandlance	*Ammodytes americanus*
Three-spined Stickleback	*Gasterosteus aculeatus*
Fourline Snakeblenny	*Eumesogrammus praecisus*
Pacific herring	*Clupea pallasi*
Arctic lamprey	*Lampetra* sp.

Sources: Gilbert 1986, Eareckson AFS personnel, Schwitters 2007, Shirley and Schwitters (2010)
Note: Species listed in phylogenic order.

Table B3: Mammal Species Observed or Potentially Occurring on or near Eareckson Air Station

Common Name	Scientific Name	Observed*
Terrestrial Mammals		
Arctic fox	*Alopex lagopus*	X
Norway rat	*Rattus norvegicus*	
Ship (roof) rat	*Rattus rattus*	X
House mouse	*Mus musculus*	
Deer mouse	*Peromyscus miniculatus*	X
Marine Mammals		
Harbor seal	*Phoca vitulina*	X
Northern fur seal	*Callorhinus ursinus*	
Northern sea otter	*Enhydra lutris kenyoni*	X
Steller’s sea lion	*Eumetopias jubatus*	X
North Pacific right whale	*Eubalena japonica*	X
Humpback whale	*Megaptera novaeangliae*	X
Sperm whale	*Phseter macrocephalus*	X
Baird’s beaked (bottlenose) whale	*Berardius bardii*	X
Stegneger’s (Bering Sea) beaked whale	*Mesoplodon stejnegeri*	X
Blue whale	*Balaenoptera musculus*	X
Fin whale	*Balaenoptera physalus*	X
Killer whale	*Orcinus orca*	X
Minke whale	*Balaenoptera acutorostrapa*	X
Dall’s porpoise	*Phocoenoides dalli*	X
Harbor porpoise	*Phocoena dalli*	X

Sources:

Schwitters 2005, 2007, 2010b
Shaw, L., National Marine Fisheries Service 1993
Shirley and Schwitters 2010
Wynne, K. 1993
Meehan 1997a, Meehan and Krom 1997, Meehan *et al*. 1996
John Martin, Maritime NWR, letter to 611 CES, May 7, 1999 (deer mouse)
Frost *et al*. 2008

Frost *et al*. 2010
USFWS 2010

* Observed by Meehan 1997a, Meehan and Krom 1997, Meehan *et al*. 1996, Micheal Schwitter (USDA - Wildlife Services) 2005 and 2007, Frost *et al*. 2008, Frost *et al*., and/or stated in USFWS (2010).

Table B4: Bird Species Observed or Potentially Occurring at Eareckson Air Station

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Whooper Swan	*Cygnus cygnus*	R	-	R	UX		2, 3, 6, 7
Tundra Swan	*Cygnus columbianus*						7
Brant	*Branta bernicla*				AX		3, 7
Taiga Bean Goose	*Anser fabalis*						7
Tundra Bean Goose	*Anser serriosterous*	R	C	-	-		1, 2, 7, 9
Greater White-fronted Goose	*Anser albifrons*				RX		3, 6, 7
Emperor Goose	*Chen canagica*	C	R	C	AX	*	1, 2, 3, 4, 5, 7, 8, 9
Snow Goose	*Chen caerulescens*						1a, 7
Brant	*Branta bernicla*						7
Aleutian Cackling Goose	*Branta hutchensii leucopareia*	U	-	Cx	RX	*	1, 2, 4, 5, 6, 7, 8, 9
Aleutian Green-winged Teal	*Anas crecca nimia*				C-AbX		3
Green-winged Teal	*Anas crecca*	C	A	Cx	RX	*	1, 2, 3, 4, 5, 6, 7, 8
Eurasian Green-winged Teal	*Anas crecca creca*						9
Baikal Teal	*Anas formosa*						4, 5, 7, 8
Falcated Duck	*Anas falcata*	-	A	-	-		1, 2, 7
Mallard	*Anas platyrhynchos*	C	C	Cx	AbX	*	1, 2, 3, 4, 5, 6, 7. 8, 9
Northern Pintail	*Anas acuta*	C	C	Cx	CX	*	1, 2, 3, 4, 5, 6, 7. 8, 9
Garganey	*Anas querquedula*	R	-	R	-		1, 1a, 2, 4, 7
Northern Shoveler	*Anas clypeata*	R	R	Rx	RX		1, 2, 3, 4, 6, 7. 8, 9
Gadwall	*Anas strepera*	-	R	-	-		1, 2, 7
American Widgeon	*Anas americana*				RX		3, 7, 8
Eurasian Widgeon	*Anas penelope*	U	C	Ux	UX		1, 2, 3, 4, 5, 6, 7, 8, 9
Common Pochard	*Aythya ferina*	R	A	A	-		1, 1a, 2, 7,

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
							9
Canvasback	*Aythya valisineria*	-	A	-	-		1, 1a, 2, 7
Redhead	*Aythya americana*						7
Tufted Duck	*Aythya fuligula*	R	C	R	R-UX		1, 2, 3, 4, 5, 6, 7, 8, 9
Greater Scaup	*Aythya marila*	C	-	C	R-UX	*	1, 2, 3, 4, 5, 6, 7, 9
Lesser Scaup	*Aythya affinis*						1a, 5, 6, 7, 9
Spectacled Eider	*Somateria fischeri*	-	-	-	R		1
Common Eider	*Somateria mollissima*	C	R	Cx	AbX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
King Eider	*Somateria spectabilis*						1a, 7
Steller's Eider	*Polysticta stelleri*	C	U	C	CX		1, 2, 3, 7
Harlequin Duck	*Histrionicus histrionicus*	C	C	Cx	AbX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
Surf Scoter	*Melanitta perspillata*						1a, 1b, 7
Black Scoter	*Melanitta nigra*	C	C	C	C-AbX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
White-winged Scoter	*Melanitta fusca*	C	C	C	RX		1, 2, 3, 5, 7, 8, 9
Common Goldeneye	*Bucephala clangula*	C	U	C	CX	*	1, 2, 3, 4, 5, 6, 7, 9
Barrow's Goldeneye	*Bucephala islandica*						1a, 7
Long-tailed Duck	*Clangula hyemalis*	C	U	C	CX	*	1, 2, 3, 5, 6, 7, 8, 9
Bufflehead	*Bucephala albeola*	C	A	C	UX	*	1, 2, 3, 4, 5, 6, 7, 9
Smew	*Mergellus albellus*	R	A	R	RX		1, 2, 3, 5, 6, 7, 9
Common Merganser	*Mergus merganser*	C	C	C	RX	*	1, 2, 3, 5, 6, 7, 9
Red-breasted Merganser	*Mergus serrator*	C	A	C	R-UX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
Rock Ptarmigan	*Lagopus muta*						5,6
Red-throated Loon	*Gavia stellata*	C	C	C	U	*	1, 1b, 2, 4, 5, 6, 7, 8, 9
Arctic Loon	*Gavia arctica*	-	R	-	-		1b, 2, 5, 7,

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
							9
Common Loon	*Gavia immer*	U	U	U	RX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Pacific Loon	*Gavia pacifica*				RX		1b, 3, 7, 9
Yellow-billed Loon	*Gavia adamsii*			R			1b, 4, 7
Horned Grebe	*Podiceps auritus*	C	U	C	R-UX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
Red-necked Grebe	*Podiceps grisegena*	U	R	U	UX	*	1,1a, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Laysan Albatross	*Phoebastria immutabilis*	C	C	C	RX		1, 1b, 2, 3, 4, 5, 7, 8, 9
Black-footed Albatross	*Phoebastria nigripes*						4, 7
Northern Fulmar	*Fulmarus glacialis*						7
Mottled Petrel	*Pterodroma inexpectata*						7
Short-tailed Shearwater	*Puffinus tenuirostris*	C	C	C	A		1, 2, 4, 5, 7. 8. 9
Fork-tailed Storm-petrel	*Oceanodroma furcata*	C	C	C	R	*	1, 2, 4, 7
Leach’s Storm-petrel	*Oceanodroma leucorhoa*	U	C	C	-	*	2, 4, 7
Pelagic Cormorant	*Phalacrocorax pelagicus*	C	C	Cx	AbX	*	1, 2, 3, 4, 5, 6, 7, 8, 9
Red-faced Cormorant	*Phalacrocorax urile*	C	-	Cx	U-CX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Grey Heron	*Ardea cinerea*						9 (4th North American Record)
Great Egret	*Ardea alba*						7
Intermediate Egret	*Egretta intermedia*						8 (1st living North American Record)
Bald Eagle	*Haliaeetus leucocephalus*				RX		3, 7, 9
White-tailed Eagle	*Haliaeetus albicalla*	R	A	R	R	*	2, 7
Steller’s Sea-eagle	*Haliaeetus pelagicus*						7
Northern Harrier	*Circus cyaneus*	-	-	A	AX		1, 1a, 2, 3, 7
Northern Goshawk	*Accipiter gentilis*						1a, 7

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Rough-legged Hawk	*Buteo lagopus*	U	U	U	-	*	1, 2, 7, 9
Eurasian Kestrel	*Falco tinnunculus*	-	-	Ax	-		1, 2, 7
Eurasian Hobby	*Falco subbuteo*	-	-	Ax	-		1, 1a, 4, 7, 8
Peregrine Falcon	*Falco peregrinus*				RX		3, 4
Peale's Peregrine Falcon	*Falco peregrinus peali*	C	U	Cx	U	*	1, 2
Gyrfalcon	*Falco rusticolus*	U	U	U	U	*	2
Common Moorhen	*Gallinula chloropus*						8 1st Alaska record and perhaps 1st North American record
Sandhill Crane	*Grus canadensis*	C	-	C	-	*	2, 4, 6, 7, 8
Northern Lapwing	*Vanellus vanellus*						4, 7
Black-bellied Plover	*Pluvialis squatarola*	C	-	C	-		1, 2, 7
Pacific Golden Plover	*Pluvialis fulva*	U	-	Ux	-		1, 2, 4, 5, 6, 7, 8, 9
Common Ringed Plover	*Charadrius hiaticula*	-	A	-	-		1a, 2, 7
Mongolian Plover	*Charadrius mongolus*	R	-	R	-	*	1, 2
Semipalmated Plover	*Charadrius semipalmatus*	-	-	A	-		1, 2, 7
Lesser Sand Plover	*Charadrius mongolus*						4,5, 7, 8, 9
Eurasian Dotterel	*Charadrius morinellus*	-	-	A	-		1, 2, 7
Black Oystercatcher	*Haematopus bachmani*						7
Black-winged Stilt	*Himantopus himantopus*						1a
Common Sandpiper	*Actitis hypoleucos*	R	U	R	-	*	1, 2, 7
Common Greenshank	*Tringa nebularia*	-	A	-	-		1, 1a, 2, 7, 9
Greater Yellowlegs	*Tringa melanoleuca*	-	A	-	-		1, 2
Lesser Yellowlegs	*Tringa flavipes*	-	A	-	-		1, 2, 7
Green Sandpiper	*Tringa glareola*	-	A	-	-		1a, 2, 7
Spotted Redshank	*Tringa erythropus*	A	-	R	-		1, 1a, 2, 5, 7, 9
Wood Sandpiper	*Tringa glareola*	U	R	R	-	*	1, 2, 4, 7, 8, 9
Wandering Tattler	*Heteroscelus incanus*	U	A	U	-	*	1, 2, 4, 7, 9

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Gray-tailed Tattler	*Tringa brevipes*	R	A	R	-		1, 2, 4, 5, 7, 8
Marsh Sandpiper	*Tringa stagnatillis*						8
Whimbrel	*Numenius phaeopus*	C	A	C	-		1, 2, 4, 7
Bristle-thighed Curlew	*Numenius tahitiensis*	-	A	-	-		1, 2, 7
Far Eastern Curlew	*Numenius madagascariensis*						1a, 7
Terek Sandpiper	*Xenus cinereus*	R	A	A	-		1, 2, 7
Black-tailed Godwit	*Limosa limosa*	A	R	-	-		1, 2, 7, 9
Bar-tailed Godwit	*Limosa lapponica*	C	R	C	-		1, 1a, 2, 5, 7, 9
Ruddy Turnstone	*Arenaria interpres*	C	U	Cx	-		1, 2, 4, 7, 8, 9
Great Knot	*Calidris tenuirostris*	-	A	-	-		1, 1a, 2
Red Knot	*Calidris canutus*	A	-	R	-		1, 2, 4, 7, 8
Sanderling	*Calidris alba*	R	-	UX	-		1, 1b, 2, 3, 7, 8
Semipalmated Sandpiper	*Calidris pusilla*	-	-	A	-		1, 2
Western Sandpiper	*Calidris mauri*	-	-	A	-		1, 2, 7
Red-necked Stilt	*Calidris ruficollis*	R	A	R	-		1, 2, 4, 7
Little Stint	*Calidris minuta*	-	A	-	-		1, 2, 7
Temminck's Stint	*Calidris temminckii*	R	A	R	-		1, 1a, 2, 4, 7
Long-toed Stint	*Calidris subminuta*	R	A	R	-		1, 1a, 2, 4, 7, 8, 9
Baird's Sandpiper	*Calidris bairdii*	R	R	U	-		1, 1a, 2, 4, 7
Pectoral Sandpiper	*Calidris melanotos*	R	-	Cx	-		1, 1a, 2, 4, 5, 6, 7, 8
Sharp-tailed Sandpiper	*Calidris acuminata*	A	-	Ux	-		1, 2, 4, 7, 8
Rock Sandpiper	*Calidris ptilocnemis*	C	C	Cx	AbX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Dunlin	*Calidris alpina*	C	C	C	U	*	1, 2, 4, 7, 8
Curlew Sandpiper	*Calidris ferruginea*	-	-	A	-		1, 1a, 2
Broad-billed Sandpiper	*Limicola falcinellus*	-	-	A	-		1, 1a, 2, 7
Buff-breasted Sandpiper	*Tryngites subruficollis*	-	-	A	-		1, 2, 4, 7, 8

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Ruff	*Philomachus pugnax*	R	-	R	-		1, 1a, 2, 4, 7, 8
Long-billed Dowitcher	*Limnodromus scolopaceus*	-	-	Ax	-		1, 2, 4, 7, 8
Common Snipe	*Gallinago gallinago*	U	U	Ux	A	*	1, 1a, 2, 4, 5, 7, 8
Red-necked Phalarope	*Phalaropus lobatus*	C	U	C	-	*	1, 2, 7, 8
Red Phalarope	*Phalaropus fulicaria*	C	U	C	-		1, 2, 4, 5, 7, 8
Pomarine Jaeger	*Stercorarius pomarinus*	C	U	C	-		1, 1a, 2
Parastitic Jeager	*Stercorarius parasiticus*	C	C	C	-	*	1, 2, 4, 6, 7, 8, 9
Long-tailed Jaeger	*Stercorarius longicaudus*	U	R	U	-	*	1, 2, 7
Black-headed Gull	*Larus ridibundus*	R	U	Ax	-		1, 2, 4, 7, 8
Black-tailed Gull	*Larus crassirostris*						7
Mew Gull	*Larus canus*	C	A	C	RX	*	1, 2, 3, 5, 7, 9
Herring Gull	*Larus argentatus*	R	-	R	R		1, 2, 4, 5, 6, 7, 8
Lesser Black-backed Gull	*Larus fuscus*						7
East Siberian Gull	*Larus vegae*						9
Slaty-backed Gull	*Larus schistisagus*	R	R	R	A		1, 2, 4, 7, 9
Glaucous-winged Gull	*Larus glaucescens*	C	C	Cx	AbX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Glaucous Gull	*Larus hyperboreus*	U	U	U	RX	*	1, 2, 3, 4, 7, 9
Black-legged Kittiwake	*Rissa tridactyla*	C	C	Cx	U	*	1, 1b, 2, 4, 5, 7, 8, 9
Red-legged Kittiwake	*Rissa brevirostris*	U	-	U	U	*	1, 2, 7
Ross's Gull	*Rhodostethia rosea*						1a
Common Tern	*Sterna hirundo*	R	U	A	-		1, 1a, 2
Arctic Tern	*Sterna paradisaea*	C	U	C	-	*	1, 2, 7, 8, 9
Aleutian Tern	*Sterna paradisaea*	U	R	U	-	*	1, 1a, 2, 4, 7, 9
Common Murre	*Uria aalge*	C	C	Cx	RX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Thick-billed Murre	*Uria lomvia*	C	C	C	RX	*	1,1b, 2, 3 7
Pigeon Guillemot	*Cepphus columba*	C	U	C	UX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Marbled Murrelet	*Brachyramphus marmoratus*	U	U	U	RX		1, 3, 8
Kittlitz's Murrelet	*Brachyramphus brevirostris*	U	U	U	RX		1, 3, 6
Ancient Murrelet	*Synthliboramphus antiquus*	C	C	C	CX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Least Auklet	*Aethia pusilla*				RX		3, 4, 7
Crested Auklet	*Aethia cristatella*	C	R	C	C	*	1, 2, 4, 7
Parakeet Auklet	*Aethia psittacula*						4, 7
Whiskered Auklet	*Aethia pygmaea*						4, 7, 8
Tufted Puffin	*Fratercula cirrhata*	C	C	Cx	U	*	1, 2, 4, 5, 6, 7, 8, 9
Common Cuckoo	*Cuculus canorus*						7
Oriental Cuckoo	*Cuculus opatuss*						7
Horned Puffin	*Fratercula corniculata*	C	U	C	U	*	1, 2, 4, 7, 8, 9
Snowy Owl	*Bubo scandiana*	R	R	R	RX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Short-eared Owl	*Asio flammeus*	C	U	C	RX	*	1, 2, 3, 6, 7, 8
White Throated Needletail	*Hirundapus caudaucutus*	-	A	-	-		1a, 2
Fork-tailed Swift	*Apus pacificus*	-	-	A	-		1, 1a, 2, 7
Great Spotted Woodpecker	*Dendrocopos major*						7
Brown Shrike	*Laninus cristatus*	-	-	A	-		1, 1a, 2, 7
Northern (Great Grey) Shrike	*Laninus excubitor*						7
Common Raven	*Corvus corax*	C	C	Cx	CX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
Sky Lark	*Alauda arvensis*	R	R	A	-	*	1, 2, 4, 5, 6, 7, 8
Horned Lark	*Eremophila alpestris*	-	-	A	-		1, 2, 7
Violet-green Swallow	*Tachycineta thalassina*	-	-	A	-		1, 2
Bank Swallow	*Riparia riparia*	-	-	A	-		1, 1a, 2, 7

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Tree Swallow	*Tachyceneta bicolor*						1a, 7
Barn Swallow	*Hirundo rustica*	-	A	A	-		1, 1a, 2, 7
Winter Wren	*Troglodytes troglodytes*	C	C	C	RX	*	1, 1b, 2, 3, 5, 6, 7
Pacific Wren	*Troglodytes pacificus*						8
Wood Warbler	*Phylloscopus sibilatrix*	-	-	A	-		1, 2, 7, 8
Dusky Warbler	*Phylloscopus fuscatus*	-	-	A	-		1, 1a, 2
Arctic Warbler	*Phylloscopus borealis*	U	U	Ux	-	*	1, 2, 7, 8
Taiga Flycatcher	*Ficedula albicilla*	-	A	-	-		1, 1a, 7
Red-breasted Flycatcher	*Ficedula parva*	-	A	-	-		1, 2
Dark-sided Flycatcher	*Muscicapa sibirica*	-	-	A	-		1, 2, 7
Gray-streaked Flycatcher	*Muscicapa griseisticta*	R	A	-	-		1, 2, 7
Bohemian Waxwing	*Bombycilla garrulus*						8
Siberian Rubythroat	*Luscinia calliope*	R	A	A	-		1, 2, 7, 8, 9
Bluethroat	*Luscinia svecica*						7
Red-flanked Bluetail	*Tarsiger cyanurus*						7
Northern Wheatear	*Oenanthe oenanthe*	R	-	R	-		1, 2, 4, 7, 8
Swainson’s Thrush	*Catharus ustulatus*						7
Gray-cheeked Thrush	*Catharus minimus*	-	-	A	-		1, 2
Eye-browed Thrush	*Turdus obscurus*	R	-	A	-		1, 2, 7, 8, 9
Dusky Thrush	*Turdus naumanii*	A	-	A	-		1, 1a, 2, 7
American Robin	*Turdus migratorius*						7
European Starling	*Sturnus vulgaris*						1a, 7
Siberian Accentor	*Prunella montanella*	-	-	A	-		1, 2
Eastern Yellow Wagtail	*Montacilla tschutschensis*	R	R	R	-		1, 2, 7
Gray Wagtail	*Montacilla cinerea*	-	R	-	-		1, 2, 7
Black-winged Wagtail	*Montacilla albalugens*	-	R	-	-		1, 2
Eastern Yellow Wagtail	*Montacilla tschutschensis*						4
White Wagtail	*Montacilla alba*						4, 6, 7, 8, 9
Olive-backed Pipit	*Anthus hodgsoni*	A	-	A	-		1, 2, 7, 8, 9
Pechora Pipit	*Anthus gustavi*						1a, 7
Red-throated Pipit	*Anthus cervinus*	R	-	R	-		1,1a, 2, 7

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Water Pipit	*Anthus spinoletta*	-	-	R	-		1, 2
American (Buff-bellied) Pipit	*Anthus rubescens*						1, 4, 7, 8, 9
Wilson's Warbler	*Wilsonia pusilla*						7
Townsend's Warbler	*Dendroica townsendi*	-	-	A	-		1, 2, 7
Yellow-rumped Warbler	*Dendroica coronata*						4, 7
Savannah Sparrow	*Passerculus sandwichensis*	-	-	A	-		1, 2, 7, 8
Song Sparrow	*Melospiza melodia*	C	U	Cx	UX	*	2, 3, 4, 5, 6, 7, 8, 9
Golden-crowned Sparrow	*Zonotrichia atricapilla*						1a, 4, 7
Dark-eyed Junco	*Junco hyemalis*						4, 7
Lapland Longspur	*Calcarius lapponicus*	C	C	Cx	A	*	1, 1a, 2, 4, 5, 6, 7, 8, 9
Little Bunting	*Emberiza pusilla*	-	-	A	-		1, 2
Gray Bunting	*Emberiza variablis*	-	A	-	-		1, 2, 7
Common Reed-bunting	*Emberiza schoeniclus*	-	A	-	-		1, 2
Rustic Bunting	*Emberiza rustica*	R	-	R	-		1, 1a, 2, 7, 8, 9
Reed Bunting	*Emberiza schoeniclus*						1, 1a, 7
Snow Bunting	*Plectrophenax nivalis*	C	-	Cx	C-AbX	*	1, 1b, 2, 3, 4, 5, 6, 7, 8, 9
McKay's Bunting	*Plectrophenax hyperboreus*						7
Brambling	*Fringilla montrifringilla*	R	-	Rx	-		1, 2, 4, 6, 7, 8, 9
Aleutian Rosy Finch	*Leucosticte arctoa*	C	U	C	U-CX	*	1, 2, 3
Gray-crowned Rosy-finch	*Leucosticte tephrocotis*						1, 1b, 4, 5, 6, 7, 8
Common Rosefinch	*Carpodacus erythrinus*	R	A	A	-		1, 1a, 2, 7, 8, 9
Common Redpoll	*Corduelis flammea*	C	A	Cx	RX	*	1, 1a, 2, 3, 4, 5, 6, 7, 9
Hoary Redpoll	*Carduelis hornemanni*	U	A	U	C		1, 2, 4
Oriental Greenfinch	*Carduelis sinica*	-	-	A	-		1, 2
Pine Siskin	*Carduelis pinus*				RX		3, 7
Oriental Greenfinch	*Carduelis sinica*						1, 1a, 7
Eurasian Bullfinch	*Pyrrhula pyrrhula*	-	-	A	-		1, 2, 7, 9

Common Name	Scientific Name	Spring	Summer	Fall	Winter (Obs)	Breeding ^	Reference
Pine Grosbeak	*Pinicola enucleator*						6, 7
Hawfinch	*Coccothraustes coccothraustes*						1b, 6, 7

Species listed in phylogenetic order.

Season Codes:
Ab - Abundant
C - Common
U - Uncommon
R - Rare
A - Accidental

Note:
When there were discrepancies, winter abundance ratings by Reference 3 were used.

1 - Gibson 1981
1a - Gibson and Byrd 2007
1b – Byrd and Scharf 2003
2 - Zeillemaker 1987
3 - Meehan 1997a, Meehan and Krom 1997, Meehan *et al.* 1996
4 - Schwitters and Martinka 2006 (all observed)

* Observed:
"X" indicates observed during one or more of the three winter surveys by Meehan 1997a, Meehan and Krom 1997, Meehan *et al*. 1996.

"x" indicates observed during fall fieldwork by ABR, Inc. - Environmental Research & Services (Boisvert and Frost) 2005.

^ Breeding:
Nesting status may be much reduced at the present time due to predators, particularly Arctic fox. The species is, at least, known to breed on other Aleutian Islands near Eareckson AS.

Note: Below references 5-9 do not include observation times, abundance ratings, or breeding status due to differences in methodologies prior to these reports. Thus, the presence of references 5-9 in the Reference column above denotes "observed." Original reports provide additional information on abundance, timing, and breeding status.

5 - Frost *et al*. 2008 (all observed)
6 - Frost *et al*. 2010 (all observed)
7 - Schwitters 2008 (all observed)
8 - Schwitters 2010 (all observed)
9 - Shirley and Schwitters 2010 (all observed)

Appendix 3.0 - Salmon. King Salmon Airport

3.0 Installation Overview

3.1 Location and Area

The state-owned airport at King Salmon and the adjacent USAF installation, King Salmon Airport are located on the northwestern section of the Alaska Peninsula along the Naknek River between Naknek Lake and Kvichak Bay, 15 miles east of the town of Naknek, 290 air miles southwest of Anchorage (INRMP Figure 3.1). The Naknek River lies to the south of the installation; Eskimo Creek flows through the central portion; and King Salmon Creek lies to the northwest (Figure 3.1). King Salmon Airport is accessible only by air or water and is adjacent to the Katmai National Park.

King Salmon Airport occupies 927 acres in the King Salmon area. This includes acreage that is adjacent to the airport, north of the commercial area of King Salmon, and other outlying areas that are leased from the State of Alaska or the U.S. Department of Interior (Figure 3.1). The cantonment (industrial and community area) is situated on a small plateau that is separated from the industrial area by Eskimo Creek. The base utilizes and maintains the 8,500-foot by 150-foot primary runway, 11-29, a Class B facility, but does not operate from the sub-standard crosswind runway, 18-36. Bristol Bay Borough uses a former military security police building via a lease arrangement.

The installation also has land holdings at two remote areas, Rapids Camp and Lake Camp. These 611 ASG sites (Naknek Recreation Annex 1 and Naknek Recreation Annex 2, respectively) are discussed separately, as excess sites, in this INRMP.

King Salmon Airport includes 16 separate parcels are located in four general areas (Figure 3.1). The base is surrounded by native corporation lands, private and state lands, airfield facilities, aviation clear zones, and natural waterways/drainages. King Salmon Airport is not clearly oriented to a main gate or ordered cantonment area and is open to public access/thoroughfare 24 hours a day. Security fencing is in place around most priority assets, and a 24-hour security patrol covers the installation.

The physical plant of the base includes several structures built in the 1940s and 1950s scattered over a large functional area. Some structures have historical significance at King Salmon Airport. A Historic Buildings Inventory and Evaluation resulted in 11 buildings and structures forming a discontinguous historic district, which was determined eligible for inclusion in the National Register of Historic Places (U.S. Air Force 2000a).

3.2 Installation History

Land development at King Salmon began in the 1930s when an air navigation silo was built. King Salmon Airport was constructed by the Civil Aeronautics Authority in 1941. Then known as Naknek, the field was turned over to the Army, which expanded the facilities and used the base as an advance staging base and refueling stop for aircraft traveling to and from the Aleutian Islands. In 1944 the airfield was officially activated as Naknek Army Air Base (Earth Technologies Corporation 1998).

Naknek AFB became a forward operating base in 1950 and interceptor deployments began in 1952. Also in 1952, one of the 10 original permanent aircraft control and warning sites was completed at Naknek. In 1954 Naknek AFB was renamed King Salmon Airport. Additional facilities, including dormitories, alert hangar, fuel storage facility, new taxiways, and a parking apron, were completed in January 1955, and additional improvements were made from 1955 through 1959. The radar mission has continued and was upgraded to a minimally-attended radar in 1980.

Following World War II, the Army returned the airport to the Civil Aeronautics Authority, which transferred control to the Alaska Department of Transportation and Public Facilities in 1959. The State continues to operate the airport today. The USAF has contracts with the State for runway maintenance, while the USAF performs runway surveys and crack sealing.

Communications between King Salmon and the rest of Alaska improved in 1957 when the site became part of Alaska’s White Alice Communications System. This Air Force system operated until 1979 when the Alaska Air Command abandoned the White Alice Communications System network in favor of more modern and reliable satellite communications circuits. The Ground Controlled Intercept mission ended with activation of the Alaska North American Air Defense Region Operations Control Center at Elmendorf AFB in 1983. However, installation of the minimally attended radar in 1984 continued the alert mission until 29 April 1994 when the last 24-hour alert by F-15 aircraft ended..

Several different fighters have stood alert at King Salmon. The first aircraft to go on alert were F-80s of the 57th Fighter Wing in September 1948. The 317th Fighter Interceptor Squadron brought F-102 Delta Daggers to King Salmon in 1956. A detachment of NORAD F-106s on rotational alert augmented the Delta Daggers in 1963. The F-4E Phantom-equipped 43rd Tactical Fighter Squadron went on alert in October 1970. The Phantoms guarded Alaskan skies for a dozen years until the 21st Tactical Fighter Wing converted to the F-15 Eagle in 1982. Eagles stationed at King Salmon scrambled to intercept many Soviet aircraft in the Alaskan Air Defense Identification Zone.

In July 1985 the 5071st Air Base Squadron was redesignated the 5071st Combat Support Squadron. In September 1991 the 5071st was redesignated the 643rd Support Squadron and was realigned under the 11th Air Control Wing.

In 1994 the installation was drawn down to its current support status. Responsibility for maintaining the facility was transferred to the 611 ASG. Formerly staffed by 300 military, civil service and contractor personnel, the facility is now maintained by 30 personnel. The State of Alaska runs the airport.

3.3 Military Mission

The mission at King Salmon Airport is a major support for Air Force activities in Alaska. It provides an emergency divert location for aircraft, backup for Elmendorf AFB operations and a staging base for deployments and USAF operations in the region. The USAF conducts quarterly exercises at King Salmon Airport. However, military aircraft are no longer routinely stationed there.

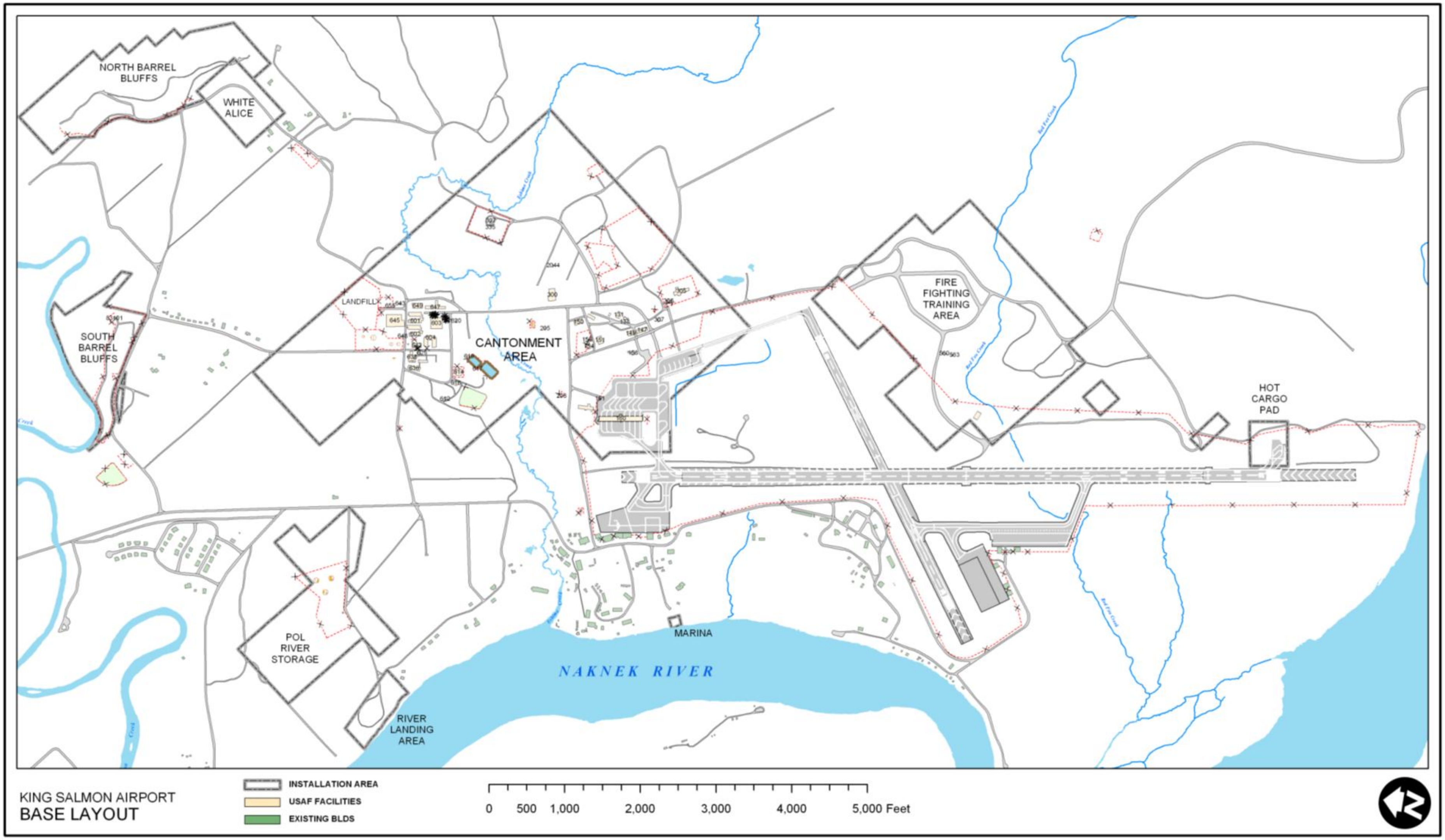
An operations and maintenance contract is used to provide manning for King Salmon Airport operation, maintenance, and support. There are no USAF military or civilian personnel permanently stationed at King Salmon Airport, a major departure from pre-1994 drawdown when the installation supported about 300 personnel.

3.4 Surrounding Communities

The community of King Salmon lies within Bristol Bay Borough, Alaska’s first borough, and is known as the *Gateway to Katmai National Park* as well as the *Red Salmon Capital of the World*. Naknek is 15 miles west of King Salmon. It is located in southwestern Alaska at the head of Kvichak Bay, an arm of the larger Bristol Bay. Bristol Bay Borough encompasses some 1,200 square miles and includes a portion of Kvichak Bay and Naknek Lake.

Figure 3.0 Aerial View of King Salmon Airport and Surrounding Area (2001)

Figure 3.1 King Salmon Airport Layout



The population of King Salmon is 374, and the population of Naknek is 544 (2010 data) (www.dced.state.ak.us 2012). The population increases tenfold each summer with the influx of tourists and personnel of the fishing industry (Chugach Development Corporation undated).

Within the Borough are three principal communities: Naknek, South Naknek, and King Salmon. The community of Naknek is the seat of government for Bristol Bay Borough and contains Borough offices, state offices, a U.S. Post Office, a district school office, and emergency service operations and facilities. King Salmon is the regional transportation center as well as site of the USAF facility. It is headquarters for a variety of air services and airlines, a U.S. Post Office, Federal Aviation Administration (FAA) operations/facilities and air traffic control, National Weather Service, USFWS Alaska Peninsula/Becharof NWR Complex and King Salmon Fishery Assistance Office, National Park Service (NPS) Katmai National Park and Preserve and Aniakchak National Monument and Preserve, State agency offices/facilities, and the Lake and Peninsula School District office.

State, federal, and local entities that own land in the King Salmon area include the Paug-Vik Native Corporation, Bristol Bay Borough, State of Alaska, USAF, USFWS, NPS, and BLM. The Paug-Vik Native Corporation holds ownership to much of the private land surrounding the base.

The economy of the Borough is based on the salmon industry in Naknek and federal, state, and Borough government activities. The economy is considered stable, with varying seasonal fluctuations depending upon the size of the annual fish harvest. Since the Borough lacks typical state resources (oil, gas, coal, minerals, and timber), it must plan carefully around one primary resource - salmon. The Bristol Bay fishing season is short, with the majority of the salmon being caught in a span of three weeks, generally in late June and early July. The employment activity is intense, and most of the labor force comes from outside the Bristol Bay Borough.

Government agencies (*i.e*. FAA, USFWS, NPS, and U.S. Post Office) offer the largest number of year-round employment opportunities and are an important economic source to residents. Tourism is also an important industry for the King Salmon area. Nearby Katmai National Park has experienced a continuing increase in visitation over the years. Park visitors often use King Salmon hotels or transportation services. Many more people visit this area to view and hunt wildlife, fish, raft rivers, and follow other recreational pursuits outside of NPS lands, creating, in total, an industry which rivals the commercial fishery in terms of economic importance. Other employment sources include the State of Alaska, flying services, construction, rental services, guided hunting and fishing, and game trapping.

3.5 Regional Land Use

Evidence of human presence in the Naknek area dates to the last glaciation, approximately 9,000 years ago (Earth Technology Corporation 1998). Many prehistoric archaeological sites are situated along the Naknek River. One site in particular is at the end of King Salmon's main runway, between the runway and the river bank. The site was excavated in 1973, and remains of a house and other artifacts, estimated to be 1,500-2,000 years old, were discovered.

Eskimo shelters dating back to the early 1900s have been found on the banks of Eskimo Creek. Other local prehistoric sites have been identified on the bank of the Naknek River across from the mouth of King Salmon Creek and upstream on the Naknek River in the vicinity of the confluence of Big Creek. Other prehistoric sites are scattered along the banks of the Naknek River between Kvichak Bay and Naknek Lake. These sites are estimated to date back 2,000 years or more.

European exploration of the area began in the late 18th Century. In 1778 Captain James Cook named Bristol Bay in honor of Admiral Earl of Bristol. In the early 1800s Russia attempted to establish the first permanent station on the Naknek River, bringing Russian Orthodoxy to the region about 1830. In 1867 the United States purchased Alaska, and American commercialism began replacing Russian trade. The region was used as a shortcut to gold in the Arctic, and a commercial salmon fishery was established (Earth Technologies Corporation 1998).

Three of the largest landowners in the King Salmon area are the federal government, the State of Alaska, and Paug-vik, Inc. (Naknek's native village corporation). The State of Alaska claimed 156 acres for the King Salmon Airport and 12.55 acres on the Naknek River for use by the ADFG. The USFWS owns 5.46 acres on the Naknek River adjacent to the parcel occupied by the ADFG. The NPS has a King Salmon office situated on 11.43 acres. Much of the land is owned by the federal government for use by the USAF and FAA.

The Alaska Native Claims Settlement Act (ANCSA) of 1971 does not acknowledge the Alaska Native Village of King Salmon as a Tribal entity. Consequently, a native village corporation has not been established for King Salmon. Approximately 24 Alaska Native allotments are near King Salmon Airport. Interim conveyance and patents to land around King Salmon have been provided to PaugA-vik, Inc., an Alaska Native corporation, which owns the land occupied by the radar installation and leases the property to the USAF.[1]

Pursuant to the Native Allotment Act of 1906, the Secretary of the Interior may provide up to 160 acres of land to individual natives with the stipulation that the claimant occupies and uses the allotment continuously. By 1982 natives had filed 24 active claims and two patented claims near King Salmon. With the passage of ANCSA, new claims were not accepted between 1971 and 1982. Provision for the approval of pending claims was established by the ANILCA in 1980. Claims are not under ANILCA in cases where protests have been filed. Certificates of claim approval are issued when claims are officially surveyed (Alaska Department of Community and Regional Affairs 1982).

3.6 Local and Regional Natural Areas

Katmai National Park and Preserve, located east of King Salmon, was originally created as a National Monument in 1918 to preserve the famed Valley of Ten Thousand Smokes, a spectacular 40 square mile, 100-700 foot deep ash flow deposited by Novarupta Volcano. Katmai was designated a National Park and Preserve in 1980. North-central and northwestern portions of the Katmai are commonly termed "*the lake region*." Naknek Lake is the principal part of the hydrologic system of lakes, ponds, rivers, streams, and marshes formed in valleys dammed by glacial deposits. The southwestern portion of the Katmai is part of the Bristol Bay coastal plain, with relatively flat terrain and many poorly drained lakes. Katmai National Park and Preserve is still famous for volcanoes, but also for brown bears (almost 100 bears visit Brooks River), pristine waterways with abundant fish, remote wilderness, and rugged coastline. One of the primary purposes of Katmai is to protect habitats for the populations of fish and wildlife, including, but not limited to, high concentrations of brown bears and their denning areas, and maintain unimpaired the watersheds and water habitat vital to red salmon spawning (www.nps.gov 2007).

Becharof NWR, located south of Katmai National Park, is a land of contrasts from its rugged coastline to the 4,835-foot summit of the Mount Peulik volcano. The Bristol Bay side of the refuge consists primarily of flat to rolling tundra, lakes, and wetlands. From these coastal lowlands, the land rises to steep glaciated mountains and then plunges to steep cliffs and sandy beaches on the Pacific side. However, the biological heart of the refuge is Becharof Lake. Becharof Lake is huge: 35 miles long, 15 miles wide, and as much as 600 feet deep. This, the second biggest lake in Alaska and the largest in the NWR system, is a veritable salmon factory. It is estimated that Becharof Lake and its tributaries provide the Bristol Bay fishery alone with as many as six million adult salmon per year (USFWS 2007a).

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[1] Memorandum for Portage, from 611 CES/CEVR (David O. Hertzog), Subject: Review of the Technical Draft King Salmon, Naknek and South Naknek Native Village Site Assessment Report, King Salmon, Alaska. 26 Oct 98.

The BLM released the Bay Resource Management Plan/Final Environmental Impact Statement (BLM 2007) for the Bay planning area in southwest Alaska. The Bay Plan will provide management for 1.9 million acres of BLM-administered public land and resources in the Bristol Bay and Goodnews Bay areas of Alaska. The Bay Plan/Final Environmental Impact Statement is a good source of information regarding the physical and biological environment of southwest Alaska.

4.0 PHYSICAL ENVIRONMENT

4.1 Climate

The King Salmon area's climate is predominantly maritime, characterized by cool, humid, and windy weather. Occasional continental climatic influences cause temperature extremes. Average summer temperatures range from 42º F to 64º F with highs in the 80s. Average winter temperatures range from 29º to 44º F. The highest temperature ever recorded at King Salmon was 88º F in 1953; the lowest -48º F in 1989 (www.weather.com). Table 4.1 shows monthly climatology for King Salmon.

Table 4.1 Monthly Climate Averages for King Salmon, Alaska

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	24ºF	27ºF	33ºF	42ºF	54ºF	61ºF	64ºF	63ºF	56ºF	41ºF	31ºF	26ºF
Average Low	9ºF	11ºF	16ºF	25ºF	35ºF	42ºF	47ºF	47ºF	40ºF	26ºF	15ºF	11ºF
Mean	17ºF	19ºF	25ºF	34ºF	45ºF	52ºF	56ºF	55ºF	48ºF	34ºF	23ºF	19ºF
Record High	53ºF (1963)	57ºF (1991)	59ºF (1934)	69ºF (2005)	85ºF (2006)	88ºF (1953)	86ºF (1951)	84ºF (1968)	75ºF (1933)	67ºF (1954)	56ºF (1986)	50ºF (2007)
Record Low	-48ºF (1989)	-43ºF (2006)	-42ºF (1971)	-19ºF (1956)	4ºF (1945)	27ºF (2006)	33ºF (1986)	25ºF (1984)	15ºF (1983)	-12ºF (1983)	-28ºF (1988)	-38ºF (2001)
Average Precipitation	1.02 inches	0.78 Inches	0.70 inches	0.97 inches	1.25 inches	1.65 inches	2.30 inches	2.05 inches	3.19 inches	2.08 inches	1.39 inches	1.323 inches

Source: www.weather.com (January 16, 2012)

Total precipitation averages about 20 inches annually, including an average snowfall of 44.7 inches. Cloud cover averages 75.8 percent year-round. Moisture-carrying winds from the southwest create fog, especially during July and August.

Winter winds, which blow predominantly from the north, have average velocities of 9.4-10.9 miles per hour (mph). Winds occasionally reach speeds of 80 mph. Summer winds blow from the south/southwest and average 9.7 to 10.6 mph. The overall wind speed averages 10.2 mph. Calm wind conditions occur only 5.1 percent of the time.

4.2 Landforms

The King Salmon area lies on poorly drained lowlands northwest of the Aleutian Range (EMCON Alaska, Inc. 1995a), specifically in the Nusahgak-Bristol Bay lowland section of the Coastal Western Alaska physiographic province. The area exhibits characteristics of past intense glaciation during Pleistocene time. Glaciated zones are bounded by well defined moraines with little gully development along morainal ridges. Details of erosional relief are preserved; kettle holes contain lakes; and most area drainage is not integrated. Ground surface elevations on King Salmon Airport range from 30 feet above msl along banks of Eskimo Creek to 68 feet above msl within the central portion of the base headquarters area.

4.3 Geology and Soils

The King Salmon area consists mostly of low moraine hills with many shallow lakes. Natural erosion has drained some lakes, and only the beds remain. A high terrace borders much of the Naknek River and is separated from it by an escarpment ranging from 50 to 100 feet in height. In some places, sand dunes occur above the escarpment; they are generally stable and fully vegetated (HQ AAC/DEPV 1988).

Upland areas bordering or overlooking King Salmon Airport consist of glacial moraine and drift materials; mixed, unsorted, and generally unstratified clay; silt; sand; gravel; cobbles; and boulders arranged in a conspicuous arcuate pattern, usually about large area lakes. The entire King Salmon area is reportedly underlain by at least 315 feet of glacial outwash plain sediments (SAIC 1993a). Sediments include stratified silt, sand, and clay deposits. Marine deposits appear to be interlayered with terrestrial materials near the lower extent of the sequence.

Soils of the King Salmon area generally consist of glacially deposited interbedded sands and gravels overlain by a 3- to 4-foot layer of volcanic ash and silty sand. The top 2-4 inches consist of a tough, fibrous, organic layer. Permafrost is discontinuous and usually only occurs at considerable depth. The area has moderately well-drained to well-drained soils in predominantly flat terrain with some low-gradient slopes.

A detailed soils mapping of the King Salmon-Naknek area was completed by the Natural Resources Conservation Service, U.S. Department of Agriculture, in 1968 (Furbush and Wiedenfeld 1968). This survey included approximately 40 square miles of land, mostly on the north side of the Naknek River between the mouth of the river and the village of King Salmon. An area in the vicinity of South Naknek, south of the river, was also included. This survey was not inclusive of King Salmon Airport USAF lands. However, data were extrapolated due to its adjacent location. Described below are the five soil series identified in the King Salmon-Naknek area survey.

Kvichak Series. The Kvichak Series consists of well drained soils formed in volcanic ash over strata of loam, sandy loam, and sand. Soils are strongly acidic throughout the profile. A typical profile has a thin layer of comparatively recent volcanic ash at the surface, thick dark upper horizons, and a dark grayish brown to dark reddish brown stratified subsoil. A thick deposit of waterworked sand underlies the soil.

These soils occur on terraces bordering the Naknek River and other streams and on some low hills and areas bordering small lakes. Slopes range from 0 to 30 percent but are predominantly less than seven percent. Included in mapping units are areas of Naknek soils that were too small to delineate separately and, usually close to the boundary with the Naknek soils, areas of unnamed moderately well drained soils. These well drained, medium-textured soils are subject to wind and water erosion.

The erosion potential is high for disturbed steeper slopes (greater than 20%) and low to moderate for lesser slopes (personal communication, J. Moore in Woodward-Clyde 1995b). Soils are classified as a Group 1 soil by the revegetation guide.

Naknek Series. The Naknek Series consists of poorly drained, perennially frozen soils with thick peaty surface mats and mottled dark brown upper mineral horizons. The upper part of the mat is commonly sphagnum moss peat, but the lower part is dominantly sedge peat. The mineral soil is composed of volcanic ash. The upper level of permafrost is usually within a few inches of the boundary between the organic mat and the mineral soil.

Naknek series soils are the principal soils of the tundra-covered low hills in the area. Slopes range from zero to seven percent but are predominantly less than three percent. In many places Naknek soils border well-drained Kvichak and Pustoi soils. Very small areas of these soils are included in mapping units. Small marshy areas are also included in places. The thickness of the peaty mat ranges from 14 to 24 inches. It may contain thin layers of volcanic ash. The lower part of the mat may consist of finely divided organic matter. The A horizon usually has a loam or silt loam texture but ranges from mucky silt loam to sandy loam. The C horizon is usually a loam, but it may be sandy loam or sandy clay loam.

The erosion potential is considered low for this soil (personal communication, J. Moore in Woodward-Clyde 1995b). This soil is classified as a Group 5 soil within the revegetation guide.

NK Series. The NK Series consists of poorly drained, mottled brown and olive gray loam, sandy loam, and silt loam. The soils have, at most, a very thin organic mat at the surface and are strongly acid. They are probably perennially frozen at depths greater than 42 inches, but because of the absence of a thick surface mat of organic material, they thaw to at least that depth in summer. NK soils occupy beds of naturally drained thaw lakes. Slope gradients are generally less than one-half percent. NK soils are not extensive and are generally closely associated with Naknek soils. The texture of the soil ranges from sandy loam to sandy clay loam or silt loam.

The erosion potential is considered low for this soil (personal communication, J. Moore in Woodward-Clyde 1995b). This soil is classified as a Group 5 soil within the revegetation guide.

Pustoi Series. The Pustoi Series consists of well drained soils in sandy volcanic materials. Typically, the soil consists of a thin upper horizon of dark grayish brown or reddish brown silt loam over layers of dark brown loamy sand and sand and a grayish brown sandy substratum. The soils are very strongly acidic.

These soils occur on stream terraces and valley sides. Slope gradients range from zero to 12 percent but are dominantly less than seven percent. Low dunes and small blowout areas are fairly common. Thin lenses of volcanic ash occur near the base of the organic surface layer. The silt loam layer at the top of the mineral profile ranges in thickness from one to seven inches. This silty lense may occur deeper in the profile. In a few places gravelly silt loam glacial till makes up the lower part of the soil.

Pustoi soils have low water-holding capacity and are subject to drought in dry years. They are also highly susceptible to soil blowing. The water erosion potential is considered low to moderate for this soil (personal communication, J. Moore in Woodward-Clyde 1995b). This soil type is classified as a Group 2 soil by the revegetation guide.

Tolsona Series. The Tolsona Series consists of poorly drained sandy soils with shallow permafrost tables. A typical profile has a fairly thick organic mat at the surface over mottled dark grayish brown and olive gray sand. Some fine gravel occurs at depths of about 12 inches, and the proportion may increase with depth. The soils are perennially frozen at about six inches below the surface of the mineral soil. They are very strongly acidic.

These soils occur on flood plains of streams draining into the Naknek River and in narrow outlet channels in hilly areas. Slope gradients are generally less than one percent. Most areas are interrupted by stream channels, abandoned channels, and oxbow-lakes. The surface organic mat ranges in thickness from six to 16 inches. The depth to permafrost ranges from four to 24 inches from the mineral surface. Depth to gravel and proportion of gravel are variable.

The erosion potential is considered low for this soil (personal communication, J. Moore in Woodward-Clyde 1995b). This soil is classified as a Group 5 soil within the revegetation guide.

4.4 Hydrology

4.4.1 General

The area surrounding King Salmon Airport is characterized by glaciated zones bounded by well defined moraines, with some gully development along morainal ridges. Many kettle basins containing lakes are present throughout the area. Most area drainage is not fully integrated.

The surface drainage pattern of King Salmon Airport is complex with a 3,600-mile^2 watershed (EMCON Alaska, Inc. 1995a). Water flowing from the extreme southeastern end of the main runway drains to an unnamed tributary and then to the Naknek River. Runoff flowing from the central airfield area and airfield support facilities is directed to Red Fox Creek and then to the Naknek River. Drainage originating in installation industrial and administrative areas is generally directed to Eskimo Creek and then to the Naknek River. The Naknek River is a principal drainage feature of the Katmai National Park. Flooding in the King Salmon area is usually restricted to the river floodplain and does not impact base operations (Woodward-Clyde 1995b). The tidal effect extends six miles beyond King Salmon Airport (EMCON Alaska 1995a).

Groundwater at King Salmon occurs in three aquifers. A near-surface shallow aquifer is present under unconfined conditions. This aquifer is comprised of moderately well sorted sands and silty sands with discontinuous areas that contain coarse gravel. The thickness of the water-bearing interval typically varies from 5 to 15 feet. Hydraulic conductivity within the unconfined aquifer averages about 350 feet/day with values ranging from 15 to 1,370 feet/day (SAIC 1993a).

A confined intermediate aquifer lies below the upper aquitard at depths ranging from 60 to 80 feet. Data relative to this aquifer are limited, but thickness appears to vary from 15 to 40 feet. The intermediate aquifer is characterized by interbedded sequences of silty sands, sandy gravels, and silty sandy gravels (SAIC 1993a).

A second aquitard is present at the base of the intermediate aquifer. The thickness of this second aquitard is estimated between 10 and 20 feet. Beneath the intermediate aquifer and second aquitard is a third aquifer, approximately 200 feet below ground surface, which is generally referred to as the “deep” aquifer (SAIC 1993a).

King Salmon Airport obtains its water supplies from two 200+-feet deep wells constructed into the glacial outwash of the upper Alaska Peninsula. The glacial outwash (and/or alluvium) is both a shallow aquifer that occurs at or near land surface and an aquifer of regional significance, capable of furnishing large quantities of good quality water to numerous consumers. Groundwater may be contained in these units under both water table and artesian conditions. Several other water wells are used at the installation to furnish local water supplies or for standby fire protection.

The community of King Salmon and King Salmon Airport also derive their water supplies from glacial outwash deposits. King Salmon Airport wells tend to be deeper than community water supply wells. Community wells are also located in a position thought to be hydraulically downgradient from the base, along the Naknek River floodplain. The number of wells is uncertain.

4.4.2 Flood Plains

Lands at King Salmon Airport are above the 100-year flood plain except for the Eskimo Creek valley. Eskimo Creek is not gauged; therefore, there is no record of its flood heights. However, the creek is well-incised, and all flood waters would be contained within its banks for that portion of the creek within installation boundaries (Legare 1998).

Eskimo Creek divides community from industrial areas. Sewer, water, and power are supplied to the industrial area from the community area, crossing Eskimo Creek in a utilidor, an enclosed bridge-like container for lines. The utilidor restricts the bridge's capacity at high flows. This would not cause significant upstream flooding, but increased turbulence during flooding would increase the erosion threat to the utilidor and road embankment (Legare 1998). The King Salmon Airport flood plain map is in *Flood Plain Identification, Forward Operating Bases, Eareckson Air Station, Galena Airport, King Salmon Airport, Alaska* (U.S. Army Corps of Engineers 1998).

5.0 ECOSYSTEMS AND THE BIOTIC ENVIRONMENT

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to King Salmon Airport. Much information included in INRMP Chapter 5.0 that includes King Salmon airport is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on King Salmon Airport and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at King Salmon Airport are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 126 Bering Tundra (Southern) Province
Description: This is a moraine- and outwash-mantled lowland province that rises from sea level to heights of 300-500 feet. Winters are cold, and summers are cool and short. Average precipitation is 13-34 inches. Dominant vegetation is moist and wet tundra communities. Inceptisols are dominant soils of the province; permafrost is sporadic or absent.

5.2 Vegetation

The King Salmon area has relatively few trees, and most plants are low-growing and small. The moist tundra, a tussock community with a complex plant association, is characterized by a variety of shrubs, herbs, grasses, and sedges, rooted in a continuous mat of lichens and mosses.

Grasses and sedges are found in depressions while crowberry, dwarf birch, several willow species, and blueberry are on raised hummocks and hills. In summer the tundra blooms with monkshood, lousewort, buttercup, lupine, fireweed, and other wild flowers. A wooded area in the western corner of King Salmon Airport is the only sizable area of undisturbed forest remaining. This area consists of spruce forest with a thick understory of cranberry and lichen. This area provides habitat for forest bird species, such as flycatchers and juncos, and forage and cover for moose and caribou.

The area north of the road and northwest of the POL tanks consists of disturbed grassland with scattered willow, dwarf birch, and lupine. Large areas of the Airport are planted with grass or devoid of vegetation and covered with gravel. Domestic grasses occur throughout the housing area.

Woodward-Clyde (1995b) identified and mapped general vegetation types of King Salmon Airport for the draft Natural Resources Plan. Significant improvements in vegetation mapping at King Salmon Airport were accomplished in 2005 (using 2001 digital aerial photography) with the preparation of a wildlife habitat map (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2008) (Frost *et al*. 2005b) and flora and fauna surveys.

Wells *et al*. (2010) updated this mapping and data analysis for King Salmon Airport using 2006 QuickBird aerial photos. Table 5.2 shows changes in acreage between 2002 and 2006-2007. Figure 5.2a shows these habitat classes for 2006-2007. Figure 5.2b shows habitat changes between 2002 and 2006-2007. Area figures are for the USAF property and surrounding area considered to be influenced by the King Salmon Airport.

Table 5.2 Area of Habitat Classes and Differences between Years in Habitat Classes Mapped from 2001 and 2006/2007 Imagery, King Salmon Airport

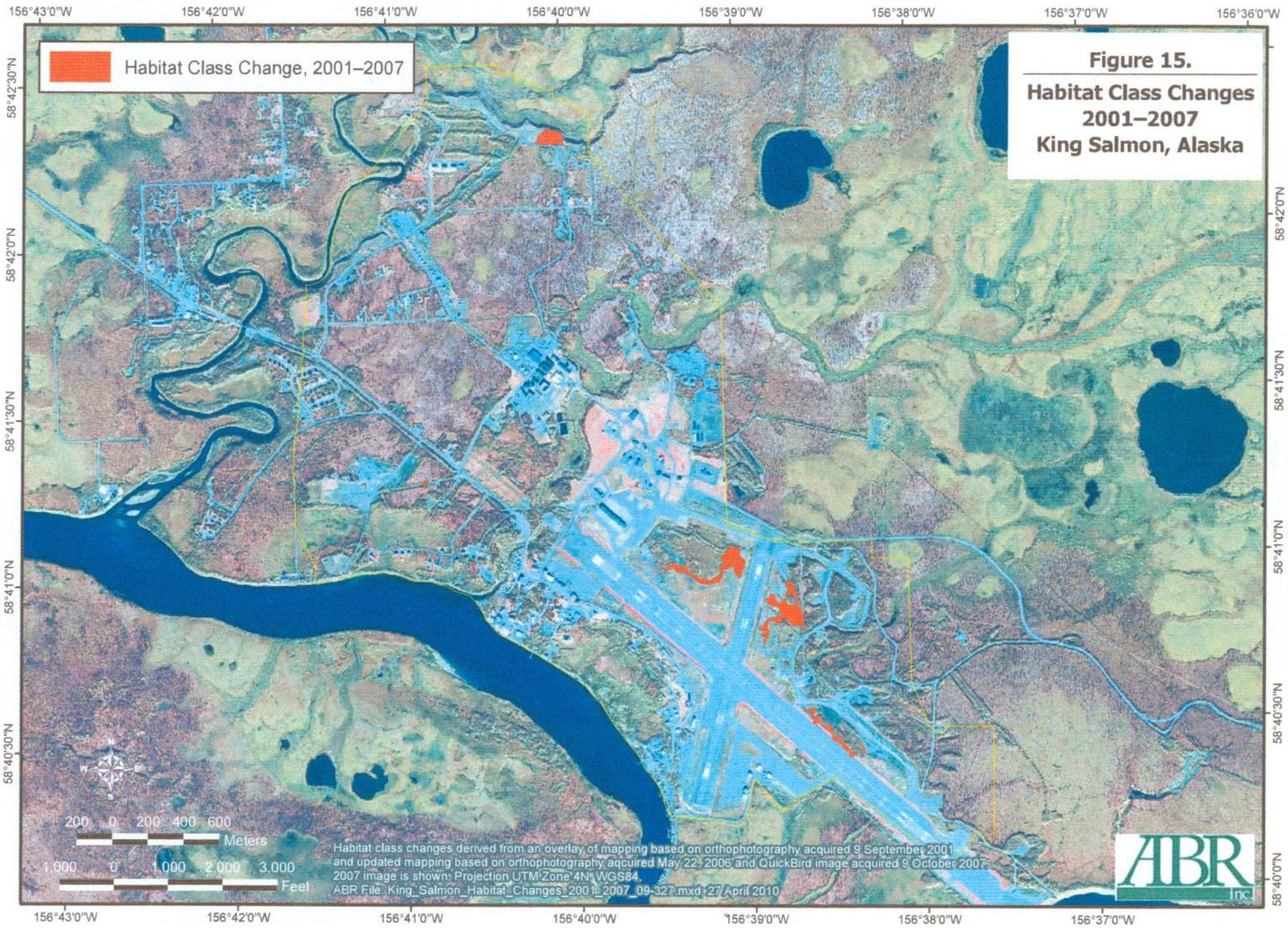
Habitat Class	Acres 2001	Acres 2006/2007	Acreage Change
Artificial (including Artficial Barrens, Artificial Partially Vegetated, and Artificial Vegetated for 2006/2007)	909.9	926.2	+16.3
Lacustrine Water	0.7	0.7	0.0
Lowland Aquatic Marsh	27.9	27.9	0.0
Lowland Dwarf Scrub	30.3	30.3	0.0
Lowland Low Open Scrub	60.0	60.0	0.0
Lowland Paper Birch Forest	25.7	25.7	0.0
Lowland Tall Open Shrub Swamp	25.7	25.7	0.0
Lowland Wet Sedge Tundra	18.2	18.2	0.0
Riverine Aquatic Sedge Marsh	3.0	3.0	0.0
Riverine Low Open Willow-Graminoid Scrub	9.3	9.3	0.0
Riverine Moist Bluejoint-Herb Tundra	48.4	48.4	0.0
Riverine Open Paper Birch-Balsam Poplar Forest	12.2	12.2	0.0
Riverine Tall Open Alder-Willow Scrub	2.1	2.1	0.0
Rivers	3.6	3.6	0.0
Upland Dry Graminoid Tundra	18.9	16.4	-2.5
Upland Dwarf Mixed Shrub-Tussock Scrub	20.2	20.2	0.0
Upland Low Open Scrub	43.6	46.1	+2.5
Upland Mixed Forest	169.9	169.9	0.0
Upland Moist Grass-Herb Tundra	3.2	3.2	0.0
Upland Paper Birch Forest	90.0	89.9	-0.1
Upland Tall Scrub	147.4	131.4	-16.0
Upland White Spruce Woodland	430.5	430.2	-0.2
Totals	**2,092.2**	**2,092.2**	**0.0**

A 2,092-acre area at King Salmon Airport was mapped (Wells *et al*. 2010). This area included the installation (696 acres) and 1,245 additional acres along King Salmon River, which included parts of the town of King Salmon (Figure 5.2a). The area has some incised river and stream channels with locally steep slopes. Two particular areas of interest at King Salmon Airport in this riverine physiography type were the North and South Bluffs in the northern section of the installation.

Artificial habitats, including structures, roads, and regularly-manipulated vegetation, such as runway rights-of-way, comprise 926.2 acres, representing 44.3% of the mapped area. The most predominant wildlife habitat in the King Salmon Airport area is Upland White Spruce Woodland, which comprises 20.6% of the mapped area (430.2 acres). Other common habitats include Upland Mixed Forest (169.9 acres) and Upland Tall Scrub (131.4 acres) (Wells *et al*. 2010). Few waterbodies occur in the area, but

Figure 5.2a King Salmon Airport Wildlife Habitat Map, 2006-2007

Figure 5.2b King Salmon Habitat Class Changes, 2001-2006/2007



there is a variety of aquatic, wet, and moist habitat types (that occur mostly in proximity to streams and river channels where they receive intermittent flooding (Frost *et al*. 2005b).

Wetter areas are used by dabbling ducks, Sandhill Cranes, and shorebirds, such as Greater Yellowlegs and Wilson's Snipe. Abundant forest and tall shrub habitats are used by a variety of passerine bird species for nesting and foraging, including Boreal and Black-capped Chickadees, and several thrushes, warblers, and sparrows. Swallow species and Common Ravens use many artificial structures within the Artificial habitats for nesting, and these species forage in open areas near these structures. Upland or Riverine Mixed Forest and Riverine Broadleaf Forest types at King Salmon Airport provide nesting habitat for raptors, such as Bald Eagles and Osprey (Frost *et al*. 2005b).

Common shrub species found in King Salmon area wetlands include *Myrica gale*, *Salix pulchra*, *Betula nana*, *Vaccinium uliginosum*, *Ledum decumbens*, and *Alnus tenuifolia*. Common emergent plant species occurring in wet, seasonally flooded active floodplain channels are *Carex lyngbyei*, *Comarum palustre*, *Equisetum fluviatile* and *Eriophorum vaginatum*.

Rumex beringensis is a plant species of special concern (Murray and Lipkin 1987). This plant has been documented near the Naknek River although studies have found the species to be more widespread than previously known (USFWS 1993a).

5.3 Fish and Wildlife

Woodward-Clyde (1995) identified a number of fish and wildlife issues related to pollution of surface water. Most of these issues have been significantly reduced due to improvements in the sewage treatment plant operation and ongoing remediation of IRP sites. This is not to assume that there are still not concerns, but the USAF has been and will continue to take action to correct these problems.

5.3.1 Fish

The Naknek River (ADFG 1990a) is the most prominent water body in the vicinity of King Salmon Airport. Sockeye salmon originating in the Naknek River are a major contributor to the Bristol Bay sockeye salmon harvest, the world's largest. Approximately one million sockeye salmon escape up the Naknek River in June and July each year. In addition to the commercial fishery, the Naknek River provides excellent recreational opportunities for tourists and local inhabitants, particularly for king salmon, coho salmon, and rainbow trout fishing. All five species of salmon (king, sockeye, coho, chum, and pink) migrate to upper reaches of the Naknek River, as do rainbow trout and Arctic grayling.

Eskimo Creek traverses Air Force property before emptying into the Naknek River. This creek (ADFG 1990a) provides habitat for chinook, chum, pink, and coho salmon; rainbow trout; grayling; whitefish; Dolly Varden; northern pike; and smelt. Chinook and coho salmon are known to rear in the creek.

King Salmon Creek is northwest of base facilities. Fish species in this creek are expected to be similar as those found in Eskimo Creek. King Salmon Creek is a popular recreational area for anglers. During some years King Salmon and Paul's creeks have been closed to king salmon fishing for specific periods to ensure an adequate salmon escapement. Waters from the mouth of King Salmon Creek to the bridge are closed to fishing for all salmon species from June 1 to July 31.

5.3.2 Mammals

The Northern Alaska Peninsula caribou herd ranges south of Iliamna Lake throughout game management units 9C and 9E. The herd is well dispersed during late summer and mid-winter. In late July the herd begins moving north to wintering grounds between Egegik and the south shore of Iliamna Lake, north of King Salmon. In late winter and early spring they start to aggregate and move toward the calving grounds near Port Heiden (Dolezal 1993). The Northern Alaska Peninsula caribou herd wintering grounds include a large area north of the Naknek River, including the vicinity of King Salmon Airport. Additionally, bands of caribou from the Mulchatna herd roam southward in the winter, intermingling with the Northern Alaska Peninsula herd (personal communication, R. Potts in Woodward-Clyde 1995b).

The Northern Alaska Peninsula and the Mulchatna caribou herds are experiencing dramatic declines; the Northern Alaska Peninsula herd numbering about 2,500 and the Mulchatna herd about 84,000. Since about 2001 or 2002, only a few animals from the Northern Alaska Peninsula herd swim the Naknek River and intermix with the Mulchatna herd. An estimated 2,000 to 3,000 animals from the Mulchatna herd winter in the Naknek drainage (personal communication, L. Butler, ADFG 2005).

Mammal species directly observed or determined to be present from sign at King Salmon Airport during the 2005 site visit in late June, included red squirrels, moose, brown bear, and lynx. Moose are residents of the King Salmon area, commonly occurring in wetland areas and early successional forest stands. After snow has driven them from the higher altitudes, moose concentrate in areas northeast and south of King Salmon. In summer they are dispersed throughout the region; however, they favor high, well-drained areas of willow and alder and areas along rivers where forage is good.

Brown bears are resident in the area and forage on tender grass shoots along Eskimo Creek or salmon in King Salmon Creek. Bears move to sub-alpine areas after emerging from their dens in April or May. During spring and summer, brown bears concentrate along salmon streams in the area. They return to the higher altitudes for berries in late summer.

Red foxes, porcupines, snowshoe hares, and short-tailed weasels prefer brushy areas in broken terrain. Open areas attract least weasels, lemmings, shrews, voles, Arctic ground squirrels, and tundra hares. Mink, beavers, muskrats, and river otters are found in or near water. Red squirrels and wolverines are found throughout the area. Wolves are not abundant, but they do range throughout the Alaska Peninsula. Wolves have been observed on and near the installation, and coyotes and lynx are present in low numbers (Dolezal 1993).

Marine mammals that may use the Naknek River in the King Salmon Airport vicinity include the beluga whale, from late March through late April and again in the fall (October). Killer whales may occur while chasing beluga whales. Harbor seals are common. A gray whale was documented in this area about 1990. Steller sea lions may, but are unlikely, to occur. The Marine Mammal Protection Act (MMPA) of 1972 describes (1) a moratorium on taking and importation of marine mammals and marine mammal products with certain exceptions and (2) an international program through cooperative agreements for protection and conservation of all marine mammals covered by the MMPA.

5.3.3 Birds

Hundreds of thousands of waterfowl on their way to and from northern nesting areas stop to feed and rest on tundra lakes, rivers, and intertidal areas of Bristol Bay. Many millions of shorebirds use the same habitats and flyways as waterfowl. Numerous passerine species and predatory birds occur in the area.

The Naknek River is a significant spring staging area for Greater White-fronted Geese, Tundra Swans, many species of ducks, shorebirds, and Arctic Terns (USFWS 1993a). During each year, spring staging has been surveyed USFWS (Savage and Murray 2007) reported high waterfowl concentrations in three shallow lagoons along the upper Naknek River. They are observable from Paradise Point beyond the southeast end of the airfield (Runway 29), another about five miles upstream of the installation observable from Big Creek Outlook, and the third from the inactive site Rapids Camp (Naknek Recreation Camp 1), another three miles upstream. Important shorebird species known to stage in spring include Hudsonian Godwit, Least Sandpiper, and Short-billed Dowitchers (Russell 1993).

Results from the 1992 USFWS spring migration watch indicated an unusually high waterfowl use of the Naknek River equaling 27,178 birds of 21 species. Ring-necked Ducks, Steller’s Eiders, and a Bewick’s race Tundra Swan were documented on the river for the first time during this survey. Eurasian Widgeons and Canvasbacks were encountered regularly in small numbers suggesting their status to be “uncommon” rather than “rare” migrants to the Alaska Peninsula. Northern Pintails were present in numbers more than double their previously recorded highest abundance. The probable cause for the 1992 high abundance was the displacement of birds from other local and regional areas due to the late spring and limited open water (USFWS 1993a).

In 2005 (Lapinski and Williamson 2005) and 2006 (Savage and Murray 2007), 22 and 23 species were documented, respectively, including Trumpeter Swans for the second and third consecutive year. Peak counts were high, and arrival and peak counts were early for many waterfowl species in 2005. Mallards, Gadwalls, Green-winged Teal, American Widgeons, Greater Scaups, Goldeneyes, Buffleheads, and Mergansers stop-over in spring and fall. Other large birds that frequent the area include Sandhill Cranes, Tundra Swans, Canada Geese, and Loons. Various King Salmon USFWS Refuge staff have performed migratory waterfowl surveys and other bird surveys from the 1970s to present; survey information is presented in reports by Savage (2008), Savage and Murray (2007), Schuster (2004), Oligschlaeger and Schuster (2004), Kirk (1999), Spies (1998), Ruhl (1997), Ruhl and Moore (1996), Moore (1996), MacGowan (1994), Scharf (1993), and Cook (1992).

Shorebird species include Rock, Least, and Western Sandpipers; Ruddy Turnstones; Hudsonian and Bar-tailed Godwits; Golden, Semipalmated, and Black-bellied Plovers; Dunlins; and Phalaropes. Glaucous-winged Gulls and Mew Gulls, Arctic Terns, and Black-legged Kittiwakes are found along sea coasts and inland waters.

Passerines known or expected to occur in the area include Song, White-crowned, and American Tree Sparrows; American Robins; Yellow-rumped, Blackpoll, and Wilson’s Warblers; and Gray-cheeked Thrush. One of the most abundant passerines is the Tree Swallow, which forages over the Naknek River and possibly helps keep mosquitoes under control (Wheeler 1993).

Bald Eagles, Ospreys, Northern Goshawks, Rough Legged Hawks, Merlins, and Great-horned, Boreal, and Short-eared Owls are also present in the area. The Peale’s Peregrine Falcon is found and may breed in this region. Bald Eagle nesting has been confirmed in the area of King Salmon Airport (personal communication, Russell in Jones Technologies, Inc. and Gene Stout and Associates 1999b). There was an Osprey nest near King Salmon Airport, but one adult and two juveniles were electrocuted in 1996. The remaining adult unsuccessfully attempted to construct a nest on King Salmon Airport the following year.

Several sensitive species potentially occurring within the vicinity of King Salmon include the Harlequin Duck, Bristle-thighed Curlew, Marbled Murrelet, and Northern Goshawk, all former Category 2 candidate species (Alaska Natural Heritage Program 1993, Woodward-Clyde 1995b). Kittlitz’s Murrelet, a federal Candidate species (USFWS 2011) potentially occurs in the King Salmon area. Other species of concern (West 1991) include the Sanderling, Hudsonian Godwit, Marbled Godwit, Wandering Tattler, Black Turnstone, Surfbird, Swainson’s Thrush, and Northern Waterthrush.

There have been considerable efforts to obtain and maintain a quality bird list for the King Salmon area, including USFWS reports (*e.g.*, Scharf 1993, MacGowan 1994, Moore 1996, Ruhl and Moore 1996, and Ruhl 1997), Christmas bird counts, 1993-97 Breeding Bird Surveys, banding studies, and local volunteer efforts. Thirty-five bird species were observed at King Salmon Airport during the 2005 survey work associated with habitat mapping. Observations included such species as Tundra Swan, Mallard, Osprey, Bald Eagle, Merlin, Greater Yellowlegs, Wilson’s Snipe, Gray-cheeked and Varied thrush, and Orange-crowned, Yellow, Yellow-rumped, Blackpoll, and Wilson’s warblers.

5.4 Threatened and Endangered Species

No threatened, endangered, or sensitive species are known to occur within the boundaries of King Salmon Airport. However, two threatened species, one candidate species, and two formerly threatened species and have been reported in the vicinity.

The American Peregrine Falcon is occasionally found on the installation. King Salmon Airport is not within the area of monitoring following the delisting of the falcon. Richard Russell (1993) sighted a Peregrine Falcon at the Lake Camp on November 11, 1993. Interior Alaska is the range of the American Peregrine Falcon, it was removed from the Endangered Species List in 1999 (USFWS 2011).

Six Aleutian Cackling Geese were reported in April 1996 (personal communication, R. Russell in Jones Technologies, Inc. and Gene Stout and Associates 1999b), which is far from their normal range. This species was formerly known as the Aleutian Canada Goose. Their Alaskan range includes the Aleutian Islands and Semidi Island, and they were delisted in 2001 (USFWS 2011).

The Steller's Eider was listed as threatened (USFWS 2011) in 1997; it is a sea duck that could be expected to use portions of Bristol Bay approximately 15 miles downstream to overwinter or molt. Observations in the area include one male at the mouth of the Naknek River in 1992, one male on the river at Grassy Point in 1994, four males near the USFWS river dock in 1995, all during April, (Cook 1992, Scharf 1993, USFWS 1993b, MacGowan 1994, Moore 1996), and two females near the river mouth in March 1996 (Ruhl and Moore 1996). No Steller's Eiders were found during March - May surveys in 1997 and 1998 (Ruhl 1997, Kirk 1999) and neither nest or winters in the area. Observations (accidental) of the federally-threatened Spectacled Eider were reported by Armstrong (1991) and USFWS (1993a). The Kittlitz's Murrelet, a candidate species, potentially could occur on or near King Salmon Airport.

5.5 Wetlands

Wetlands at King Salmon Airport are associated with active and abandoned floodplain features. Less well-drained areas are characterized by wet, seasonally flooded substrates. The most common wetland types are seasonally flooded or saturated scrub shrub types. Other common types with more dominant emergent vegetation tend to occur in active floodplain channels at the lowest elevations. Common shrub species found in King Salmon area wetlands include *Myrica gale*, *Salix pulchra*, *Betula nana*, *Vaccinium uliginosum*, *Ledum decumbens*, and *Alnus tenuifolia*. Common emergent plant species occurring in wet, seasonally flooded active floodplain channels are *Carex lyngbyei*, *Comarum palustre*, *Equisetum fluviatile* and *Eriophorum vaginatum* (Frost *et al*. 2005b).

Woodward-Clyde (1995b) identified and mapped general vegetation types of King Salmon Airport for the draft Natural Resources Plan. This map's wetlands features were updated and emphasized by the NWI map, which was completed in 2000. Table 5.2 summarizes wetland data for King Salmon Airport.

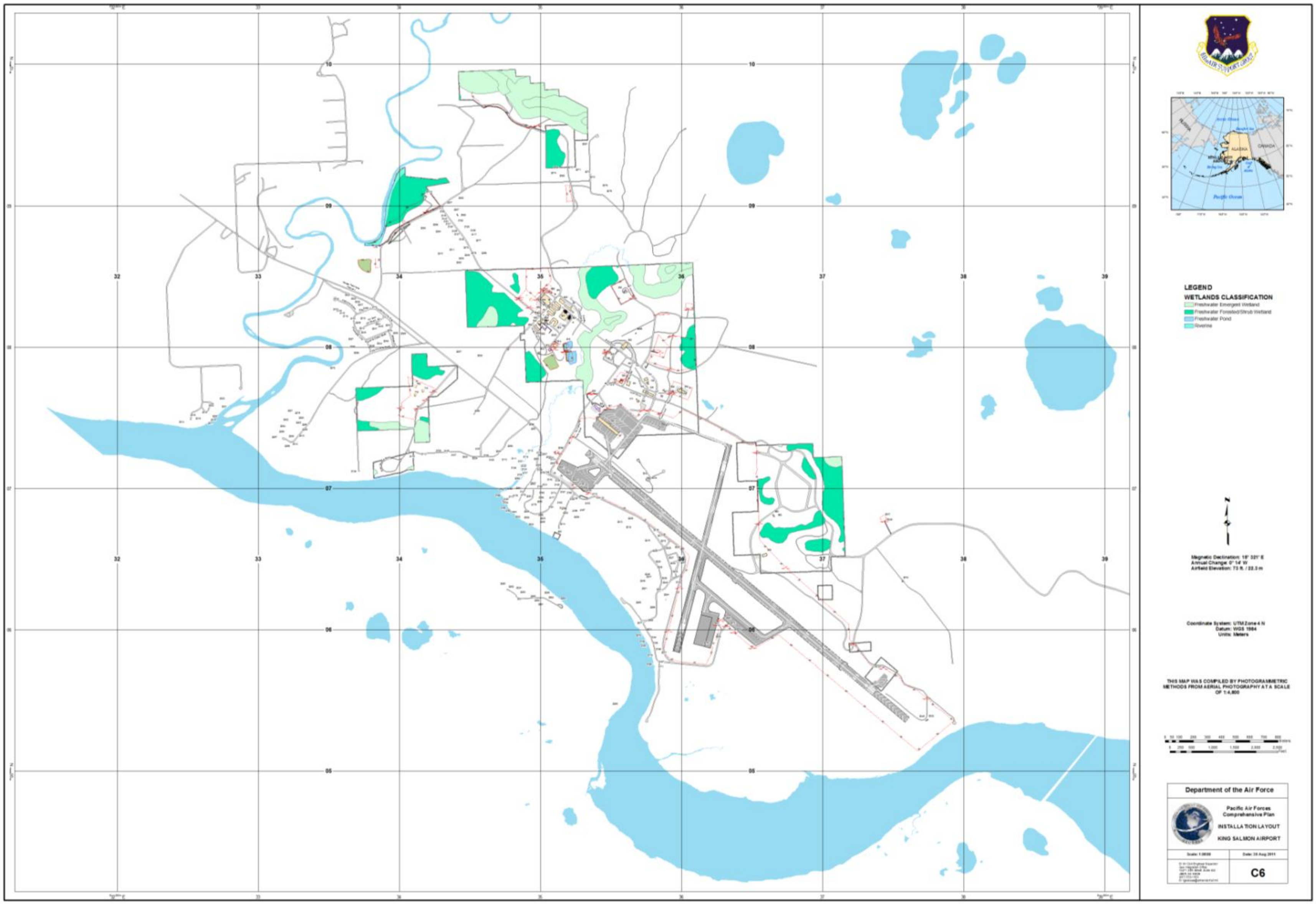
This was further enhanced by the 2002 and 2006/2007 habitat mapping projects (Frost *et al*. 2005b and Wells *et al*. 20010, respectively. Table 5.2 summarizes wetland acreages on King Salmon Airport. These sources are used to facilitate decisions regarding facility siting. King Salmon Airport's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (295.09 acres). Figure 5.5 shows wetlands on King Salmon Airport from 2011 data.

5.6 Other Natural Resources Information

5.6.1 Subsistence

Subsistence resources are relied upon by King Salmon residents. Cultural preferences and the relatively high cost of imported food foster the continued use of subsistence resources. The importance of

Figure 5.5 King Salmon Airport Wetlands, 2011



subsistence to King Salmon residents is reflected in the high participation rates of households that harvest (88%) subsistence resources. The annual subsistence round at King Salmon is defined by the seasonal salmon runs in local streams. Residents also rely heavily on land mammals. Fish account for 54% and land mammals for 46% of the annual subsistence harvest in terms of total pounds. The importance of subsistence resources is even more significant to residents of Naknek and South Naknek due to the mixed economy of Naknek and the seasonality of wage work at South Naknek (Braund and Associates 2004).

Woodward-Clyde (1995) identified the competition for caribou and other resources among military, recreational, and local subsistence users as an ongoing conflict. This is a serious local issue even though downsizing significantly reduced the issue. There remains a concern that non-local hunters are reducing the number of animals available to local subsistence users in the King Salmon area (personal communication, L. Butler, ADF&G 2005).

5.6.2 Outdoor Recreation

There are no organized outdoor recreation opportunities at King Salmon Airport. It is solely operated by a relatively small contract force. Since the 1994 drawdown and removal of active military personnel, official recreation requirements ended, and non-appropriated funds are not available for morale, welfare, and recreation.

Outdoor recreation opportunities available in the King Salmon Airport area include fishing, big and small game hunting, trapping, wildlife viewing, ATV riding, hiking, nature study and photography, and boating opportunities provided by local guides on the Naknek River. King Salmon Airport has billeting and dining facilities available to military and military-related personnel visiting the area. The following discussion relates to the consumptive use of natural resources on USAF sites.

Hunting is not permitted on King Salmon Airport. However, military personnel do come to King Salmon Airport to hunt and fish in the area. All personnel wishing to access King Salmon Airport are required to submit a “Site Arrival Request” seven days in advance of a requested arrival date. Installation Manager’s approval is required for access to King Salmon Airport resources, facilities, or support. Upon arrival in King Salmon, military personnel must register their firearms with base security. Hunters and anglers should be aware of the need to properly dispose of wastes to minimize bear/human conflicts.

Hunting within the vicinity of King Salmon Airport is primarily big game hunting for caribou, brown bear, and moose. Small game hunting is limited, but hares, grouse, and ptarmigan can be found. Waterfowl staging areas along the Naknek River provide hunting opportunities. However, waterfowl hunting by visiting military personnel is very limited.

Naknek River and King Salmon Creek provide recreational fishing opportunities for contract personnel stationed at King Salmon Airport and visiting personnel. Various salmon species are targeted, although other species may be taken, such as rainbow trout, Dolly Varden, and northern pike.

Hunting, trapping, and fishing activities are regulated by ADFG. Restrictions on sport fishing are announced by emergency orders that are issued from ADFG. These orders are usually issued in response to concerns about inadequate escapement of (king) salmon into local streams. King Salmon is within Subunit C of Unit 9 of the Game Management Unit System. Hunting and trapping activities done in the area must comply with these regulations.

In 1998 the ADFG created a Naknek Controlled Use Area (the Naknek River drainage upstream from and including the King Salmon Creek drainage). This area is closed to the use of any motorized vehicle, except an aircraft, boat, or snowmachine, for hunting gear and or parts of game from August 1 through November 30; however, this does not apply to a motorized vehicle on the Naknek-King Salmon, Lake

Camp, and Rapids Camp roads, King Salmon Creek trails, and on frozen surfaces of the Naknek River and Big Creek.

Wildlife viewing opportunities are available throughout the King Salmon area, as well as at Lake Camp and Rapids Camp. Large concentrations of waterfowl and shorebirds during migration, as well as moose, caribou, and bear on or near the installation provide excellent viewing opportunities. Whales can sometimes be seen in the Naknek River and more regularly in Bristol Bay.

The Air Force marina on the Naknek River has been closed. Lake Camp and Rapids Camp no longer have any facilities beyond a NPS boat dock at Lake Camp.

Lake Camp has IRP remediation projects that must be completed prior to transfer of land by the USAF. Only uncontaminated property can be transferred. The NPS has proposed a public facility be developed at the Lake Camp site, including a boat launching ramp, two docks, a vehicle turnaround, a facility for transferring fuel to the NPS landing craft/tanker vessel, a 30-car parking lot with boat trailer parking, two picnic/wind shelters, five campsites, a double vault toilet, a well with hand pump, a one-mile nature trail along the river, and interpretive exhibits. The NPS has been invited to coordinate future planning with the King Salmon Remediation Advisory Board.

Several all-terrain vehicles (ATV) trails occur on King Salmon Airport as well as in the surrounding community. Potts (1993) reported significant impacts from ATVs and four-wheel drive vehicles along the King Salmon Creek corridor. The Naknek Controlled Use Area was established in response to this issue. ATV use by military and base-associated civilian personnel is minimal compared to pre-drawdown times. There is a need to educate ATV users in the King Salmon community to remain on established road systems. Trail proliferation is an area-wide issue.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Land management at King Salmon Airport is coordinated through applicable jurisdictions, plans, and policies for the area, including Borough subdivision, zoning, and planning ordinances; ADFG regulations; and local/regional native corporation federal mandates. The Bristol Bay Borough administers a zoning ordinance and a comprehensive plan and cooperates with the USAF through mutual agreements. The Bristol Bay Borough Police Department has a lease for shared use of Building 150 with the USAF for law enforcement.

Portions of King Salmon Airport are held in fee simple. A significant portion was a Public Land Order withdrawal from the public domain while areas immediately surrounding the airport were deeded to the state under the Statehood Omnibus Act. On these lands, the deed contains a reserve clause for free use by the United States of those lands currently occupied. The King Salmon withdrawal expired on October 17, 2011 and is currently authorized under a Federal Land Policy and Managtement Act right-of-way (AA-93105) which expires December 31, 2014. The Air Force has submitted a new withdrawal request to the BLM, and the request is currently being processed (average processing time for a new withdrawal is 2-3 years).

The NPS owns property adjoining the Naknek River, which is used for access to Brooks Lodge at Katmai National Park on upper Naknek Lake. The Lake Camp parcel (Appendix 3.0-Naknek) is also used as a boating access point for recreational users. A boat ramp was built at this site and is being managed by NPS for transporting fuel and supplies to Katmai National Park. The NPS leases the former marina building at King Salmon Airport for storage. There is a plan to transfer that property to the NPS.

The Air Force leases space to the following organizations: the University of Alaska at Fairbanks, Bristol Bay Telephone Company, Naknek Electric Association, Bristol Bay Borough Police Department, Bristol Bay Housing Authority, AT&T, the State of Alaska, and National Park Service. The Bristol Bay Housing Authority leases Building 647 for a vocational school. There are easements to private parties providing for access to their parcels across UASF-owned land from the public (right-of-way for private use of the road adjacent to Barrel Bluff on King Salmon Airport). The University of Alaska has a lease for 6.6 acres of land for operation and maintenance of the Super DARN antenna array. Bristol Bay Housing Authority leases for Southwest Alaska Vocational Education Center – SAVEC. The USAF purchased land at the Barrel Bluffs along Sockeye Road; a portion of this land cut off the driveway access to three private lots. Three easements were let to the owners of the lots to allow them access to their property.

Industrial facilities in the community area include the Base Supply Warehouse, vehicle operations/ maintenance, Minimally Attended Radar (MAR) tower, Base Civil Engineering shops, utilities plant, billeting facilities, and diesel storage tanks. Billeting facilities are adjacent to Building 603 (Composite Facility). Building relationships are characteristic of the compact arrangement of the community area and are sited to reduce walking distances, enhance the community atmosphere, and improve efficiency of utilities distribution and operation. Former housing facilities in buildings 615 and 616 were demolished in 2003. The installation was connected to the King Salmon sewage system in 2006, and lagoons on the site are planned for removal (Richard Homan, February 2012 e-mail communication to Matt Moran).

A field area where the Missile Defense Agency parked containers with electronic equipment was vacated in 2005. Vacating this area allows wildlife to once again use the area.

The current land parcel configuration of King Salmon Airport is a result of the Alaskan Native Claims Settlement Act (ANCSA) of 1971 and the Alaska Omnibus Act, which identified real estate necessary to maintain the Air Force mission. Most development lies in the larger parcels, west and north of the airfield. Also located in this parcel are the alert hangar, base operations, munitions storage area, and various support activities.

King Salmon is a recreational terminus for military personnel from Alaska and the western U.S. Recreational use of fish and wildlife resources by military personnel is not documented, but impacts on caribou, moose, and sport fish harvest were apparently substantial when the installation was fully staffed with civilian and military personnel (personal communication, Hood in Woodward-Clyde 1995b). In the past, easy access to the Naknek River from both Rapids Camp and Lake Camp resulted in heavy fishing pressure on rainbow trout from military personnel. Impacts today from military use are likely insignificant in terms of wildlife populations.

Jet noise is an issue over Katmai National Park where people expect a pristine environment. This is largely a commercial aircraft issue since the 1994 drawdown at King Salmon Airport, but the USAF still contributes to the overall issue, particularly during certain exercises. The local population was apparently somewhat habituated to fighter aircraft noise when such aircraft were stationed at King Salmon Airport. However, now that such aircraft are gone, the noise is more irritating for local residents during special exercises.

Management issues related to land use identified by Woodward-Clyde (1995) are still applicable, including revegetation of disturbed sites including future demolition sites, local damage to tundra vegetation from the use of motorized vehicles in natural areas, preservation of wetlands, and surface water quality.

APPENDIX A: Natural Resources of King Salmon Airport

Table A1: Vascular Plant Species Observed or Potentially Occurring on or near King Salmon Airport

Common Name	Scientific Name	Observed	Reference
Trees and Shrubs			
American green alder	*Alnus crispa*		1, 2
Sitka alder	*Alnus sinuata*	X	1, 2
Thinleaf alder	*Alnus tenuifolia*	X	1, 2, 4, 5
Pacific serviceberry	*Amelanchier florida*		1, 2
Bog rosemary	*Andromeda polifolia*	X	1, 2, 3
Alpine bearberry	*Arctostaphylos alpina*	X	1, 2, 4, 5
Bearberry (kinikinik)	*Arctostaphylos uva-ursi*	X	1, 2, 5
Shrub birch	*Betula glandulosa*	X	1, 2
Dwarf arctic birch	*Betula nana*	X	1, 2
Alaska paper birch	*Betula papyrifera v. humilis*		1, 2
Kenai birch	*Betula papyrifera v. Kenaica*	X	1, 2, 5
Alaska cassiope	*Cassiope lycopodiodes*		1, 2
Starry cassiope	*Cassiope stelleriana*		1, 2, 3
Leatherleaf	*Chamaedaphne calyculata*	X	1, 2, 5
Bunchberry	*Cornus canadensis*	X	1, 2, 3
Lapland cornel	*Cornus suecica*		1,2
Pincushion plant	*Diapensia lapponica*		1, 2, 3
Yellow mountain-avens	*Dryas drummondii*		3
White mountain-avens	*Dryas integrifolia*	X	1, 2, 3, 5
Eight-petal mountain-avens	*Dryas octopetala*	X	1, 2, 3, 5
Crowberry	*Empetrum nigrum*	X	1, 2, 5
Narrowleaf Labador tea	*Ledum decumbens*	X	1, 2, 5
Twin-flower	*Linnaea borealis*		1, 2
Alpine-azalea	*Loiseleuria procumbens*		1, 2, 3
Partridgefoot	*Luetkea pectinata*		1, 2, 3

Common Name	Scientific Name	Observed	Reference
Sweet gale	*Myrica gale*	X	1, 2
Aleutian mountain-heath	*Phyllodoce aleutica*		1, 2
White spruce	*Picea glauca*	X	1, 2, 5
Black spruce	*Picea mariana*	X	1, 2, 5
Balsam poplar	*Populus balsamifera*	X	1, 2, 5
Shrubby cinquefoil	*Potentilla fruticosa*	X	1, 2, 5
Kamchatka rhododendron	*Rhododendron camtschaticum*		1, 2, 3
Skunk currant	*Ribes glandulosum*		1, 2
Swamp gooseberry	*Ribes lacustre*		1, 2
American red current	*Ribes triste*	X	1, 2
Prickly rose	*Rosa acicularis*	X	1, 2, 3, 5
Nagoonberry	*Rubus arcticus*	X	1, 2
Cloudberry	*Rubus chamaemorus*	X	1, 2, 4
Feltleaf willow	*Salix alaxensis*	X	1, 2, 4
Littetree willow	*Salix arbusculoides*	X	1, 2
Arctic willow	*Salix arctica*	X	1, 2, 4
Barclay willow	*Salix barclayi*	X	1, 2
Bebb’s willow	*Salix bebbiana*	X	1, 2
Undergreen willow	*Salix commutate*		1, 2
Alaska bog willow	*Salix fuscescens*	X	1, 2
Grayleaf willow	*Salix glauca*	X	1, 2
Low blueberry willow	*Salix myrtillifolia*	X	1, 2
Skeletonleaf willow	*Salix phlebophylla*		1, 2
Diamondleaf willow	*Salix pulchra*	X	1, 2
Netleaf willow	*Salix reticulate*		1, 2
Richardson’s willow	*Salix richardsonii*	X	2
Least willow	*Salix rotundifolia*	X	1, 2
Scouler willow	*Salix scouleriana*	X	1, 2
Sprouting willow	*Salix stolonifera*		1, 2

Common Name	Scientific Name	Observed	Reference
Pacific red-elder	*Sambucus callicarpa*		1, 2
Green mountain ash	*Sorbus scopulina*		1, 2
Sitka mountain ash	*Sorbus sitchensis*		1, 2
Beauverd spirea	*Spiraea beauverdiana*	X	1, 2
Small cranberry	*Vaccinium oxycoccos*	X	1, 4
Bog blueberry	*Vaccinium uliginosum*	X	1, 3, 5
Mountain cranberry	*Vaccinium vitis-idaea*	X	1, 4, 5
Highland cranberry	*Viburnum edule*	X	1, 5
Herbaceous Plants			
Red baneberry	*Acatea rubra*		1, 4
Common yarrow	*Achillea millefolium*	X	1, 3
Monkshood	*Aconitium delphiniifolium*	X	1, 3
Wild chives	*Allium schoenoprasum*		1, 3
Meadow foxtail	*Alopecurus aequalis*	X	1, 3
Northern jasmine	*Androsace sepientrionalis*		1, 4
Narcissus-flower anemone	*Anemone narcissiflora*		1, 3
Pasque flower	*Anemone drummondii*		1, 3
Yellow anemone	*Anemone richardsonii*		1, 3
Wild celery	*Angelica lucida*		1, 4
Cats paws	*Antennaria monocephala*		1, 4
Lyre-leaf rockcree	*Arabis lyrata*	X	4, 5
Broad-leaf arctic-bent grass	*Arctagrostis latifolia*	X	1, 4, 5
Pendent grass	*Arctophila fulva*	X	1, 4, 5
Pacific silverweed	*Argentina egedii*		1, 3
Sea thrift	*Armeria maritima*	X	1, 3
Narrowleaf leopardbane	*Arnica angustifolia*	X	1, 3
Frigid arnica	*Arnica frigida*		1, 3
Lessing's arnica	*Arnica lessingii*		1, 4

Common Name	Scientific Name	Observed	Reference
Northern wormwood	*Artemisia borealis*		1, 4
Common wormwood	*Artemisia tilesii*	X	1, 4
Arctic wormwood	*Artemisia arctica*		1, 4
Purple wormwood	*Artemisia globularia*		1, 3
Goatsbeard	*Aruncus sylvester*		1, 3
Siberian aster	*Aster sibiricus*		1, 3
Wintercress	*Barbarea orthoceras*		1, 4
Broomrape	*Boschniakia rossica*		1, 3
Moonwort	*Botrychium boreale*		1, 4
Moonwort	*Botrychium lunaria*		1, 4
Bluejoint grass	*Calamagrostis canadensis*	X	1, 4, 5
Reed bent grass	*Calamagrostis stricta*	X	1, 4, 5
Marsh marigold	*Caltha palustris*	X	1, 3
Alaska bellflower	*Campanula lasiocarpa*		1, 3
Cuckoo flower	*Cardamine pratensis*	X	1, 4, 5
Water sedge	*Carex aquatilis*	X	1, 4, 5, 6
Sedge	*Carex bigelowii*	X	1, 4, 5, 6
Sedge	*Carex chordorrhiza*	X	1, 6
Sedge	*Carex lyngbyei*	X	1, 4, 5, 6
Sedge	*Carex microchaeta*	X	1, 6
Sedge	*Carex rariflora*	X	1, 6
Sedge	*Carex rotundata*	X	1, 6
Sedge	*Carex saxatilis*	X	1, 6
Paintbrush	*Castilleja* sp.	X	1, 4, 5
Coastal paintbrush	*Castilleja unalaschcensis*		1, 3
Fischer’s mouse-ear chickweed	*Cerastium fischerianum*	X	1, 4, 5
Bering Sea chickweed	*Cerastium beeringianum*	X	1, 4
Fireweed	*Chamerion angustifolium*	X	1, 3, 4, 5
Dwarf fireweed	*Chamerion latifolium*	X	1, 3

Common Name	Scientific Name	Observed	Reference
Arctic daisy	*Chrysanthemum arcticum*		1, 3
Mackenzie's water hemlock	*Cicuta virosa*	X	1, 3, 4
Alaska spring beauty	*Claytonia sarmentosa*		1, 3
Marsh five-finger	*Comarum palustre*	X	1, 3
Coral root	*Corallorrhiza trifida*		1, 3
Pink lady's slipper	*Cypripedium guttatum*		1, 3
Keyflower	*Dactylorhiza aristata*		1, 3
Long leaved sundew	*Drosera angelica*		1, 3
Round-leaf sundew	*Drosera rotundifolia*	X	1, 3
Spreading woodfern	*Dryopteris expansa*	X	1, 3
Pale spike-rush	*Eleocharis palustris*	X	1, 3
Fringed willowherb	*Epilobium ciliatum*	X	1, 3
Marsh willowherb	*Epilobium palustre*	X	1, 3
Field horsetail	*Equisetum arvense*	X	1, 4
Swamp horsetail	*Equisetum fluviatile*	X	1, 4
Meadow horsetail	*Equisetum pratense*	X	1, 4
Dwarf scouring-rush	*Equisetum scirpoides*	X	1, 4
Woodland horsetail	*Equisetum sylvaticum*	X	1, 4
Blue fleabane	*Erigeron acris*		1, 4
Arctic alpine fleabane	*Erigeron humilis*		1, 3
Tall cottongrass	*Eriophorum angustifolium*	X	1, 3
Russett-bristle cotton-grass	*Eriophorum russeolum*	X	1, 4
White cotton-grass	*Eriophorum scheuchzeri*		1, 4
Tussock cotton-grass	*Eriophorum vaginatum*	X	1, 3
Worm-seed wallflower	*Erysimum cheiranthoides*	X	1, 3
Rough fescue	*Festuca altaica*	X	1, 4, 5
Baffin fescue	*Festuca baffinensis*	X	1, 4, 5
Chocolate lily	*Fritillaria camschatcensis*		1, 3

Common Name	Scientific Name	Observed	Reference
Northern bedstraw	*Galium boreale*	X	1, 3
White gentian	*Gentiana frigida*		1, 3
Wild geranium	*Geranium erianthum*	X	1, 3
Ross avens	*Geum rossii*		1, 3
Oak fern	*Gymnocarpium dryopteris*	X	1, 3
Cow parsnip	*Heracleum lanatum*		1, 3
Common mare's tail	*Hippuris vulgaris*	X	1, 3
Wild iris	*Iris setosa*		1, 3, 4
Chestnut rush	*Juncus castaneus*	X	1, 3
Drummond's rush	*Juncus drummondii*	X	1, 3
Moor rush	*Juncus stygius*	X	1, 3
Poverty rush	*Juncus tenuis*	X	1, 3
Glaucous weaselsnout	*Lagotis glauca*		1, 3
Vetching	*Lathyrus palustris*	X	1, 4, 5
Common duckweed	*Lemna minor*	X	1, 3
American lyme grass	*Leymus mollis*	X	1, 3
Scot's lovage	*Ligusticum scoticum*	X	1, 3
Alp lily	*Lloydia serotina*		1, 3
Nootka lupine	*Lupinus nootkatensis*	X	1, 3
Common wood-rush	*Luzula multiflora*	X	1, 3
Alpine club moss	*Lycopodium alpinum*		1, 4
Bladder campion	*Melandrium apetalum*		1, 4
Bogbean	*Menyanthes trifoliata*		1, 4
Chiming bells	*Mertensia paniculata*	X	1, 4
Seep monkeyflower	*Mimulus guttatus*		1, 3
Arctic sandwort	*Minuartia arctica*		1, 4
Grove sandwort	*Moehringia lateriflora*	X	1, 4
Shy maiden	*Moneses uniflora*	X	1, 3, 4
Chamisso's candy-flower	*Montia chamissoi*	X	1, 3, 4

Common Name	Scientific Name	Observed	Reference
Alpine forget-me-not	*Myosotis alpestris*		1, 3, 4
Yellow pond lily	*Nuphar polysepalum*		1, 3
Sidebells	*Orthilia secunda*	X	1, 3
Black locoweed	*Oxytropis nigrescens*		1, 3
Arctic poppy	*Papaver lapponicum*		1, 3
Grass of parnassus	*Parnassia palustris*	X	1, 3, 4
Nakedstem wallflower	*Parrya nudicaulis*		1, 3
Capitate lousewort	*Pedicularis capitata*		1, 3
Labrador lousewort	*Pedicularis labradorica*	X	1, 3
Woolly lousewort	*Pedicularis lanata*	X	1, 3
Oeder's lousewort	*Pedicularis oederi*		1, 3
Sudetic lousewort	*Pedicularis sudetica*	X	1, 3
Bumblebee flower	*Pedicularis verticillata*		1, 3
Arctic coltsfoot	*Petasites frigidus*	X	1, 3
Bog violet	*Pinguicula vulgaris*		1, 3, 4
Small northern bog orchid	*Platanthera obtusata*	X	1, 3
Annual blue grass	*Poa annua*	X	1, 4, 5
Tall Jacob's ladder	*Polemonium acutiflorum*	X	1, 3
Meadow bistort	*Polygonum bistorta*		1, 3
Alpine meadow bistort	*Polygonum viviparum*		1, 4
Norwegian cinquefoil	*Potentilla norvegica*	X	1, 3
Pixie eyes	*Primula cuneifolia*		1, 3
Pink pyrola	*Pyrola asarifolia*		1, 3
Far-northern buttercup	*Ranunculus hyperboreus*	X	1, 3
Little yellow-rattle	*Rhinanthus minor*	X	1, 3
Roseroot	*Rhodiola rosea*		1, 3
Arctic dock	*Rumex arcticus*	X	1, 4
Grassleaf sorel	*Rumex graminifolius*	X	1, 4, 5

Common Name	Scientific Name	Observed	Reference
Bering Sea dock	*Rumex beringensis*		
Canadian burnet	*Sanguisorba canadensis*	X	1, 3
Brook saxifrage	*Saxifraga punctata*		1, 3
Spotted saxifrage	*Saxifraga bronchialis*		1, 3
Yellow marsh saxifrage	*Saxifraga hirculis*		1, 3, 4
Heart-leaf saxifrage	*Saxifraga punctata*		1, 3
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*		1, 3
Mastodon flower	*Senecio congestus*	X	1, 3
Black-tipped groundsel	*Senecio lugens*	X	1, 3
Moss campion	*Silene acaulis*		1, 3
Arctic goldenrod	*Solidago multiradiata*	X	3
Bur-reed	*Sparganium augustifolium*		1, 4
Ladies' tresses	*Spiranthes romanzoffiana*		1, 3
Dandelion	*Taraxacum* sp.	X	1, 3, 5
False asphodel	*Tofieldia coccinea*	X	1, 3
Star flower	*Trientalis europaea*	X	1, 3
Seaside arrow-grass	*Triglochin maritima*		1, 4
Marsh arrow-grass	*Triglochin palustris*	X	1, 4
Narrow false oat	*Trisetum spicatum*	X	1, 4
Clustered valerian	*Valeriana capitata*	X	1, 3
False hellebore	*Veratrum eschscholtzii*		1, 3
American brook lime	*Veronica americana*		1, 3
Two-flowered violet	*Viola biflora*		1, 3
Alaska violet	*Viola langsdorffii*		1, 3
Great spurred violet	*Viola selkirkii*		1, 3

Reference:
1 - Hulten 1968
2 - Viereck and Little 1972
3 - White 1974
4 - Pratt 1991
5 - Woodward-Clyde 1995b
6 - Tande and Lipkin 2003

Note:
Species listed alphabetically by scientific name.
Observed includes species collected and identified during June 1993 field visit (Woodward-Clyde 1995b) and during 2005 site visit (Boisvert and Frost, ABR, Inc.). Current nomenclature is taken from the Biota of North America Program database (http://www.invasivespecies.org/Bonap/index.html).

Table A2: Fish Species Found in the Naknek River Drainage

Common Name	**Scientific Name**
Sockeye (red) salmon	*Oncorhynchus nerka*
Chinook (king) salmon	*Oncorhynchus tshawytscha*
Coho (silver) salmon	*Oncorhynchus kisutch*
Chum salmon	*Oncorhynchus keta*
Pink salmon	*Oncorhynchus gorbuscha*
Rainbow Trout	*Salmo gairdneri*
Arctic char	*Salvelinus alpinus*
Dolly Varden	*Salvelinus malma*
Whitefish (humpback)	*Coregonus pidschian*
Boreal smelt	*Osmerus mordax*
Arctic grayling	*Thymallus arcticus*
Northern pike	*Esox lucius*
Lake trout	*Salvelinus namaycush*
Burbot	*Lota lota*
Round whitefish	*Prosopium cylindraceum*
Pygmy whitefish	*Prosopium coulteri*
Least cisco	*Coregonus sardinella*
Longnose sucker	*Catostomus catostomus*
Slimy sculpin	*Cottus cognatus*
Coast-range sculpin	*Cottus aleuticus*
Alaska blackfish	*Dallia pectoralis*
Three-spine stickleback	*Gasterosteus aculeatus*
Nine-spine stickleback	*Pungitius pungitius*
Arctic lamprey	*Lampetra japonica*
Starry flounder	*Platichthys stellatus*
Pond smelt	*Hypomesus olidus*
Green sturgeon	*Acipenser medirostris*

Sources:
Richard Russell 1993
Morrow 1980
Robins *et al*. 1991
Woodward-Clyde 1995b

Table A3: Mammal Species Observed or Potentially Occurring in the King Salmon Airport Area

Common Name	Scientific Name	Observed
Little brown bat	*Myotis lucifuguis*	X
Dusky shrew	*Sorex vagrans*	
Cinereus shrew	*Sorex cinereus*	
Brown/grizzly bear	*Ursus arctos*	X
Arctic fox	*Alopex lagopus*	
Coyote	*Canis latrans*	X
Red fox	*Vulpes vulpes*	X
Wolf	*Canis lupus*	X
Short-tailed weasel (Ermine)	*Mustela erminea*	X
Least weasel	*Mustela rixosa*	X
Mink	*Mustela vison*	X
Otter	*Lutra canadensis*	X
Wolverine	*Gulo gulo*	X
Canada lynx	*Felis lynx*	X
Snowshoe hare	*Lepus americanus*	X
Alaskan hare	*Lepus othus*	X
Arctic ground squirrel	*Spermophilus paryi*	X
Red squirrel	*Tamiasciurus hudsonicus*	X
Brown lemming	*Lemmus trimucronatus*	
Bog lemming	*Synaptomys borealis*	X
Varying lemming	*Dicristonyx torquatus*	
Red-backed vole	*Clethrionomys rutilus*	X
Tundra vole	*Microtus oeconomus*	
Meadow vole	*Microtus pennsylvanicus*	
Jumping mouse	*Zapus hudsonius*	
Beaver	*Castor canadensis*	X
Porcupine	*Erethizon dorsatum*	X
Muskrat	*Ondatra zibethica*	X
Moose	*Alces alces*	X
Caribou	*Ringifer taranus*	X
Beluga whale	*Delphinapterus leucas*	X
Harbor seal	*Phoca vitulina*	X

Notes:
Species listed by phylogenic order.
Observed by Richard Russell (ADFG King Salmon 1971-1993) reported in Woodward-Clyde 1995b and by Boisvert and Frost (ABR, Inc.) during 2005 site visit.

Table A4: Bird Species Observed on or Potentially Occurring in the King Salmon Airport Area

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Greater White-fronted Goose	*Anser albiforns*	C	C	C	A	X	X	1, 2, 3, 4, 5, 6, 7
Snow Goose	*Chen caerulescens*	C	-	C	-			1, 2
Emperor Goose	*Chen canagica*	C	U	C	C	X		1, 2, 4, 5, 6, 7
Brant	*Branta bernicla*	C	R	C	R		X	1, 2, 3, 4, 5, 6, 7
Canada Goose	*Branta canadensis*	U	R	C	A	X	X	1, 2, 3, 4, 5, 6, 7
Aleutian Cackling Goose	*Branta hutchinsii leucopareia*	A					X	
Tundra Swan	*Cygnus columbianus*	C	C	C	R	X	X	1, 2, 3, 4, 5, 6, 7, 10
Whooper Swan	*Cygnus cygnus*	R	R	R	U			1
Green-winged Teal	*Anas crecca*	C	C	C	U	X	X	1, 2, 3, 4, 5, 6, 7, 10
Mallard	*Anas platyrhynchos*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7, 10
Northern Pintail	*Anas acuta*	C	C	C	U	X	X	1, 2, 3, 4, 5, 6, 7
Northern Shoveler	*Anas clypeata*	R	R	R	A		X	1, 2, 3, 4, 5, 6, 7
Gadwall	*Anas strepera*	U	U	U	U	X	X	1, 2, 3, 4, 5, 6, 7
Eurasian Wigeon	*Anas penelope*	U	R	U	R		X	1, 2, 3, 4, 5, 6, 7
American Wigeon	*Anas americana*	C	C	C	R	X	X	1, 2, 3, 4, 5, 6, 7
Canvasback	*Aythya valisineria*	R	A	R	R		X	1, 2, 3, 4, 5, 6, 7
Redhead	*Aythya americana*	A	A	A	-		X	1, 2, 3, 4, 5, 6, 7
Ring-necked Duck	*Aythya collaris*	A	A	A	-		X	1, 2, 3, 4, 5, 6, 7
Tufted Duck	*Aythya fuligula*	A	A	A	A			1, 2, 7
Greater Scaup	*Aythya marila*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7, 8
Common Eider	*Somateria*	C	C	C	C	X		1, 2, 3, 4,

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
	mollissima							5, 6, 7
King Eider	*Somateria spectabilis*	C	R	C	C			1, 2, 3, 4, 5, 6, 7, 8
Spectacled Eider	*Somateria fischeri*	-	-	-	A			1, 2
Steller's Eider	*Polysticta stelleri*	C	U	C	C			1, 2, 3, 4, 5, 6, 7
Harlequin Duck	*Histrioncus histrioncus*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7
Black Scoter	*Melanitta nigra*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7
Surf Scoter	*Melanitta perspicillata*	C	U	C	C			1, 2, 3, 4, 5, 6, 7
White-winged Scoter	*Melanitta fusca*	C	C	C	C		X	1, 2, 3, 4, 5, 6, 7
Common Goldeneye	*Bucephala clangula*	C	U	C	U	X	X	1, 2, 3, 4, 5, 6, 7, 8
Oldsquaw	*Clangula hyemalis*	C	U	C	C	X	X	1, 2, 3, 4, 5, 6, 7, 8
Barrow's Goldeneye	*Bucephala islandica*	C	U	C	C	X	X	1, 2, 3, 4, 5, 6, 7
Bufflehead	*Bucephala albeola*	C	U	C	C	X	X	1, 2, 3, 4, 5, 6, 7
Hooded Merganser	*Lophodytes cucullatus*	A	A	A	A			1, 2
Common Merganser	*Mergus merganser*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7, 8
Red-breasted Merganser	*Mergus serrator*	C	C	C	C	X	X	1, 2, 3, 4, 5, 6, 7, 8
Spruce Grouse	*Dendragapus canadensis*	R	R	R	R	X	X	1, 2, 8
Willow Ptarmigan	*Lagopus lagopus*	C	C	C	C	X	X	1, 2, 8
Rock Ptarmigan	*Lagopus mutus*	U	U	U	U	X		1, 2
Red-throated Loon	*Gavia stellata*	C	C	C	U	X	X	1, 2
Pacific Loon	*Gavia pacifica*	C	C	C	R	X		1, 2
Common Loon	*Gavia immer*	U	U	U	U	X	X	1, 2
Horned Grebe	*Podiceps auritus*	C	U	C	C	X	X	1, 2
Red-Necked Grebe	*Podiceps grisegena*	U	R	U	U	X		1, 2
Mottled Petrel	*Pterodroma*	U	U	U	-			1

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
	inexpectata							
Sooty Shearwater	*Puffinus griseus*	R	R	R	A			1, 2
Short-tailed Shearwater	*Puffinus tenuirostris*	R	R	R	A			1, 2
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	R	R	R	R	X		1, 2
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	U	C	C	-	X		1, 2
Double-crested Cormorant	*Phalacrocorax auritus*	C	C	C	U	X		1, 2
Pelagic Cormorant	*Phalacrocorax pelagicus*	C	C	C	C	X		1, 2
Red-faced Cormorant	*Phalacrocorax urile*	C	C	C	C	X		1, 2
Osprey	*Pandion haliaetus*	R	R	R	-	X	X	1, 2, 10
Bald Eagle	*Haliaeetus leucocephalus*	C	C	C	C	X	X	1, 2, 8, 10
Northern Harrier	*Circus cyaneus*	U	U	U	R	X	X	1, 2, 10
Sharp-shinned Hawk	*Accipter striatus*	R	R	R	R			2
Northern Goshawk	*Accipiter gentilis*	U	U	U	U	X	X	1, 2, 8
Rough-legged Hawk	*Buteo lagopus*	U	C	U	-	X	X	1, 2
Golden Eagle	*Aquila chrysaetos*	U	U	U	R	X		1, 2
American Kestrel	*Falco sparverius*	R	R	R	R			2
Merlin	*Falco columbarius*	U	U	U	A	X	X	1, 2, 10
Peregrine Falcon	*Falco peregrinus*	C	U	C	U	X	X	1, 2, 8
Gyrfalcon	*Falco rusticolus*	U	U	U	U	X	X	1, 2
Sandhill Crane	*Grus canadensis*	C	C	C	-	X	X	1, 2, 10
Black-bellied Plover	*Pluvialis squatarola*	C	-	C	-		X	1, 2
American Golden-plover	*Pluvialis dominica*	C	-	C	-		X	1, 2
Semi-palmated Plover	*Charadrius semipalmatus*	C	C	C	-	X	X	1, 2, 9, 10
Greater Yellowlegs	*Tringa melanoleuca*	C	C	C	-	X	X	1, 2, 10
Solitary Sandpiper	*Tringa solitaria*	A	R	-	-	X		1, 2

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Wandering Tattler	*Heteroscelus incanus*	U	R	U	-	X	X	1, 2, 9
Spotted Sandpiper	*Actitis macularia*	R	R	R	-	X	X	1, 2, 9
Whimbrel	*Numenius phaeopus*	C	C	C	-		X	1, 2
Bristle-thighed Curlew	*Numenius tahitiensis*	R	A	R	-			1, 2
Hudsonian Godwit	*Limosa haemastica*	A	R	R	-	X	X	1, 2
Bar-tailed Godwit	*Limosa lapponica*	C	U	C	-			1, 2
Marbled Godwit	*Limosa fedoa*	R	R	R	-	X	X	1, 2, 9
Ruddy Turnstone	*Arenaria interpres*	C	U	C	-		X	1, 2
Black Turnstone	*Arenaria melanocephala*	C	U	C	R	X	X	1, 2, 9
Surfbird	*Aphriza virgata*	R	R	R	R	X	X	1, 2, 9
Sanderling	*Calidris alba*	U	-	U	R			1, 2
Semipalmated Sandpiper	*Calidris pusilla*	R	-	R	-			1, 2
Western Sandpiper	*Calidris mauri*	C	R	C	-		X	1, 2
Least Sandpiper	*Calidris minutilla*	C	C	C	-	X	X	1, 2, 9
Baird's Sandpiper	*Calidris bairdii*	R	-	U	-			1, 2
Pectoral Sandpiper	*Calidris melanotos*	R	R	C	-			1, 2
Sharp-tailed Sandpiper	*Calidris acuminata*	A	-	U	-			1, 2
Rock Sandpiper	*Calidris ptilocnemis*	C	C	C	C	X	X	1, 2, 9
Dunlin	*Calidris alpina*	C	C	C	U	X	X	1, 2
Short-billed Dowitcher	*Limnodromus griseus*	C	C	C	-	X	X	1, 2
Long-billed Dowitcher	*Limnodromus scolopaceus*	U	-	U	-		X	1, 2
Wilson's Snipe	*Gallinago gallinago*	C	C	C	A	X	X	1, 2, 9, 10
Red-necked Phalarope	*Phalaropus lobatus*	C	C	C	-	X	X	1, 2
Red Phalarope	*Phalaropus fulicaria*	C	U	C	-			1, 2
Pomarine Jaeger	*Stercorarius pomarinus*	C	U	C	-			1, 2

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Parastitic Jeager	*Stercorarius parasisticus*	C	C	C	-	X	X	1, 2
Long-tailed Jaeger	*Stercorarius longicaudus*	U	U	U	-	X	X	1, 2
Bonaparte's Gull	*Larus philadelphia*	U	U	U	-	X	X	1, 2, 9
Mew Gull	*Larus canus*	C	C	C	C	X	X	1, 2, 8, 9
Herring Gull	*Larus argentatus*	R	R	R	R			1, 2
Glaucous-winged Gull	*Larus glaucescens*	C	C	C	C	X	X	1, 2, 8, 9, 10
Glaucous Gull	*Larus hyperboreus*	U	U	U	U	X		1, 2
Black-legged Kittiwake	*Rissa tridactyle*	C	C	C	U	X		1, 2
Sabine's Gull	*Xema sabini*	U	U	U	-	X	X	1, 2
Ivory Gull	*Pagophila eburnea*	R	-	R	U			1, 2
Arctic Tern	*Sterna paradisaea*	C	U	C	-	X	X	1, 2, 9
Aleutian Tern	*Sterna aleutica*	U	U	U	-	X		1, 2
Common Murre	*Uria aalge*	C	C	C	C	X		1, 2
Thick-billed Murre	*Uria lomvia*	C	C	C	C	X		1, 2
Marbled Murrelet	*Brachyramphus marmoratus*	U	U	U	U	X		1, 2
Kittlitz's Murrelet	*Brachyramphus brevirostris*	U	U	U	R	X		1, 2
Least Auklet	*Aethia pusilla*	C	C	C	C	X		1, 2
Whiskered Auklet	*Aethia pygmaea*	U	U	U	A	X		1, 2
Rock Dove	*Columba livia*				R		X	8
Great-horned Owl	*Bubo virginianus*	U	U	U	U	X	X	1, 2
Snowy Owl	*Nyctea scandiana*	R	R	R	U	X		1, 2
Northern Hawk Owl	*Surnia ulula*	R	R	R	U	X	X	1, 2, 8
Short-eared Owl	*Asio flammeus*	C	C	C	R	X	X	1, 2
Boreal Owl	*Aegolius funereus*	U	U	U	U	X	X	1, 2, 8
Belted Kingfisher	*Ceryle alcyon*	U	U	U	U	X	X	1, 2, 9
Downy Woodpecker	*Picoides pubescens*	R	R	R	R	X	X	1, 2, 8, 9
Hairy Woodpecker	*Picoides villosus*	R	R	R	R			1, 2

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Three-toed Woodpecker	*Picoides tridactylus*	U	U	U	U	X	X	1, 2, 8
Olive-sided Flycatcher	*Contopus borealis*	R	R	R	-	X	X	1, 2, 9
Alder Flycatcher	*Empidonax alnorum*	U	U	U	-	X	X	1, 2, 9, 10
Tree Swallow	*Tachycineta bicolor*	C	C	C	-	X	X	1, 2, 9, 10
Violet-green Swallow	*Tachycineta thalassina*	U	U	U	-	X	X	1, 2, 9
Bank Swallow	*Riparia riparia*	U	U	U	-	X	X	1, 2, 9, 10
Cliff Swallow	*Hirundo pyrrhonota*	U	U	U	-	X		1, 2
Gray Jay	*Perisoreus canadensis*	U	U	U	U	X	X	1, 2, 8, 10
Black-billed Magpie	*Pica pica*	C	C	C	C	X	X	1, 2, 8, 9, 10
Common Raven	*Corvus corax*	C	C	C	C	X	X	1, 2, 8, 10
Black-capped Chickadee	*Parus atricapillus*	U	U	U	U	X	X	1, 2, 8, 9
Boreal Chickadee	*Parus hudsonicus*				C		X	8, 9, 10
Red-breasted Nuthatch	*Sitta canadensis*				R		X	8, 9
Brown Creeper	*Certhia americana*	U	U	U	U	X	X	1, 2, 9
Winter Wren	*Troglodytes troglodytes*	C	C	C	C	X	X	1, 2, 9
American Dipper	*Cinclus mexicanus*	C	C	C	C	X	X	1, 2, 9
Golden-crowned Kinglet	*Regulus satrapa*	U	U	U	U	X	X	1, 2, 9
Ruby-crowned Kinglet	*Regulus calendula*	R	R	R		X	X	1, 2, 9
Northern Wheatear	*Oenanthe oenanthe*	A	A	A	-	X		1, 2
Gray-cheeked Thrush	*Catharus minimus*	C	C	C	-	X	X	1, 2, 9, 10
Swainson's Thrush	*Catharus ustalatus*	U	U	U	-	X	X	1, 2, 9
Hermit Thrush	*Catharus guttatus*	C	C	C	-	X	X	1, 2, 9
American Robin	*Turdus migratorius*	C	C	C	-	X	X	1, 2, 9, 10
Varied Thrush	*Ixoreus naevius*	C	C	C	R	X	X	1, 2, 9, 10

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Yellow Wagtail	*Montacilla flava*	A	A	A	-			1, 2
American Pipit	*Anthus rubescens*	C	C	C	A	X	X	1, 2, 9
Bohemian Waxwing	*Bombycilla garrulus*	R	R	R	-		X	1, 2, 8
Northern Shrike	*Laninus excubitor*	U	U	U	U	X	X	1, 2, 8, 9
Orange-crowned Warbler	*Vermivora celata*	C	C	C	-	X	X	1, 2, 9, 10
Yellow Warbler	*Dendroica petechia*	C	C	C	-	X	X	1, 2, 9, 10
Yellow-rumped (Myrtle) Warbler	*Dendroica coronata*	U	U	U	-	X	X	1, 2, 9, 10
Blackpoll Warbler	*Dendroica striata*	C	C	C	-	X	X	1, 2, 9, 10
Northern Waterthrush	*Seiurus noveboracensis*	C	C	C	-	X		1, 2
Wilson's Warbler	*Wilsonia pusilla*	C	C	C	-	X	X	1, 2, 9, 10
American Tree Sparrow	*Spizella arborea*	U	U	U	R	X	X	1, 2, 9, 10
Chipping Sparrow	*Spizella passerina*	R					X	9
Savannah Sparrow	*Passerculus sandwichensis*	C	C	C	A	X	X	1, 2, 9, 10
Fox Sparrow	*Passerella iliaca*	C	C	C	-	X	X	1, 2, 9, 10
Song Sparrow	*Melospiza melodia*	C	C	C	C	X	X	1, 2, 9
Lincoln's Sparrow	*Melospiza lincolnii*	U	U	U	-	X	X	1, 9, 10
Golden-crowned Sparrow	*Zonotrichia atricapilla*	C	C	C	-	X	X	1, 2, 8, 9
White-crowned Sparrow	*Zonotrichia leuophrys*	C	C	C	-	X	X	1, 2, 8, 9, 10
Dark-eyed (Slate-colored) Junco	*Junco hyemalis*	U	U	U	R	X	X	1, 2, 9, 10
Lapland Longspur	*Calcarius lapponicus*	C	C	C	A	X	X	1, 2, 9
Snow Bunting	*Plectrophenax nivalis*	C	C	C	C	X	X	1, 2, 8
Mckay's Bunting	*Plectrophenax hyperboreus*				R		X	8
Rusty Blackbird	*Euphagus carolinus*	U	U	U	-	X	X	1, 2, 9, 10
Rosy Finch	*Leucosticte arctoa*	C	C	C	C	X		1, 2
Pine Grosbeak	*Pinicola enucleator*	U	U	U	U	X	X	1, 2, 8, 9

Common Name	Scientific Name	Spring	Summer	Fall	Winter	Breeding	Observed	Reference
Red Crossbill	*Loxia curvirostra*	-	R	A	-			1, 2
White-winged Crossbill	*Loxia leucoptera*	U	U	U	U	X	X	1, 2, 8, 9
Common Redpoll	*Corduelis flammea*	C	C	C	C	X	X	1, 2, 8, 9, 10
Hoary Redpoll	*Carduelis hornemanni*	U	-	U	C		X	1, 2, 8, 9

Codes:
C - Common
U - Uncommon
R - Rare
A - Accidental

Sources:
1. Armstrong 1991
2. USFWS 1993a
3. Scharf 1993
4. MacGowan 1994
5. Moore 1996
6. Ruhl and Moore 1996
7. Ruhl 1997
8. Anonymous undated (a)
9. Anonymous undated (b)
10. ABR, Inc., (Boisvert and Frost) site visit 2005

Note: Species listed by phylogenic order.

Appendix 3.0 - Barter. Barter Island Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Barter Island LRRS

3.1 Location and Area

Barter Island LRRS is located on the northern coast of Alaska near the Canadian border, 646 miles north of Anchorage, 389 miles north of Fairbanks, and about 310 miles east of Barrow (INRMP Figure 3.1). The facility is sited on 641 acres (Figure 3.1) of low-lying tundra within the Arctic NWR. The surrounding area is nearly flat, with land surface elevation at all points of the installation within 50 feet above sea level.

3.2 Installation History

DEW Line construction stretched across the northern coast of Alaska and Canada. There were six main stations (two in Alaska: Point Barrow and Barter Island), 20 auxiliary stations, and 28 intermediate stations (Denfeld 1993). Barter Island LRRS became operational in 1957. In the mid-1980s Barter Island was upgraded into a North Warning LRRS.

Two contract personnel are responsible for the operation, maintenance, and support of the LRRS. Clean Sweep activities occurred at Barter Island in 2006 and 2007. Future plans for the site are to reduce the Air Force Public Land Order withdrawal to approximately 50 acres. Excess property held under this order will be relinquished through the BLM and transferred to the village of Kaktovik, Kaktovik Inupiat Corporation, with excess facilities, including the airfield and hangar.

Even though the USAF owns the airfield at Barter Island, the USAF has shared the airfield with the Native Village of Kaktovik ever since it was built in the late 1940s. As there are no other airfields in the immediate vicinity available to this village, it serves as their link to the rest of Alaska. 611 ASG has a Memorandum of Agreement with the North Slope Borough for their use of the airfield in exchange for airfield management and needed snow removal support for the site, to include the airfield. Of note, a new airfield is being constructed on the other side of the island and is anticipated to be completed in 2014.

3.3 Surrounding Communities

The native village of Kaktovik is one mile southeast of the main living area at Barter Island. Kaktovik has a population of 239 (2010 estimate) persons (www.dced.state.ak.us 2012). The village dates back to 1923 when a trading station was established during the height of the fur trade. The community relocated in 1947, 1952, and 1964 to accommodate the establishment and expansion of the Barter Island LRRS (ICF Technology, Inc. 1996a).

Kaktovik was incorporated in 1971. Due to Kaktovik's isolation, the village has maintained its Inupiat Eskimo traditions. Subsistence is highly dependent upon caribou. Economic opportunities in Kaktovik are limited due to the isolated location. Most employment is in education, the North Slope Borough, or in providing city services (www.dced.state.ak.us 2012).

3. 4 Regional Land Use

The U.S. Department of Interior owns the property occupied by Barter Island LRRS. Barter Island LRRS is withdrawn from public domain by public land order for military purposes. Barter Island's location within the Arctic NWR requires coordination between the USFWS and USAF to conduct the military mission of the LRRS while protecting waterfowl and wildlife resources of the refuge. The USFWS retains the authority to manage fish and wildlife habitat on Arctic NWR.

Six cultural resources sites, including traditional land use and prehistoric sites, are known in the vicinity of Barter Island. The oldest and most substantial site, Qaaktugvik, consists of 30-40 house pits and probably represents the Thule Tradition. Most other sites represent Traditional Land Use sites. None of the sites have been evaluated for listing in the National Register of Historic Places (ICF Technology, Inc. 1996a).

3. 5 Local and Regional Natural Areas

The Arctic NWR encompasses Barter Island LRRS. Renowned for its wildlife, the Arctic NWR is inhabited by 45 species of land and marine mammals, ranging from the pygmy shrew to the bowhead whale. Thirty-six species of fish occur in refuge waters, and 180 species of birds have been observed on the refuge. Eight million acres of the Arctic NWR are designated wilderness, and three rivers (Sheenjek, Wind, and Ivishak) are designated Wild Rivers. Two areas are designated Research Natural Areas, and several rivers, canyons, lakes, and rock mesa have been recommended as national Natural Landmarks. The refuge encompasses the traditional homelands and subsistence areas of Inupiaq Eskimos of the arctic coast and the Athabascan Indians of the Interior (USFWS 2007a).

Figure 3.1 Barter Island LRRS

4.0 Physical Environment

4.1 Climate
The climate of Barter Island is determined by the surrounding open Arctic water surface. There are no elevations of consequence closer than the Brooks Range, 65 miles to the south, and no local topographic features to affect winds, temperatures, and precipitation (CH2M Hill 1981).

Temperatures remain below freezing most of the year with the daily maximum temperature higher than freezing only 116 days annually. The daily minimum temperature drops below freezing 313 days of the year, and freezing temperatures have been noted in every month. February is generally the coldest month, and July is the warmest. Average daily minimum and maximum temperatures in summer are 30°F and 46°F, respectively. In winter these temperatures are -20°F and -6°F, respectively. The record low temperature of -59°F occurred in February 1950, and the record high temperature of 78°F occurred in July 1974. Strong winter winds can cause the wind chill factor to reach below -100°F (CH2M Hill 1981).

Precipitation is light, year-round, averaging just 6.5 inches annually, mostly occurring as rain in July and August. Snowfall occurs all months of the year and averages 47 inches annually (Legare 1998). Most snowfall occurs in September and October, and the least falls in July and August (CH2M Hill 1981).

Prevailing winds are easterly and average nearly 13 mph with very little annual variation; however, October and November winds are the strongest. Steady winds of 38 mph have been reported every month of the year, and an extreme steady speed of 81 mph with gusts to 91 mph was reported in January 1974 (CH2M Hill 1981).

4.2 Landforms
Barter Island LRRS is situated in the Arctic Coastal Plain physiographic region. The Coastal Plain is a relatively smooth surface showing little relief, sloping downward to the north from the foothills of the Brooks Range. Due to the flat terrain and the continuous occurrence of permafrost, marshes and lakes are abundant. The coastline is characterized by low coastal banks with narrow gravel beaches. Coastal erosion occurs as thermal undercutting of the frozen bank and slumping into the sea (CH2M Hill 1981).

The LRRS is located on the northeastern shore of Barter Island, a tundra-remnant island formed by the sea’s thermal erosion of its ice-rich soils. Northeastern and northwestern ends of the island are sand and gravel spits formed by long shore drift processes. The island is nearly flat; local features include a few small incised stream channels, small thaw lakes and ponds, and tundra polygons. The island reaches an elevation of 55 feet above msl, but the installation sits at a somewhat lower elevation (CH2M Hill 1981).

4.3 Geology and Soils
Except for gravel spits on its ends, Barter Island is composed of permanently frozen sediments of the Quaternary Gubik Formation - mixtures and lenses of marine and alluvial clay, silt, sand, and gravel that mantle most of the Arctic Coastal Plain. The upper foot or so of the soil is composed of windblown silts topped by a thin, peaty tundra mat, which supports a variety of tundra vegetation.

Permafrost is continuous at Barter Island and is probably hundreds of feet deep. Summer thaw depths in the active layer range from about 18 inches in the tundra soils to four feet or more beneath larger lakes that do not freeze to the bottom in winter. Larger thaw bulbs may exist.

Polygonal ground exists throughout most of the island, indicating that ice lenses extend downward several feet into the frozen silts. The water content of these permafrost soils is high, making them unstable when thawed and resulting in considerable slumping and subsidence.

4.4 Hydrology

4.4.1 General

Several small streams cross the facility, draining generally to the north. Surface runoff occurs as sheet flow and ephemeral streams and may drain into larger streams or directly to the ocean. Infiltration to shallow depths occurs during summer when active layers thaw.

Several large and small lakes are located in the vicinity of the LRRS. They are generally less than 10 feet deep, and many freeze to the bottom during winter. Fresh Water Lagoon, about 1/3 mile south of the facility, is about nine feet deep and freezes to about six feet in winter. This freshwater lake provides drinking water for the LRRS.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. The 5.77-foot msl elevation of the 1964 storm represents the 100-year flood level. All facilities except the airport are at 45 feet msl. The airport on the spit is vulnerable to severe coastal storms. Most airport facilities are minimally elevated or slightly above the 100-year flood plain. One spot elevation on the western end of the runway is 4.73 feet msl, which is in the 100-year flood plain.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Barter Island LRRS. Much information included in INRMP Chapter 5.0 that includes Barter Island LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Barter Island LRRS and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at Barter Island LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M121 Brooks Range Tundra-Polar Desert Province
Description: The province's landscape varies from rugged peaks of 9,000 feet to U-shaped valleys, braided stream channels, and rolling plateaus. The climate is similar to the arctic coastal plain, but at higher altitudes, precipitation increases. Since the province is above the Arctic Circle, it gets several days of 24-hour sunlight in June and sunless days in December. Precipitation averages 7-15 inches. Higher elevation consists of low mats of shrubby flora species, lower elevations are covered by mats of sedge and shrub. Soils for the province are rocky and poorly developed; Inceptisols are found on lower slopes.

5.2 Vegetation

Specific habitat types of the coastal zone identified by the USFWS are sedge-grass marsh, tussock-heath tundra, tundra-freshwater pond or lake edge, river waters, lagoons, and reefs. There are three major habitat types on Barter Island: beach and spit, tidal salt marsh, and tundra (ICF Technology, Inc. 1996a). Arctic wormwood commonly occurs at margins of gravel roads throughout the site.

A general vegetation map of Barter Island LRRS was presented in Woodward-Clyde (1995c). Schick *et al*. (2004) made significant improvements in vegetation mapping at Barter Island LRRS (using 2000 digital aerial photography) with the preparation of a wildlife habitat map (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Barter Island LRRS in 2001 and 2010. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth for each site and, if available, 2009-2010 SPOT-5 satellite imagery (http://www.alaskamapped.org/ortho). Table 5.2 shows these acreages and changes over this 9-year period. Figure 5.2a shows habitat classes for 2010, and Figure 5.2b shows changes in habitat classes between 2001through 2010.

Table 5.2 Habitat Class Differences between 2001 and 2010, Barter Island LRRS

Habitat Class	Acres 2001	Acres 2010	Acreage Change
Barren Land	167.4	166.1	-1.3
Dwarf Shrub	12.4	12.4	0.0
Emergent Herbaceous Wetlands	74.7	74.7	0.0
Open Water	141.6	150.9	9.2
Perennial Ice/Snow	8.9	8.9	0.0
Sedge/Herbaceous	254.2	246.2	-8.0
Totals	**659.2**	**659.2**	**0.0**

The Barter Island LRRS area encompasses about 641 acres. Wildlife habitats at the LRRS are primarily marine, lacustrine, and lowland tundra types with no riverine and or upland habitat types present. Inshore marine and coastal water bodies comprise 21.57% (131.70 hectares) of the LRRS, and lacustrine freshwaters cover 10.47% (63.92 hectares) of the area. Of the water bodies, Marine Water and Deep Water are predominant types (126.90 hectares and 56.28 hectares, respectively). However, only one large deep lacustrine lake comprises the Deep Water type and is located in the south-central portion of the LRRS. Additionally, small shallow coastal brackish ponds are located along the spit, and several smaller lacustrine lakes and ponds are scattered in the central portion and along the southern boundary of the LRRS. Freshwater lakes and ponds with islands and/or polygonized margins, which provide preferred habitat for nesting and brood-rearing water birds, occur at Barter Island LRRS but they are not common (5.09 hectares, 0.83% of the land area) (Schick *et al*. 2004).

Young and Old Basin Wetland Complexes, which also provide quality nesting habitat for waterbirds, constitute 27.63 hectares or 4.53% of the LRRS. Of note is the small Young Basin Wetland Complex in the southern portion of the property, which surrounds a set of interconnected shallow ponds with both islands and polygonized margins. This mixture of habitats is ideal nesting habitat for waterbirds. Coastal Salt Marsh, a habitat often used by brood-rearing waterfowl, occurs along the spit in the northeastern section of the LRRS, but constitutes only 0.20 hectares (0.03%) of the area. Of remaining habitats, freshwater marsh and lowland tundra habitats are the primary wildlife habitats at the LRRS and cover 2.03 % (12.37 hectares) and 50.74% (309.77 hectares) of the land area, respectively. Of the tundra habitats, Lowland Moist Sedge–Shrub Tundra is by far the most common (265.86 hectares), followed by Lowland Patterned Wet Tundra (14.64 hectares) and Lowland Wet–Moist Patterned Tundra Complex (9.38 hectares, Table 7). Artificial habitats including gravel fill and drainage impoundments occupy 48.39 hectares of the LRRS (7.92% of the area).

Figure 5.2a Barter Island LRRS Habitat Map, 2010

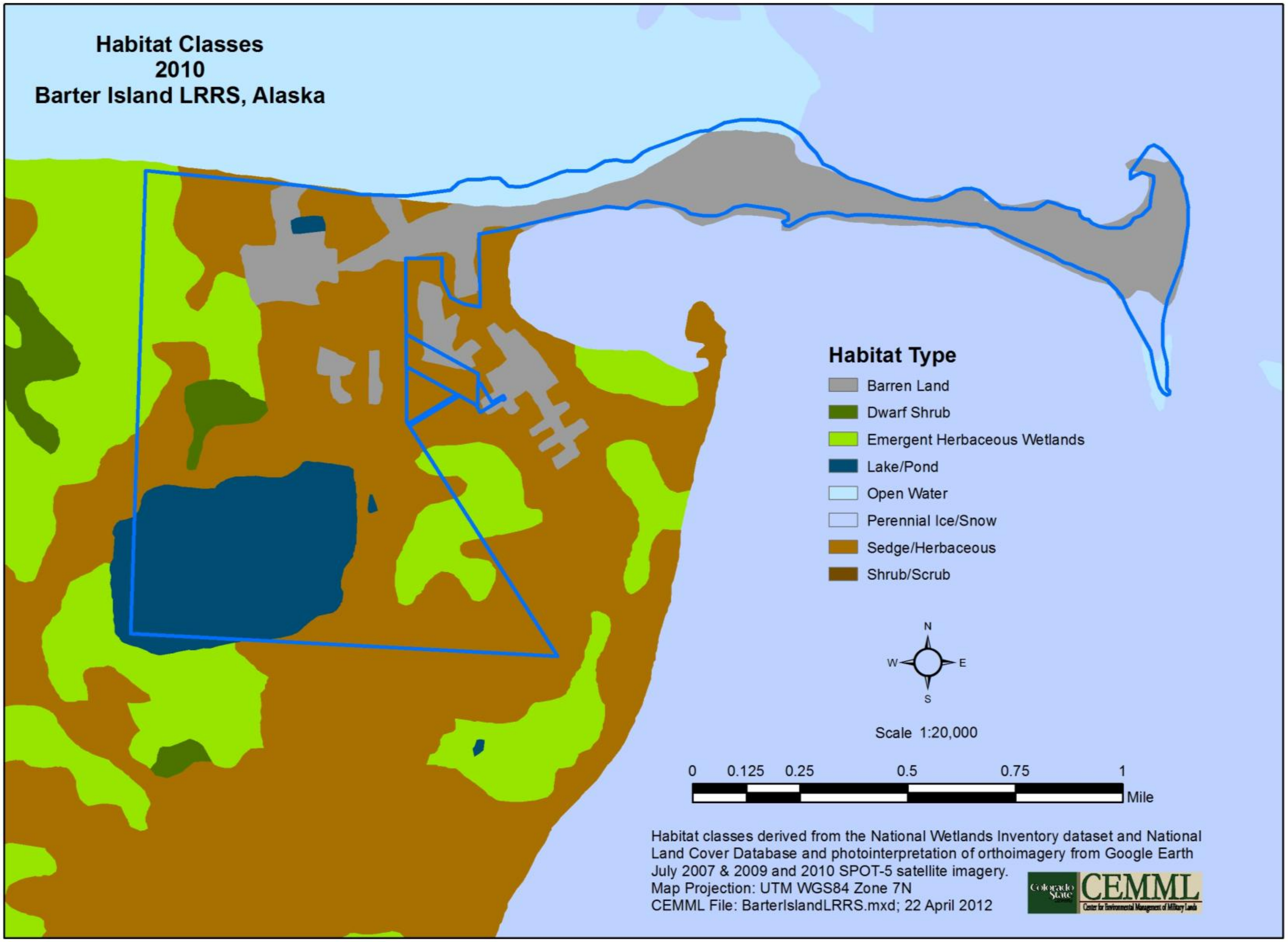


Figure 5.2b Changes in Habitat Classes at Barter Island LRRS between 2001 and 2010

5.3 Fish and Wildlife

5.3.1 Fish

Several species of anadromous fish have been described as principal species of the southern Beaufort Sea, including broad and humpback whitefish, Arctic and least cisco, Arctic char, inconnu, rainbow smelt, and pink and chum salmon (ADFG 1992). Arctic char is the most commonly targeted species for subsistence and recreational fishing. A commercial fishery for broad whitefish occurs annually on the Colville River. Arctic char are the most numerous fish species in the Kaktovik Lagoon area. Other species in the area are saffron cod, Arctic grayling, and eelpout (personal communication, Hupp, USFWS in Woodward-Clyde (1995c); ICF Technology, Inc. 1996a).

5.3.2 Mammals

The most common small mammals on the Arctic Coastal Plain are brown and collared lemmings. Caribou are abundant on the Arctic Coastal Plain. However, they are uncommon and only occur in small numbers on Barter Island. The tundra vole has been found in Barter Island (Barkalow 1952). Three muskox herds move along riparian habitats south of Barter Island (ICF Technology, Inc. 1996a).

The beluga whale and bowhead whale occur on a regular basis and are harvested by native hunters. Gray whales and narwhales are infrequent visitors to the area. Other marine mammals include the killer whale, bearded seal, ringed seal, and polar bear (Wynne 1993). Bearded and ringed seals are harvested by local natives (personal communication, R. Suydam, Wildlife Management Department, North Slope Borough in Woodward-Clyde 1995c).

Although most marine mammals are under the jurisdiction of the NMFS, the polar bear is under the jurisdiction of the USFWS. The LRRS is within the range of the polar bear (Bridges 2001), a protected species under the MMPA. As discussed in INRMP Section 7.4.5, *Polar Bear Interaction Reduction*, there are concerns involving polar bear-human interactions at this site.

5.3.3 Birds

The wet tundra environment of the coastal zone of the Arctic NWR provides nesting and foraging habitat for a wide variety of bird species. The 2002 survey occurred during July and August, which is outside the nesting period. Thus, 2002 sightings are post-breeding sightings. Twenty-one bird species were observed at Barter Island LRRS during the 2002 survey.

Migratory birds using the area, and observed during 2002 site visits, include the White-fronted Goose, Tundra Swan, Mallard, Northern Shoveler, Northern Pintail, Common Eider, Longtail Duck, and Red-throated and Pacific Loons. American Golden-plover; Semipalmated, Baird’s, and Pectoral Sandpipers; Long-billed Dowitcher, and Red-necked Phalarope were observed during 2002. Other species observed include the Peregrine Falcon, Sandhill Crane, Glaucous Gull, Common Raven, Lapland Longspur, and Snow Bunting.

Predatory birds that use the coastal zone include Snowy Owls, Short-eared Owls, Pomarine Jaegers, Long-tailed Jaegers, and Parasitic Jaegers. A pair of nesting Ravens uses one of the smaller radar towers on the property. Arctic Peregrine Falcons, a formerly threatened species, nested on the tundra bluff facing the Beaufort Sea of the LRRS in 1991 and 1992 (personal communication, Hupp, USFWS in Woodward-Clyde 1995c).

5.4 Threatened and Endangered Species

Six protected species potentially occur within the vicinity of Barter Island: the endangered Spectacled Eider and bowhead whale, threatened polar bear, candidate Kittlitz’s Murrelet, and threatened ringed seal and bearded seal. Day *et al*. (1995) surveyed for Spectacled and Steller's Eiders at remote USAF sites but did not locate either species at Barter Island LRRS, and the site was identified as having little potential for nesting Spectacled Eiders or nesting Steller's Eiders. The polar bear and both seals are confirmed for Barter Island. The North American lynx, a former Category 2 Candidate species, is likely found at Barter Island.

5.5 Wetlands

Wetlands at Barter Island LRRS are predominantly classified as palustrine, persistent emergent/broad-leaved deciduous shrub. These areas are typically moist and wet tundra and are either saturated or seasonally flooded, depending on microtopography and landscape position. Some lower, wetter, and seasonally flooded areas lack the shrub component. Deep and shallow open water habitats are also common, including lakes and ponds, sometimes with emergent vegetation (*e.g*., *Arctophila fulva* and *Carex aquatilis*) growing in permanently flooded shallow margins. Coastal areas of Barter Island include wildlife habitats such as Coastal Salt Marsh, Coastal Brackish Water, and Marine Water, which are classified as marine or estuarine wetlands. Wetlands in the vicinity of the airstrip are mostly irregularly flooded estuarine intertidal areas with emergent vegetation (Schick *et al*. 2004).

The general Barter Island LRRS vegetation map's wetland features (Woodward-Clyde 1995c) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). These sources are used to facilitate decisions regarding facility siting. Barter Island LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (50.55 acres). Figure 5.5 shows wetlands on Barter Island LRRS from 2011 data.

5.6 Other Natural Resource Information

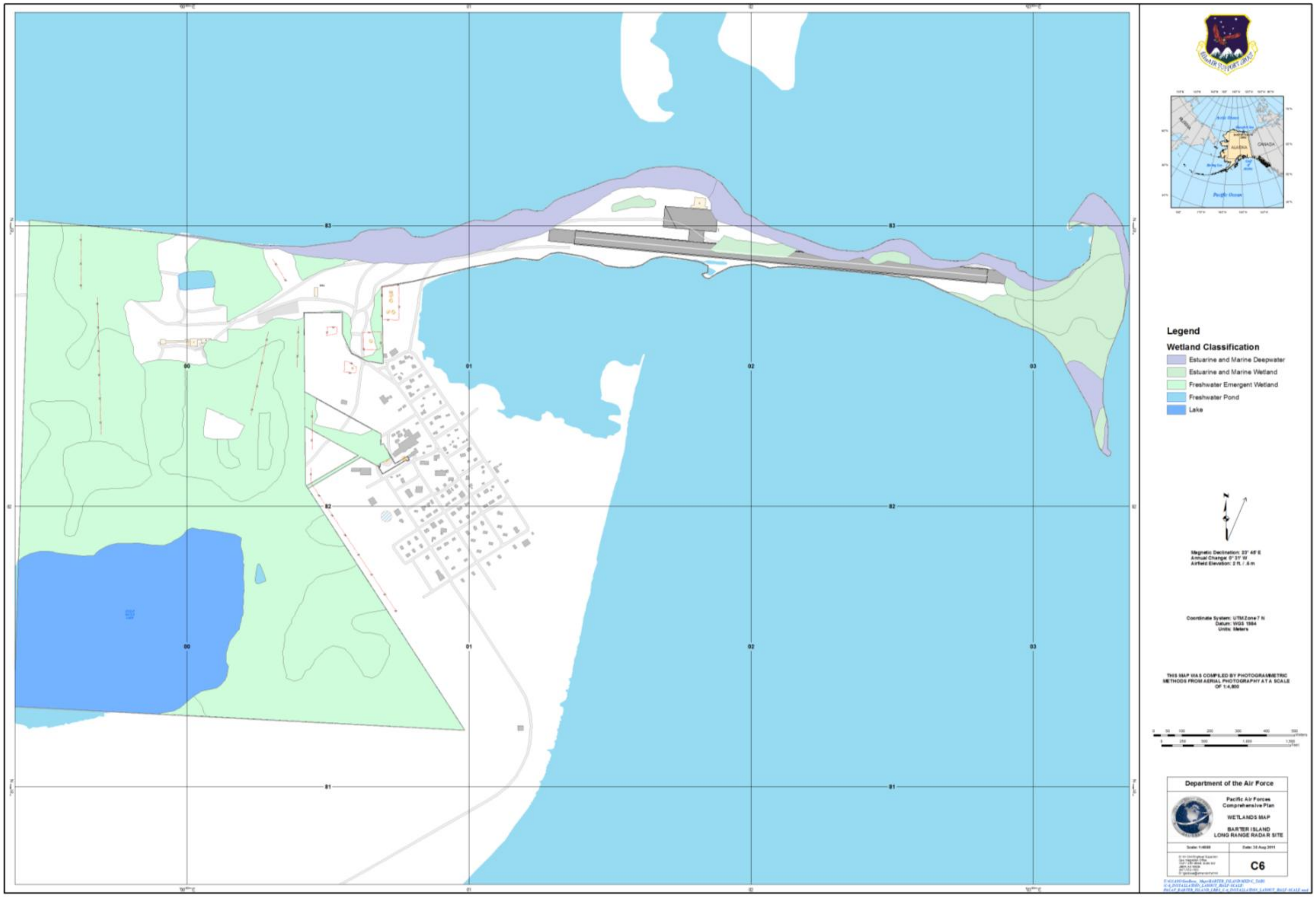
5.6.1 Subsistence

Kaktovik lies within the Arctic National Wildlife Refuge, and residents use those lands for much of their subsistence activity. Caribou and bowhead whales are staple subsistence items, and seals (bearded, ringed, and spotted) are important, as are ducks, geese, and several fish species. Kaktovik is one of 10 Alaska Eskimo Whaling Commission communities. Whaling is the basis for much of the social organization in the region. The Kaktovik subsistence use area extends from Prudhoe Bay to the Canadian/ Alaskan border. Kaktovik residents rely heavily on large land and marine mammals and fish. Three species, bowhead whale, caribou, and char, account for about 84 percent of Kaktovik's annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Natural resources-related recreational activities are fairly limited because Barter Island is isolated from the rest of the Arctic Coastal Plain. Caribou and brown/grizzly bear are relatively scarce and do not provide hunting opportunities. A limited amount of recreational fishing for Arctic char is available to LRRS personnel. Even hiking or walking is often limited due to extreme or poor weather conditions. Wildlife viewing of polar bears occurs in the area primarily by tourists (personal communication, P. Cooley 2007). The 1951 Public Land Order no. 715 that withdrew lands for military purposes includes a provision that allows "the right of the natives to hunt, fish, trap, and otherwise use the land in their customary manner."

Figure 5.5 Barter Island LRRS Wetlands, 2011



6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities at Barter Island LRRS include the main site area, an airfield, and a fuel storage and filling area. The North Slope Borough has a license to use Building 3054 for the School District. The USAF is interested in transferring this building to the Borough. The Borough has a lease to use the runway (in exchange for runway maintenance) and a terminal building. The runway is 4,820 feet long with 260-foot and 480-foot overruns on the eastern and western ends, respectively (ICF Technology, Inc. 1996a). The Borough also has easements (expired) for water and fuel utility lines. The National Aeronautics and Space Administration has a permit (expired) to use a building as an observatory for upper atmosphere and aurora research. The Federal Aviation Authority has permits (expired) for the Visual Approach Slope Indicator system and the Alaska National Airspace Interfacility Communication System. The USFWS has permits (expired) for use of a warehouse and 0.1 acre for two fuel tanks; however, there is an effort to change the location and increase the size of the tanks. The City of Kaktovik has a lease (expired) to use a whaling Shack at beach.

APPENDIX A: Natural Resources of Barter Island, Oliktok, and Point Barrow Long Range Radar Sites

Table A1: Vascular Plant Species Observed or Potentially Occurring on or near Barter Island, Oliktok, and Point Barrow Long Range Radar Sites

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
Shrub	Bog rosemary	*Andromeda polifolia*					
shrub	Alpine bearberry	*Arctostaphylos alpine*			X		2, 4
shrub	Red-fruit bearberry	*Arctostaphylos rubra*	X	X	X		2
shrub	Dwarf birch	*Betula nana*					
shrub	Lapland cassiope	*Cassiope tetragona*	X	X	X	All	2, 3, 4, 5, 6
shrub	Bunchberry	*Cornus Canadensis*		X			1, 2, 3
shrub	Diapensia	*Diapensia lapponica*					2, 3
shrub	Arctic avens	*Dryas integrifolia*	X	X	X	OLI, BTI	1, 2, 3, 5, 6
shrub	White Mtn.-avens	*Dryas octopetala*					2
shrub	Crowberry	*Empetrum nigrum*			X	BTI	2, 5, 6
shrub	Narrowleaf labrador tea	*Ledum palustre* ssp. *Decumbens*	X	X	X	OLI	2
shrub	Alpine azalea	*Loiseleuria procumbens*					1, 3
shrub	Lapland rosebay	*Rhododendron lapponicum*					2, 3
shrub	Cloudberry	*Rubus chamaemorus*	X	X	X	BTI	2, 4,5, 6
shrub	Feltleaf willow	*Salix alaxensis*	X	X	X		2, 4
shrub	Arctic willow	*Salix arctica*	X	X	X	All	2, 4, 5, 6
shrub	Chamisson's willow	*Salix chamissonis*			X	BTI	
shrub	Alaska bog willow	*Salix fuscescens*	X	X	X	BTI	2
shrub	Northern willow	*Salix glauca*	X	X	X	BRW	2, 5
shrub	Woolly willow	*Salix richardsonii*	X	X	X	BRW, BTI	2, 5
shrub	Snow willow	*Salix niphoclada*			X	BTI	
shrub	Oval-leafed willow	*Salix ovalifolia*	X	X	X	All	2, 5
shrub	Veiny-leafed willow	*Salix phlebophylla*	X	X	X	BRW, BTI	2, 5
shrub	Polar willow	*Salix polaris*	X	X	X	BRW	2, 6
shrub	Diamond-leaf willow	*Salix pulchra*	X	X	X	All	1, 4, 5
shrub	Net-veined willow	*Salix reticulate*	X	X	X	BTI, OLI	2, 3, 5
shrub	Round-leaf willow	*Salix rotundifolia*	X	X	X	All	2, 5
shrub	Bog blueberry	*Vaccinium uliginosum*			X		2
shrub	Mountain cranberry	*Vaccinium vitis-idaea*	X	X	X	All	2
herbaceous	Alpine foxtail	*Alopecurus alpinus*	X	X	X	BRW, OLI, BTI	5, 6
herbaceous	Rock jasmine	*Androsace chamaejasme*	X	X	X	OLI, BTI	1, 3, 5
herbaceous	Northern jasmine	*Androsace septentrionalis*	X	X	X		1, 4

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous	Pasque flower	*Anemone multiceps*			X		1, 4
herbaceous	Narcissus-flower anemone	*Anemone narcissiflora*					1, 3
herbaceous	Northern anemone	*Anemone parviflora*	X	X	X		1, 3
herbaceous	Yellow anemone	*Anemone richardsonii*	X	X	X		1, 3
herbaceous	Pussytoes	*Antennaria friesiana*	X	X	X		1, 4
herbaceous	Cats paws	*Antennaria monocephala*	X	X	X		1, 4
herbaceous	Polar grass	*Arctagrostis latifolia*	X	X	X	All	5
herbaceous	Pendent grass	*Arctophila fulva*	X	X	X	All	1, 4, 5, 6
herbaceous	Tall sandwort	*Arenaria capillaris*					1, 4
herbaceous	Alpine arnica	*Arnica alpina*	X	X	X		1, 3, 4
herbaceous	Frigid arnica	*Arnica frigida*	X	X	X		1, 3
herbaceous	Lessing’s arnica	*Arnica lessingii*					1, 4
herbaceous	Arctic wormwood	*Artemisa arctica* ssp. *arctica*		X	X	BTI, OLI	1, 4
herbaceous	Arctic wormwood	*Artemisa arctica* ssp. *comata*			X	BTI	1, 4, 5, 6
herbaceous	Northern wormwood	*Artemisa borealis*		X	X		1, 4
herbaceous	Purple wormwood	*Artemisia globularia*					1, 3
herbaceous	Wormwood	*Artemisia* sp.		X	X	OLI, BTI	6
herbaceous	Siberian aster	*Aster sibiricus*	X	X	X		1, 3
herbaceous	Alpine milkvetch	*Astragalus alpinus*	X	X	X	BTI, OLI	1, 3, 4, 5
herbaceous	Milkvetch	*Astragalus umbellatus*	X	X	X	BTI, OLI	1, 3, 5
herbaceous	Mountain meadow bistort	*Polygonum bistorta*	X	X	X	BTI, OLI	5
herbaceous	Alpine bistort	*Polygonum viviparum*	X	X	X	All	5
herbaceous	Moonwort	*Botrychium lunaria*					1, 4
herbaceous	Purplish braya	*Braya purpurascens*			X	BTI	5
herbaceous	Bluejoint	*Calamagrostis canadensis*					1, 4, 6
herbaceous	Reed bent grass	*Calamagrostis deschampioides*		X		OLI	6
herbaceous	Reed bent grass	*Calamagrostis* sp.		X	X		1, 4
herbaceous	Reed bent grass	*Calamagrostis stricta*	X			BRW	5
herbaceous	Marsh marigold	*Caltha palustris*	X	X	X	All	1, 3, 5
herbaceous	Bluebell	*Campanula lasiocarpa*	X	X	X		1, 3
herbaceous	Bittercress	*Cardamine digitata*			X	BTI	1, 3, 5
herbaceous	Boreal bittercress	*Cardamine hyperborea*					
herbaceous	Cuckoo flower	*Cardamine pratensis*	X	X	X	BRW, BTI, OLI	1, 4, 5, 6
herbaceous	Sedge	*Carex aquatilis*	X	X	X	All	1, 4, 5, 6

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous	Sedge	*Carex atrofusca*					
herbaceous	Sedge	*Carex bigelowii*	X	X	X	BTI, OLI	1, 4, 5, 6
herbaceous	Sedge	*Carex capillaris*		X	X	OLI, BTI	5
herbaceous	Sedge	*Carex glareosa*			X	BTI	5
herbaceous	Sedge	*Carex maritima*			X	BTI	5
herbaceous	Sedge	*Carex membranacea*			X	BTI	5
herbaceous	Sedge	*Carex misandra*			X	BTI	5
herbaceous	Sedge	*Carex rariflora*		X	X	BTI, OLI	5
herbaceous	Sedge	*Carex rotundata*		X	X	BTI, OLI	5
herbaceous	Sedge	*Carex saxatilis*		X	X	BTI, OLI	5
herbaceous	Sedge	*Carex subspathacea*	X	X	X	All	5
herbaceous	Sedge	*Carex ursina*	X	X	X	BRW, BTI, OLI	5
herbaceous	Sedge	*Carex vaginata*					
herbaceous	Elegant paintbrush	*Castilleja elegans*					1, 3
herbaceous	Paintbrush	*Castilleja* sp.					1
herbaceous	Beringian chickweed	*Cerastium beeringianum*	X	X	X	All	1, 4, 5, 6
herbaceous	Chickweed	*Cerastium jenisejense*	X		X	BRW, BTI	5
herbaceous	Arctic daisy	*Chrysanthemum arcticum*			X		1, 3
herbaceous	Entire-leaved chrysanthemum	*Chrysanthemum integrifolium*	X	X	X	BTI, OLI	1, 3, 5
herbaceous	Northern water carpet	*Chrysosplenium tetrandrum*	X		X	BTI, BRW	5
herbaceous	Bering Sea water carpet	*Chrysosplenium wrightii*	X		X	BTI	5
herbaceous	Alaska spring beauty	*Claytonia sarmentosa*					1, 3
herbaceous	Scurvy grass	*Cochlearia officinalis*	X	X	X	All	5
herbaceous	Coral root	*Corallorrhiza trifida*		X	X		1, 3
herbaceous	Cushion hawk's beard	*Crepis nana*			X		1, 3, 4
herbaceous	Dwarf larkspur	*Delphinium brachycentrum*					
herbaceous	Frigid shooting star	*Dodecatheon frigidum*		X	X		1, 3
herbaceous	Ochotsk douglasia	*Douglasia ochotensis*		X	X		1, 3
herbaceous	Draba	*Draba alpina*			X	BTI	5
herbaceous	Smoothing whitlow-grass	*Draba hirta*		X	X		1, 3, 6
herbaceous	Draba	*Draba lactea*	X		X	BRW, BTI	5, 6
herbaceous	Tundra grass	*Dupontia fischeri*	X	X	X	All	5, 6
herbaceous	Tundra grass	*Dupontia fisheri* ssp. *Psilosantha*	X		X	BRW, BTI	5
herbaceous	Fireweed	*Epilobium angustifolium*					

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous		*Epilobium davuricum*					
herbaceous	River beauty	*Epilobium latifolium*	X	X	X	BTI	1, 3, 5, 6
herbaceous	Common horsetail	*Equisetum arvense*			X	BTI	5
herbaceous	Variegated horsetail	*Equisetum variegatum*			X	BTI	5
herbaceous	Cutleaf fleabane	*Erigeron compositus*					1, 3
herbaceous	Dwarf fleabane	*Erigeron eriocephalus*			X	BTI	5
herbaceous	Fleabane	*Erigeron humilis*			X		1, 3
herbaceous	Arctic fleabane	*Erigeron hyperboreus*			X		1, 3
herbaceous	Narrow-leafed cottongrass	*Eriophorum angustifolium*	X	X	X	All	5
herbaceous	Russet cottongrass	*Eriophorum russeolum*	X	X	X	All	5
herbaceous	Arctic cottongrass	*Eriophorum scheuchzeri*	X	X	X	All	1, 3, 5, 6
herbaceous	Cottongrass	*Eriophorum triste*	X		X	BRW, BTI	5
herbaceous	Sheathed cottongrass	*Eriophorum vaginatum*	X	X	X	All	5
herbaceous	Arctic forget-me-not	*Eritichum aretioides*	X	X	X		1, 3
herbaceous	Edward's eutrema	*Eutrema edwardsii*			X	BTI	5
herbaceous	Alpine fescue	*Festuca brachyphylla*	X		X	BRW, BTI	5
herbaceous	Red fescue	*Festuca rubra*			X	BTI	5
herbaceous	Fescue grass	*Festuca* sp.	X	X	X		1, 4, 6
herbaceous	Glaucous gentian	*Gentiana glauca*	X				1, 3
herbaceous	Glacier avens	*Geum glaciale*			X		1, 3
herbaceous	Alpine eskimo potato	*Hedysarum hedysaroides*					1, 4
herbaceous	Alpine holy grass	*Hierochloe alpine*	X	X	X	All	5
herbaceous	Arctic holy grass	*Hierochloe pauciflora*	X	X	X	All	5
herbaceous	Mare's tail	*Hippuris tetraphylla*			X	BTI	5
herbaceous	Mare's tail	*Hippuris vulgaris*			X	BTI	
herbaceous	Seabeach sandwort	*Honckenya peploides*	X	X	X	All	5
herbaceous	Rush	*Juncus biglumis*	X		X	BTI, BRW	5
herbaceous	Glaucous weaselsnout	*Lagotis glauca*			X	BTI	1, 3, 5
herbaceous	Bladder pod	*Lesquerella arctica*		X	X		1, 4
herbaceous	Lyme grass	*Leymus mollis*	X		X	BRW	5
herbaceous	Alp lily	*Lloydia serotina*	X	X	X	OLI	1, 3
herbaceous	Alpine azalea	*Loiseleuria procumbens*					1, 3
herbaceous	Arctic lupine	*Lupinus arcticus*	X	X	X		1, 4
herbaceous	Arctic woodrush	*Luzula arctica*	X		X	BTI, BRW	5

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous	Northern woodrush	*Luzula confuse*	X		X	BRW, BTI	5
herbaceous	Many-flowered woodrush	*Luzula multiflora*			X	BTI	5
herbaceous	Tundra woodrush	*Luzula tundricola*					
herbaceous	Wahlenberg's woodrush	*Luzula wahlenbergii*					
herbaceous	Fir club moss	*Lycopodium selago*		X		OLI	
herbaceous	Catchfly	*Melandrium affine*					
herbaceous	Bladder campion	*Melandrium apetalum*	X	X	X	OLI, BTI	1, 4, 6
herbaceous	Oysterleaf	*Mertensia maritime*	X		X	BRW, BTI	5
herbaceous	Arctic sandwort	*Minuartia arctica*			X	BTI	1, 4, 5
herbaceous	Alpine forget-me-not	*Myosotis alpestris*					1, 3
herbaceous	Moutain sorrel	*Oxyria digyna*	X		X	BRW, BTI	5
herbaceous	Boreal oxytrope	*Oxytropis borealis*					
herbaceous	Blackish oxytrope	*Oxytropis nigrescens* ssp. *bryophila*		X	X	BTI	1, 3, 5
herbaceous	Arctic poppy	*Papaver hultenii*	X			BRW	5
herbaceous	Lapland poppy	*Papaver lapponicum*	X	X	X	BTI	1, 3, 5
herbaceous	Macoun's poppy	*Papaver macounii*	X	X	X	BRW, OLI, BTI	5, 6
herbaceous	Kotzebue bog star	*Parnassia kotzebuei*					
herbaceous	Grass of parnassus	*Parnassia palustris*		X	X		1, 3, 4
herbaceous	Mustard	*Parrya nudicaulis*					
herbaceous	Lousewort	*Pedicularis capitata*	X	X	X	BTI	1, 3, 5
herbaceous	Lousewort	*Pedicularis kanei*	X	X	X	All	
herbaceous	Lousewort	*Pedicularis labradorica*					
herbaceous	Lousewort	*Pedicularis lanata*	X		X	BRW, BTI	5
herbaceous	Lousewort	*Pedicularis langsdorffii*	X			BRW	5
herbaceous	Oeder's lousewort	*Pedicularis oederi*					1, 3
herbaceous	Lousewort	*Pedicularis sudetica*	X	X	X	All	1, 3, 5, 6
herbaceous	Lousewort	*Pedicularis sudetica* ssp. *albolabiata*	X		X	BRW, BTI	5
herbaceous	Bumble bee flower	*Pedicularis verticillata*	X	X	X		1, 3, 6
herbaceous	Sweet coltsfoot	*Petasites frigides*	X	X	X	All	1, 5, 6
herbaceous	Snow grass	*Phippsia algida*	X		X	BRW, BTI	5
herbaceous	Siberian phlox	*Phlox sibirica*					1, 3
herbaceous	Common bluegrass	*Poa alpigena*	X		X	BRW, BTI	5
herbaceous	Alpine bluegrass	*Poa alpine*					1, 4
herbaceous	Arctic bluegrass	*Poa arctica*	X	X	X	All	5

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous	Blue grass	*Poa glauca*	X	X	X	All	6
herbaceous	Blue grass	*Poa* sp.	X	X	X		1, 4
herbaceous	Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	X		1, 3
herbaceous	Boreal Jacob's ladder	*Polemonium boreale*			X	BTI	5
herbaceous	Two-flowered cinquefoil	*Potentilla biflora*					1, 3
herbaceous	Arctic cinquefoil	*Potentilla hyparctica*	X		X	BRW, BTI	5
herbaceous	Marsh fivefinger	*Potentilla palustris*		X	X		1, 3
herbaceous	Bright conquefoil	*Potentilla pulchella*			X	BTI	5
herbaceous	One-flowered cinquefoil	*Potentilla uniflora*		X	X		1, 3
herbaceous	Northern primrose	*Primula borealis*		X	X	BTI, OLI	1, 3, 5
herbaceous	Anderson's alkali grass	*Puccinellia andersonii*					
herbaceous	Dwarf alkali grass	*Puccinellia langeana*	X		X	BTI, BRW	5
herbaceous	Creeping alkali grass	*Puccinellia phryganodes*	X	X	X	All	5
herbaceous	Large-flowered wintergreen	*Pyrola grandiflora*	X	X	X	OLI	1, 3
herbaceous	Gmelin's buttercup	*Ranunculus gmelinii*			X	BTI	5
herbaceous	Arctic buttercup	*Ranunculus hyperboreus*	X		X	All	5
herbaceous	Snow buttercup	*Ranunculus nivalis*	X		X	BRW, BTI	5
herbaceous	Pallas's buttercup	*Ranunculus pallasii*	X		X	BRW, BTI	5
herbaceous	Pygmy buttercup	*Ranunculus pygmaeus*	X		X	BRW, BTI	5
herbaceous	Buttercup	*Ranunculus* sp.	X	X	X		1, 4, 6
herbaceous	White water crowfoot	*Ranunculus trichophyllus*					
herbaceous	Roseroot	*Rhodiola integrifolia*		X	X	OLI, BTI	5
herbaceous	Arctic dock	*Rumex arcticus*	X	X	X	OLI, BRW	1, 4, 5
herbaceous	Dock	*Rumex graminifolius*					1, 4, 6
herbaceous	Snow pearlwort	*Sagina nivalis*	X		X	BTI, BRW	5
herbaceous	Narrow-leafed saussurea	*Saussurea angustifolia*	X	X	X	BTI, OLI	1, 3, 5
herbaceous	Spotted saxifrage	*Saxifraga bronchialis*	X	X	X	OLI	1, 3, 6
herbaceous	Tufted saxifrage	*Saxifraga caespitosa*	X	X	X	BRW, BTI, OLI	5, 6
herbaceous	Bulbous saxifrage	*Saxifraga cernua*	X	X	X	All	1, 3, 5
herbaceous	Saxifrage	*Saxifraga davurica*					
herbaceous	Whiplash saxifrage	*Saxifraga flagellaris*	X	X	X		1, 3
herbaceous	Foliolose saxifrage	*Saxifraga foliolosa*	X	X	X	All	5
herbaceous	Hawkweed-leafed saxifrage	*Saxifraga heiracifolia*	X	X	X	All	1, 3, 5
herbaceous	Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	X	All	1, 3, 4, 5, 6

Form	Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed	References
herbaceous	Brook saxifage	*Saxifraga nelsoniana*	X	X	X	BRW, BTI	1, 3, 5
herbaceous	Alpine saxifrage	*Saxifraga nivalis*	X			BRW	5
herbaceous	Purple saxifrage	*Saxifraga oppositifolia*	X	X	X	BRW, OLI, BTI	1, 3, 5
herbaceous	Heart-leaf saxifrage	*Saxifraga punctata*	X	X	X		1, 3
herbaceous	Alpine brook saxifrage	*Saxifraga rivularis*	X		X	BRW, BTI	5
herbaceous	Thyme-leaved saxifrage	*Saxifraga serpyllifolia*					1, 3
herbaceous	Arctic senecio	*Senecio atropurpureus* ssp. *frigidus*	X	X	X	All	5
herbaceous	Marsh fleawort	*Senecio congestus*	X	X	X	All	1, 3, 5, 6
herbaceous	Black-tipped groundsel	*Senecio lugens*	X	X	X		1, 3
herbaceous	Alaska-Yukon senecio	*Senecio yukonensis*			X	BTI	5
herbaceous	Moss campion	*Silene acaulis*			X	BTI, OLI	1, 3
herbaceous	Smelowskia	*Smelowskia calycina*					1, 3
herbaceous	Goldenrod	*Solidago multiradiata*		X	X		1, 3
herbaceous	Fleshy stitchwort	*Stellaria crassifolia*			X	BTI	5
herbaceous	Edwards's stitchwort	*Stellaria edwardsii*	X		X	BTI, BRW	
herbaceous	Low chichweed	*Stellaria humifusa*	X	X	X	ALL	
herbaceous	Long-stalked stitchwort	*Stellaria laeta*	X		X	BRW, BTI	1, 5, 6
herbaceous	Lyrate dandelion	*Taraxacum alaskanum*			X	BTI	5
herbaceous	Horned dandelion	*Taraxacum ceratophorum*	X	X	X	ALL	5
herbaceous	Dandelion	*Taraxacum* spp.	X	X	X		1, 3
herbaceous	Wild chamomile	*Tripleurospermum phaeocephalum*			X	BTI	5
herbaceous	Spiked trisetum	*Trisetum spicatum*			X	BTI	5
herbaceous	Common butterwort	*Utricularia vulgaris*			X	BTI	5
herbaceous	Capitate valerian	*Valeriana capitata*	X	X	X	BTI	1, 3, 5
herbaceous	Mountain heliotrope	*Valeriana sitchensis*			X		1, 3

Codes: OLI - Oliktok, BTI - Barter Island, BRW - Point Barrow.

Data for Potentially-Occurring Plants From: 1) Hulten (1968), 2) Viereck and Little (1972), 3) White (1974), 4) Pratt (1991), 5) Elias *et al*. (1996), and 6) Woodward-Clyde (1995c).

Observed: Identified during 1993 site visit (Woodward-Clyde 1995c), and/or during 1993-94 site visits by Elias *et al*. (1996), and/or during 2002 site visits by Schick and Frost (ABR, Inc.).

Note: Species listed alphabetically by scientific name.

Table A2: Fish Species Potentially Occurring on or near Barter Island, Oliktok, and Point Barrow Long Range Radar Sites and Wainwright and Bullen Point Sites

Common Name	**Scientific Name**	**Point Barrow**	**Oliktok**	**Barter Island**	**Wainwrigh t**	**Bullen Point**
Chum salmon	*Oncorhynchus keta*	X	X	X	X	X
Pink salmon	*Oncorhynchus gorbuscha*	X	X	X	X	X
Arctic char	*Salvelinus alpinus*	X	X	X	X	X
Broad whitefish	*Coregonus nasus*	X	X	X	X	X
Humpback whitefish	*Coregonus pidschian*	X	X	X	X	X
Least cisco	*Coregonus sardinella*	X	X	X	X	X
Bering cisco	*Coregonus laurettae*	X	X		X	
Arctic cisco	*Coregonus autumnalis*	X	X	X	X	X
Rainbow smelt	*Osmerus mordax*	X	X	X	X	X
Starry flounder	*Platichthys stellatus*	X				
Saffron cod	*Eleginus gracilis*	X		X	X	X
Arctic cod	*Boreogadus saida*	X	X		X	
Fourhorn sculpin	*Myoxocephalus quadricor*		X	X	X	X
Arctic flounder	*Liopsetta glacialis*	X	X	X	X	X
Pacific herring	*Clupea harengus*		X		X	
Inconnu	*Stenodus leucichthys*		X	X		X
Eelpout	*Lycodes* sp.			X	X	X
Arctic grayling	*Thymallus arcticus*	X	X	X	X	X
Northern pike	*Esox lucius*	X				
Round whitefish	*Prosopium cylindraceum*		X			
Burbot	*Lota lota*		X			
Capelin	*Mallotus villosus*				X	

Sources:
ADFG 1992
Craig 1984
ICF Technology, Inc. 1996a
John Craighead-George 1993, personal communication (Woodward-Clyde 1995c)
Jones Technology, Inc., and Gene Stout and Associates 1999c
Morrow 1980
Robbins *et al*. 1991
U.S. Dept. Interior March 1987a
USFWS 1986b
Walker 1993, personal communication (Woodward-Clyde 1995)
Woodward-Clyde 1995c

Table A3: Mammal Species Potentially Occurring on or near Barter Island, Oliktok, and Point Barrow Long Range Radar Sites

Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island
Terrestrial				
Brown/Grizzly bear	*Ursus arctos*	X	X	X
Arctic fox	*Alopex lagopus*	X	X	X
Red fox	*Vulpes vulpes*		X	
Wolf	*Canis lupus*	X		X
Least weasel	*Mustela rixosa*	X	X	X
Short-tailed weasel (ermine)	*Mustela erminea*	X	X	
Wolverine	*Gulo gulo*	X		
Hoary marmot	*Marmora caligata*			
Arctic ground squirrel	*Spermophilus paryi*	X	X	X
Brown lemming	*Lemmus trimucronatus*	X	X	X
Collared lemming	*Dicrostonyx groenlandicus*	X	X	X
Red-backed vole	*Clethrionomys rutilus*			X
Tundra vole	*Microtus oeconomus*			X
Moose	*Alces alces*	X		
Caribou	*Rangifer taranus*	X	X	X
Marine				
Bowhead whale	*Balaena mysticetus*	X	X	X
Beluga whale	*Delphinapterus leucas*	X	X	X
Gray whale	*Eschrichtius robustus*	X	X	X
Killer whale	*Orcinus orca*	X	X	X
Minke whale	*Balaenoptera acutorostrata*	X		
Harbor porpoise	*Phocoena phocoena*	X		
Narwhal	*Monodon monoceros*	X	X	
Ringed seal	*Phoca hispida*	X	X	X
Bearded seal	*Erignathus barbatus*	X	X	X
Spotted seal	*Phoca larga*	X	X	X
Walrus	*Odobenus rosmarus*	X	X	
Polar bear	*Ursus maritimus*	X	X	X

Sources:
Day *et al*. 1995
Frost *et al*. 2007 (includes observations from 1994, 2000, 2002-2003 and 2006 surveys; and reported in Woodward-Clyde Inc 1995c, Hall 1972, Suydam (in litt.), and Gibson (pers. comm.)).
John Craighead-George 1993, personal communication (Woodward-Clyde 1995c)
Robert Suydam 1993, personal communication (Woodward-Clyde 1995c)
Wynne 1993
U.S. Dept. Interior 1987b
Woodward-Clyde 1995c

Table A4: Bird Species Known to or Potentially Occurring on or near Barter Island, Oliktok, and Point Barrow Long Range Radar Sites

Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	All
Arctic Loon	*Gavia arctica*		X	X	
Pacific Loon	*Gavia pacifica*	X	X	X	All
Yellow-billed Loon	*Gavia adamsii*	X	X	X	BRW, OLI
Red-necked Grebe	*Podiceps grisegena*			X	
Northern Fulmar	*Fulmarus glacialis*	X			BRW*
Tundra Swan	*Cygnus columbianus*	X	X	X	OLI, BTI
Greater White-fronted Goose	*Anser albiforns*	X	X	X	All
Snow Goose	*Chen caerulescens*	X	X	X	OLI
Brant	*Branta bernicla*	X	X	X	BRW, OLI
Canada Goose	*Branta canadensis*	X	X	X	OLI
Green-winged Teal	*Anas crecca*	X	X	X	OLI
Mallard	*Anas platyrhynchos*		X	X	BTI, OLI
Northern Pintail	*Anas acuta*	X	X	X	All
Northern Shoveler	*Anas clypeata*	X	X	X	BTI, OLI
American Wigeon	*Anas americana*		X	X	OLI
Greater Scaup	*Aythya marila*	X	X	X	OLI
Common Eider	*Somateria mollissima*	X	X	X	All
King Eider	*Somateria spectabilis*	X	X	X	BRW, OLI
Spectacled Eider	*Somateria fischeri*	X	X	X	BRW, OLI
Steller's Eider	*Polysticta stelleri*	X			BRW
Long-tailed Duck	*Clangula hyemalis*	X	X	X	All
Surf Scoter	*Melanitta perspicillata*	X	X	X	All
White-winged Scoter	*Melanitta fusca*		X	X	OLI
Red-breasted Merganser	*Mergus serrator*	X	X	X	OLI
Bald Eagle	*Haliaeetus leucocephalus*			X	
Northern Harrier	*Circus cyaneus*			X	
Rough-legged Hawk	*Buteo lagopus*		X	X	OLI
Golden Eagle	*Aquila chrysaetos*			X	
Peregrine Falcon	*Falco peregrinus*	X	X	X	BTI, BRW
Gyrfalcon	*Falco rusticolus*	X	X	X	BRW, OLI
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	OLI
Rock Ptarmigan	*Lagopus mutus*			X	
Sandhill Crane	*Grus canadensis*	X		X	BRW, BTI
Black-bellied Plover	*Pluvialis squatarola*	X	X	X	OLI
American Golden-Plover	*Pluvialis dominica*	X	X	X	All
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	All
Killdeer	*Charadriusvociferus*		X		
Eurasian Dotterel	*Charadrius morinellus*			X	
Lesser Yellowlegs	*Tringa flavipes*			X	
Whimbrel	*Numenius phaeopus*			X	
Bristle-thighed Curlew	*Numenius tahitiensis*			X	
Bar-tailed Godwit	*Limosa lapponica*		X		

Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed
Sanderling	*Calidris alba*			X	
Ruddy Turnstone	*Arenaria interpres*	X	X	X	OLI, BRW
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	All
Western Sandpiper	*Calidris mauri*	X	X		BRW
Least Sandpiper	*Calidris minutilla*			X	
White-rumped Sandpiper	*Calidris fisciollis*	X	X	X	BRW, OLI
Baird’s Sandpiper	*Calidris bairdii*	X	X	X	All
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	All
Sharp-tailed Sandpiper	*Calidris acuminata*	X	X		
Dunlin	*Calidris alpina*	X	X	X	OLI, BRW
Stilt Sandpiper	*Calidris himantopus*			X	
Buff-breasted Sandpiper	*Tryngites subruficollis*	X	X	X	BRW, OLI
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	All
Common Snipe	*Gallinago gallinago*	X	X	X	BTI
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	All
Red Phalarope	*Phalaropus fulicaria*	X	X	X	All
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	X	All
Parasitic Jaeger	*Stercorarius parasisticus*	X	X	X	All
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	All
Herring Gull	*Larus argentatus*			X	
Glaucous-winged Gull	*Larus glaucescens*			X	
Glaucous Gull	*Larus hyperboreus*	X	X	X	All
Black-legged Kittiwake	*Rissa tridactyle*	X			BRW
Red-legged Kittiwake	*Rissa brevirostris*				
Ross’ Gull	*Rhodoctethia rosea*	X			
Sabine’s Gull	*Xema sabini*	X	X	X	OLI
Ivory Gull	*Pagophila eburnea*	X			
Arctic Tern	*Sterna paradisaea*	X	X	X	BRW, OLI
Common Murre	*Uria aalge*	X			
Thick-billed Murre	*Uria lomvia*	X			
Black Guillemot	*Cepphus grille*	X	X		OLI
Kittlitz’s Murrelet	*Brachyramphus brevirostris*	X			
Least Auklet	*Aethia pusilla*				
Tufted Puffin	*Fratercula cirrhata*	X			
Snowy Owl	*Bubo scandiacus*	X	X	X	BRW, OLI
Short-eared Owl	*Asio flammeus*	X		X	
Eastern Kingbird	*Tyrannus tyrannus*				
Horned Lark	*Eremophila alpestris*			X	
Barn Swallow	*Hirundo rustica*				OLI
Tree Swallow	*Tachycineta bicolor*	X			BRW
Gray Jay	*Perisoreus canadensis*			X	
Common Raven	*Corvus corax*	X	X	X	All
American Robin	*Turdus migratorius*		X		
Varied Thrush	*Ixoreus naevius*				OLI
Gray-cheeked Thrush	*Catharus minimus*	X			BRW
Yellow Wagtail	*Montacilla flava*		X	X	OLI, BTI

Common Name	Scientific Name	Point Barrow	Oliktok	Barter Island	Observed
White Wagtail	*Montacilla alba*				
Red-throated Pipit	*Anthus cervinus*			X	
American Pipit	*Anthus rubescens*			X	
Yellow-rumped Warbler	*Dendroica petechia*		X		OLI
Common Redpoll	*Corduelis flammea*	X		X	All
Hoary Redpoll	*Carduelis hornemanni*	X	X		BRW, OLI
Savannah Sparrow	*Passerculus sandwichensis*	X	X		BRW, OLI
White-crowned Sparrow	*Zonotrichia leucophrys*	X			BRW
Lapland Longspur	*Calcarius lapponicus*	X	X	X	All
Snow Bunting	*Plectrophenax nivalis*	X	X	X	All

Codes: BRW - Point Barrow, OLI - Oliktok, BTI - Barter Island.
Data for Potentially-Occurring Species From: Woodward-Clyde (1995d), Day *et al*. (1995), Suydam (in Day *et al*. [1995]), Gibson (in Day *et al*. [1995]), Garner and Reynolds (1987), Gusey (1988), Hall (1972), King (1977), Norton *et al*. (1993), Pitelka (1974), Spindler (1978; 1979).
Observed: Seen by Woodward-Clyde and/or USAF biologists during 1993 site visit, and/or USFWS biologists in 1997 (Andres and Brann 1997), Schick and Frost (ABR, Inc.) during July 2002, and as reported in Frost *et al*. 2007 (includes observations from 1994, 2000, 2002-2003 and 2006 surveys); reported in Woodward-Clyde Inc. 1994, Hall 1972, Suydam (in litt.), Gibson (pers. comm.)), and observed by Oasis Environmental, Inc. (2008).
Notes: Species listed in phylogenic order; * - found dead on beach

Appendix 3.0 - Lisburne. Cape Lisburne Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Cape Lisburne LRRS, Lower Camp

3.1 Location and Area

Cape Lisburne LRRS consists of 1,125 acres along the shore of the Chukchi Sea and lies within the Chukchi Sea Unit of the Alaska Maritime NWR. The LRRS is 810 miles northwest and 750 miles northwest of Anchorage and Fairbanks, respectively (INRMP Figure 3.1). The remote site (1,125 acres) is accessible only by air or sea. Radar equipment is located at an Upper Camp, and facilities in support of radar operations are located at a Lower Camp. The two camps are connected by a 3.9-mile winding road (Figure 3.1).

3. 2 Installation History

The installation at Cape Lisburne was one of the 12 original Aircraft Control and Warning (AC&W) sites built in the early 1950s to establish an air defense system in Alaska. The facility was activated in 1957 (Denfeld 1993). Communications were initially provided by high frequency radio. A WACS site was co-located with the AC&W radar site. In 1979 the WACS was replaced with a commercial satellite earth terminal. In 1985 a Minimally Attended Radar (MAR) system was installed and remains active. Unnecessary facilities were removed as the radar systems were increasingly automated and Clean Sweep activities were completed at the site during 2001-2004.

In 1977 the Alaska Air Command implemented a site support contract, which eliminated 79 military positions at Cape Lisburne. The remaining 14 positions were primarily in operations. A Joint Surveillance System was installed in 1982, enabling radar and beacon data to be transmitted via satellite to the Elmendorf Regional Operations Control Center. After 1983 only contractor personnel remained at the site to maintain the radar. Four personnel maintain the site.

3.3 Surrounding Communities

Point Hope, located 35 miles to the southwest of the LRRS, is the nearest community. No road connects Point Hope and Cape Lisburne LRRS. The population of Point Hope is 674 (2010 estimate), primarily comprised of Tikeraqmuit Inupiat Eskimos who are dependent upon marine subsistence (www.dced.state.ak.us 2012).

Most full time positions in Point Hope are with city and borough governments. Residents manufacture whalebone masks, baleen baskets, ivory carvings, and Eskimo clothing. Seals, bowhead whales, beluga whales, caribou, polar bears, birds, fish, and berries are utilized (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Cape Lisburne was discovered and named by Captain Cook in 1778. At that time whaling was a subsistence activity and an economic focus in the region. The vicinity supported an Eskimo settlement, Wevok, which was abandoned in the 1940s. Wevok was a satellite of Point Hope, which had a population of 276 according to the 1880 census (Selkregg 1974). The population of the entire Point Hope area, including settlements such as Wevok, was between 400 and 500 (Selkregg 1974).

3.5 Local and Regional Natural Areas

Cape Lisburne LRRS is within the Chukchi Sea Unit of the Alaska Maritime NWR. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 20007a).

4.0 Physical Environment

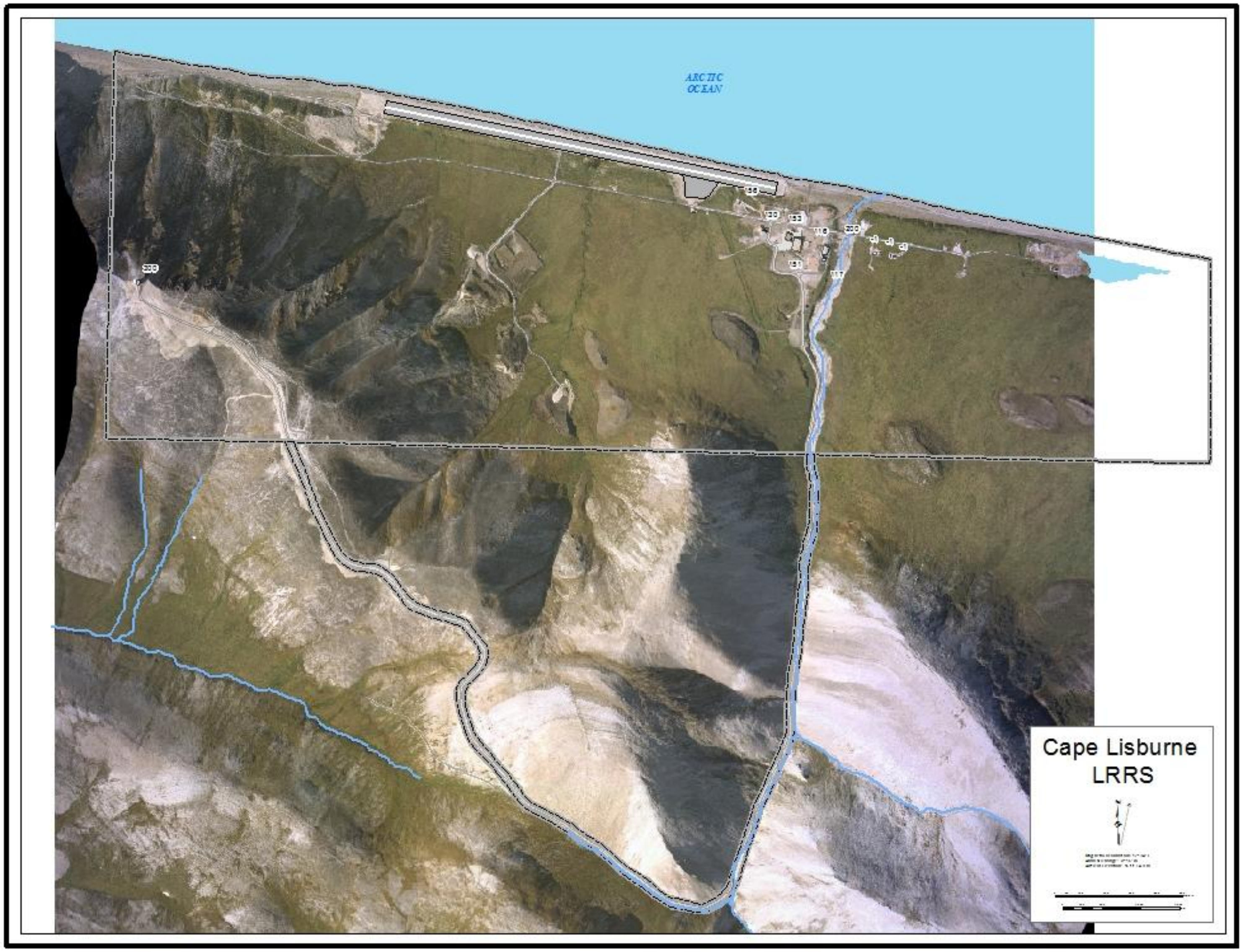
4.1 Climate

Cape Lisburne lies on the fringe of the Arctic Climatic Zone. Winds are predominantly from the east at 9 knots, with recorded extremes up to 70 knots. The mean annual temperature is 18ºF. Average summer temperatures rarely exceed the high 40s to low 50s (ºF). Average winter temperatures range between -2º and -14ºF. (Hostman 1988). Temperatures range from -49 to 78 °F. Precipitation is light, averaging only 10 inches annually, with 36 inches of snowfall. The Chukchi Sea is ice-free from late June until mid-September (www.dced.state.ak.us 2012).

4.2 Landforms

Cape Lisburne is part of the Kotzebue Sound subregion of Alaska. This subregion encompasses 41,000 square miles and includes the De Long Mountains. Headwaters of the subregion's major waterways (the Kivalina, Wulik, Noatak, Kobuk, and Ambler rivers) rise in the De Long and Baird Mountains. Cape Lisburne LRRS is located in the Lisburne Hills of the De Long Mountains (Gutleber undated(a)).

Figure 3.1 Cape Lisburne LRRS



Elevations at Cape Lisburne LRRS range from 5 to 1,580 feet above msl. Lower Camp is situated along the beach at the lower elevation, and Upper Camp is located at the higher elevation (Gutleber undated(a)).

4.3 Geology and Soils

A variety of events, including tectonism, volcanism, sedimentation, and erosion, have shaped the landscape, rocks, soils, and minerals of the area. By the late Paleozoic time, the geologic framework of the Northwest Region of Alaska included a broad sedimentary trough, known as the Brooks Range geosyncline, in approximately the position of the present Brooks Range, Arctic foothills, and Arctic Coastal Plain. It was bordered on the north by the high Arctic Platform and on the south by the Yukon Shelf (Gutleber undated(a)).

The Arctic Platform delivered great thickness of sediment into the geosyncline throughout Paleozoic time. During the Triassic time, sedimentation from the northern source continued in the northern part of the large basin, but the site of the present Brooks Range had become a stable area where Triassic limestones and charts were formed (Gutleber undated(a)).

During the mid-Jurassic time, mountain building began and eventually resulted in the formulation of the present topography. Thrust faults in the Lisburne hills, which extend 45 miles from Cape Lisburne southeast to the Kupkuk River, were probably connected to a thrust zone in the eastern Seward Peninsula and western Yukon-Koyukuk Province from late Cretaceous to early Tertiary time. This thrusting activity probably resulted from an eastward drift of the Siberian continental plate. A marine connection between Pacific and Arctic basins on the eastern side of Seward Peninsula was probably closed during this time (Gutleber undated(a)).

The geology of the Cape Lisburne LRRS Lower Camp and airfield is dominated by highly permeable talus and alluvial fan deposits, consisting of clay, silt, sand, gravel, and cobbles with some boulders. A tundra surface layer mantles coastal lowlands. The material may be mixed where they occur as talus (deposited as a result of downslope unchannelized runoff) but appears to be stratified along the course of Selin Creek. The stream alluvium is on the order of 40 feet thick near the LRRS's water intake. The unconsolidated deposits are underlain by block shale. The geology at Upper Camp is dominated by relatively thin accumulations of gravelly residuum. Shale bedrock outcrops along steep-walled slopes and in eroded areas (Gutleber undated(a)).

Permafrost is relatively continuous in the Cape Lisburne area. The permafrost layer may reach a maximum depth of 600 to 800 feet below grade at the coast and, further inland, maximum permafrost depths may reach 1,330 feet below grade (Gutleber undated(a)).

4.4 Hydrology

4.4.1 General

Drainage at Cape Lisburne LRRS flows overland to diversion channels which terminate at the Chukchi Sea. Some LRRS runoff is directed to Selin Creek, which also discharges to the Chukchi Sea. Selin Creek is significant because the LRRS obtains its water resources from shallow alluvial sediments underlying the stream (Gutleber undated(a)).

The largest freshwater lakes in the subregion are Imuruk (28 square miles), Walker (14 square miles), and Shelby (eight square miles). Lakes in the Kotzebue Sound subregion fall into four groups: (1) those resulting from the regional deformation where down-warped areas along the seacoast formed large collecting basins, (2) glacial lakes scattered throughout the mountains and foothills, (3) tundra lakes of all shapes and sizes that occupy the bench and flat valleys, and (4) lakes formed by volcanic action on the central Seward Peninsula (Gutleber undated(a)).

Lower Camp is underlain by thick, continuous permafrost. The depth of summer thawing (active zone) in undisturbed ground ranges from one to four feet; during winter, seasonal frost penetrates completely to the top of underlying permafrost (Gutleber undated(a)). Shallow groundwater occurs in the active zone above the permafrost layer during summer and fall. The shallow groundwater is discharged to the Chukchi Sea.

The existence of groundwater at Upper Camp is unknown. If groundwater is present, it is likely contained in fractures, fissures, faults, bedding planes, or other secondary openings in local bedrock.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. The land rises quickly from the sea, so there is no coastal flooding. The coastal flood plain is below the headland of the beach. The flood plain of Selin Creek is within the banks of the creek as it leaves the mountain valley and flows by Lower Camp. The creek and the road to Upper Camp both occupy the valley floor. The flood level within the valley is less than three feet.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Cape Lisburne LRRS. Much information included in INRMP Chapter 5.0 that includes Cape Lisburne LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Cape Lisburne LRRS and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at Cape Lisburne LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M121 Brooks Range Tundra-Polar Desert Province
Description: The province's landscape varies from rugged peaks of 9,000 feet to U-shaped valleys, braided stream channels, and rolling plateaus. The climate is similar to the arctic coastal plain, but at higher altitudes, precipitation increases. Since the province is above the Arctic Circle, it gets several days of 24-hour sunlight in June and sunless days in December. Precipitation averages 7-15 inches. Higher elevation consists of low mats of shrubby flora species, lower elevations are covered by mats of sedge and shrub. Soils for the province are rocky and poorly developed; Inceptisols are found on lower slopes.

5.2 Vegetation

The Cape Lisburne area is primarily comprised of alpine and moist tundra interspersed with extensive areas of barren ground, particularly at higher elevations. Lush vegetation grows in the valleys and surrounding Lower Camp, and wetlands occur along the runway. Alpine tundra occurs in mountainous areas and along well-drained rocky ridges. Much of this tundra consists of barren rocks, but low mat plants, both herbaceous and shrubby, are interspersed between the bare rocks and rubble (Gutleber undated(a)).

Plants with a low growth form are typical of this exposed, windswept area. Common species at Cape Lisburne LRRS include mountain avens, Arctic willow, crowberry, narrowleaf Labrador tea, arnica, cassiope and cotton grass. On drier, more stony and barren areas, cushion plants, such as moss campion and saxifrages, may be found (Gutleber undated(a)).

A general vegetation map of the Cape Lisburne LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995d). Schick *et al*. (2004) made significant improvements in vegetation mapping at Cape Lisburne LRRS (using 2000 digital aerial photography) with the preparation of a wildlife habitat map (map, habitat acreages, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Cape Lisburne LRRS in 2001 and 2009. This project used 2001 National Land Cover Database data (http://www.mrlc. gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth for each site and, if available, 2009-2010 SPOT-5 satellite imagery (http://www. alaskamapped.org/ortho). Table 5.2 shows these acreages and changes over this 8-year period. Figure 5.2a shows habitat classes for 2009, and Figure 5.2b shows changes in habitat classes between 2001 and 2009.

Table 5.2 Habitat Class Differences between 2001 and 2009, Cape Lisburne LRRS

Habitat Class	Acres 2001	Acres 2009	Acreage Change
Barren Land	290.2	321.9	31.8
Developed, Low Intensity	72.6	74.5	2.0
Dwarf Shrub	219.2	194.8	-24.4
Emergent Herbaceous Wetlands	14.2	11.7	-2.5
Evergreen Forest	10.6	10.6	0.0
Open Water	32.3	33.1	0.8
Sedge/Herbaceous	158.9	152.7	-6.2
Shrub/Scrub	305.6	304.5	-1.1
Woody Wetlands	17.3	16.9	-0.4
Totals	**1,120.8**	**1,120.8**	**0.0**

Cape Lisburne LRRS encompasses about 1,125 acres of gently sloping tundra and steep mountainous terrain. The most common wildlife habitats at the LRRS are lowland tundra near the coast and dwarf scrub and partly barren rock in the mountains. Relatively little riverine and no lacustrine habitat is present. Near the coast, gently sloping terrain is dominated by lowland moist and wet tundra types. These areas may be used by nesting passerines and some shorebirds. Well-drained mountainous sites are likely used by sparsely distributed nesting passerines and some shorebirds. Nesting seabirds occur on the cliffs to the west of the LRRS (modified from Schick *et al*. 2004).

5.3 Fish and Wildlife

5.3.1 Fish

Twenty-five species of fish have geographical distributions that encompass rivers, streams, and lakes of the Chukchi Sea coastal area (U.S. Department of Interior 1987a). However, only 12 species of freshwater and anadromous fish are known to occur in the streams and lakes of the Cape Lisburne LRRS region, including Arctic grayling, silver salmon, Arctic cisco, Dolly Varden, Arctic Char, whitefish, slimy sculpin, rainbow smelt, nine-spined stickleback, and chum, king, sockeye, and pink salmon (ADFG 1992). Although fish surveys have not been conducted in Cape Lisburne streams, the ADFG believes Selin Creek has potential fish habitat (ADFG 1999).

Figure 5.2a Cape Lisburne LRRS Habitat Map, 2009

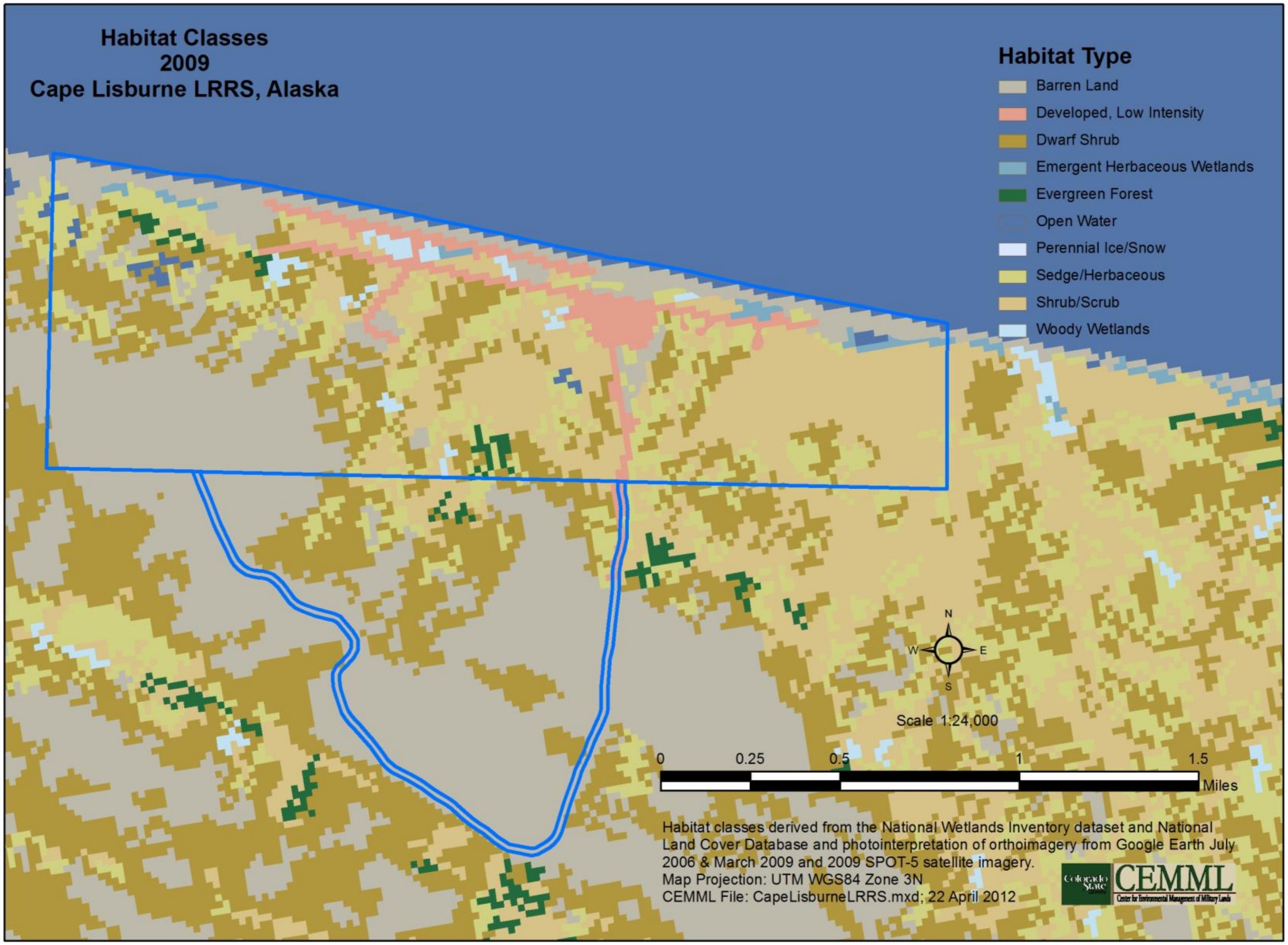


Figure 5.2b Changes in Habitat Classes at Cape Lisburne LRRS between 2001 and 2009

5.3.2 Mammals

A fairly diverse range of terrestrial mammals inhabits northwestern Alaska. Caribou are the most wide-ranging and conspicuous species. Cape Lisburne is part of the summer range of the Western Arctic herd, one of two large herds recognized in the area (Gutleber undated(a)). Approximately 2,500 to 4,000 caribou migrate annually through the area. Caribou are nomadic herd animals and must travel constantly to find adequate food. In summer they feed on leaves of willow and dwarf birches, grasses, sedges, and succulent plants. After the autumn frost, they feed on lichens and dried sedges.

Wolves inhabit the entire region (Gutleber undated(a)) and travel extensively, generally along water courses. They prey on animals, such as Arctic hares, ground squirrels, and waterfowl; however, caribou are their principal prey. In higher and drier alpine communities of the Lisburne Hills, brown/grizzly bears, red foxes, ground squirrels, and hoary marmots den in dry soils of the tundra. Other mammals likely inhabiting the area include musk oxen, Arctic foxes, wolverines, lemmings, shrews, voles, tundra hares, porcupines, short-tailed and least weasels, mink, river otters, and North American lynx (Gutleber undated(a)). Reindeer and musk oxen have been introduced/reintroduced into the area.

The Chukchi Sea supports many marine mammal species. Pacific walruses, four species of seal (bearded, spotted, ringed, and ribbon), six species of whale (bowhead, fin, minke, gray, beluga, and killer), harbor porpoises, and polar bears occur regularly in the region (Wynne 1993). The Cape Lisburne area is especially important for beluga whales for molting and possibly for feeding and calving (personal communication, Suydam 1993 in Woodward-Clyde 1995d). Although most marine mammals are under the jurisdiction of the NMFS, walruses and polar bears are under the jurisdiction of the USFWS. The distribution and types of marine mammal species found in the Cape Lisburne area are determined by the presence of ice. As the ice pack moves with the seasons, so do these mammals. The LRRS is within the range of the polar bear (Bridges 2001), a protected species under the provision of the MMPA.

5.3.3 Birds

Common and Thick-billed Murres, Tufted and Horned Puffins, Black Guillemot, Pelagic Cormorant, Glaucous Gull, and Black-legged Kittiwake are primary seabird species found in sea cliff habitats at Cape Lisburne, Cape Lewis, and Cape Thompson (Springer *et al*. 1979, Sowls *et al*. 1978). Along beaches and barrier islands of the Cape Lisburne region, 26 species of birds have been observed (Springer *et al*. 1979).

A large seabird colony inhabits cliffs and rocky shores at Cape Lisburne. Tens of thousands of seabirds nest on cliffs, including murres, Black-legged Kittiwake, Tufted and Horned Puffins, and Black Guillemot (Sowls *et a*l. 1978). The western boundary of the LRRS is shared with the USFWS Cape Lisburne portion of the Alaska Maritime NWR. Cliffs of the cape are inhabited by a growing population of approximately 350,000 seabirds from May to mid October each year (personal communication, D. Roseneau 1999 with G. Augustine). Common and Thickbilled Murres are the largest population component at 300,000 birds followed by 40,000 Black-legged Kittiwakes. Based upon USFWS 1995-1998 estimates, approximately 4,000 to 7,000 birds inhabit the cliffs beginning 3/4 mile west of the airfield, called First Beach. Along the cliff above Kittiwake Beach, the next western area, about 20,000 to 50,000 murres and kittiwakes inhabit cliffs.

Other birds frequenting these coastal habitats include loons; Tundra Swan; Canada and White-fronted Geese; Harlequin Duck; Common, King, Steller's, and Spectacled Eiders; Longtail Duck; Black and Surf Scoters; Red-breasted Merganser; Sandhill Crane; several species of plovers and sandpipers; jaegers; and gulls. Fluviatile and lacustrine waters of the area are used by many aquatic birds for feeding, nesting, courting, escaping, and/or molting purposes (Gutleber undated(a)).

Bird species found in upland habitats include Willow and Rock Ptarmigan, Whimbrel, Buff-breasted Sandpiper, Parasitic and Long-tailed Jaegers, and Lapland Longspur. Savannah Sparrow, Golden Plover, Common Redpoll, and Snow Bunting are also common inhabitants of upland tussock and mountain avens communities. Birds of prey include Rough-legged Hawk, Golden Eagle, Peregrine Falcon, and Gyrfalcon. Snowy, Boreal, and Short-eared Owls have been sighted in uplands and river basins around Cape Lisburne (Gutleber undated(a)).

Twenty-four bird species were observed at Cape Lisburne LRRS during the ABR, Inc. 2002 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included species, such as Brant, Common Eider, Golden Eagle, Wandering Tattler, Black-tailed Gull, Black-legged Kittiwake, Thick-billed Murre, Horned and Tufted Puffins, and American Pipit.

5.4 Threatened and Endangered Species

Ten protected species potentially occur in the vicinity of Cape Lisburne LRRS. Day *et al*. (1995) surveyed for the Spectacled Eider and Steller's Eider, both threatened species (USFWS 2011), at remote USAF sites, including Cape Lisburne. There is a low potential for either the Spectacled Eider or Steller's Eider to nest at Cape Lisburne LRRS. Offshore waters of Cape Lisburne may be used by endangered marine species, including bowhead and fin whales. The threatened polar bear is confirmed on or near the site. Threatened ringed and bearded seals may also occur on or near the site.

The Pacific walrus (candidate) is confirmed near Cape Lisburne LRRS. Cape Lisburne LRRS is within the range of the threatened polar bear (Bridges 2001), a protected species under the provision of the MMPA. The candidate Kittlitz's Murrelet is known in the area, and the candidate Yellow-billed Loon is potentially in the area.

Several formerly listed or former Category 2 species (Harlequin Duck, Arctic Peregrine Falcon, North American lynx, and gray whale) are either confirmed or possible near Cape Lisburne LRRS. Rumex (*Rumex krausei*), a former Category 2 plant, is possible at Cape Lisburne (Alaska Natural Heritage Program 1993). Lipkin (1999) did not find rumex at Cape Lisburne LRRS.

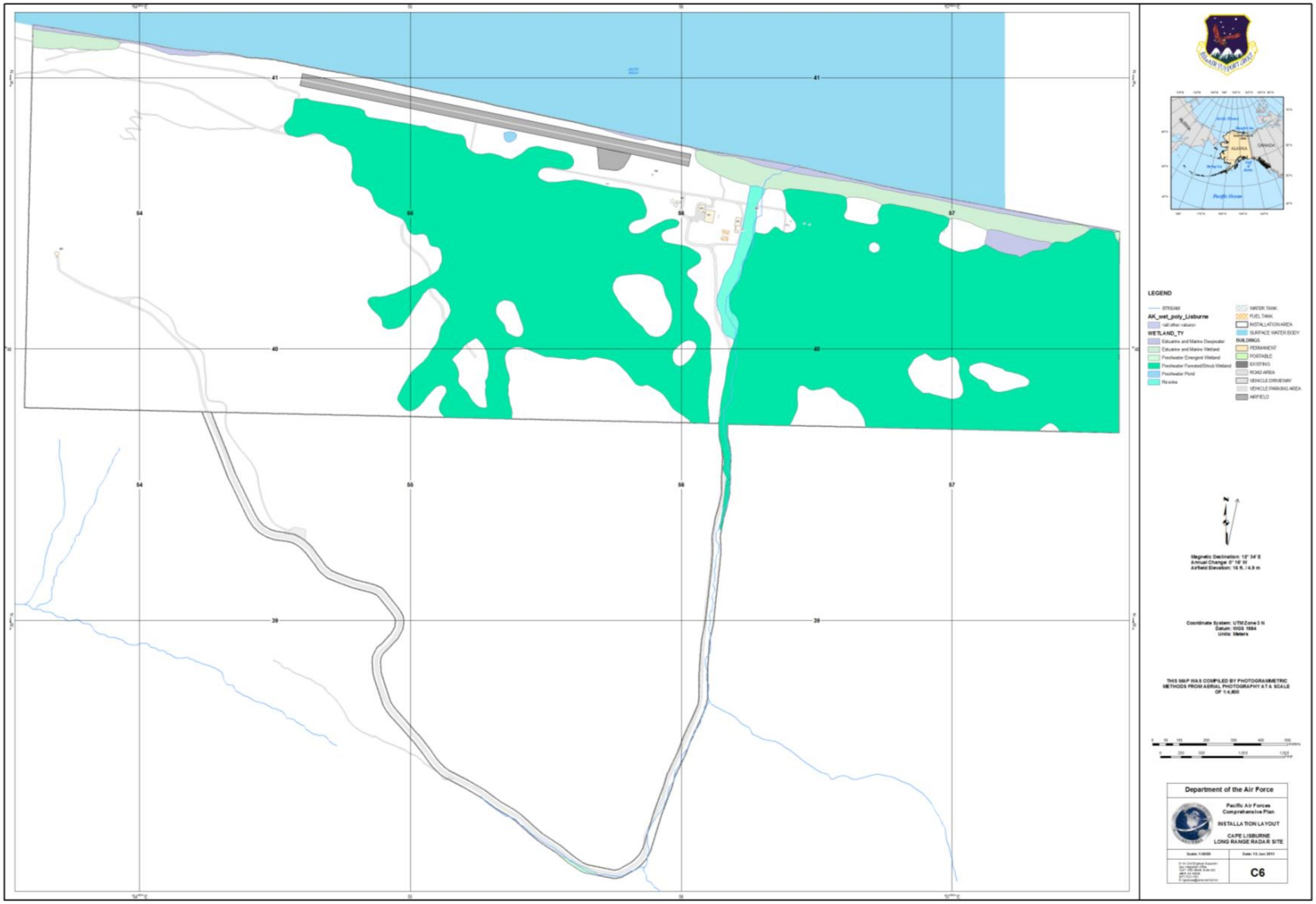
5.5 Wetlands

The most common wetland type at the Cape Lisburne LRRS is palustrine, persistent emergent vegetation with some scrub-shrub component. These areas typically occur near the coast and are composed of moist tundra, ranging from saturated to moderately well-drained, depending on microtopography and landscape position. The major wildlife habitat type comprising these wetlands is Lowland Moist Graminoid–Shrub Tundra. Dominant herbaceous plants include *Eriophorum angustifolium, Carex aquatilus, Dupontia fisheri, Arctagrostis latifolia* and others; the shrub component of these wetlands is dominated by *Salix pulchra*, *S. rotundifolia*, and *Dryas integrifolia*. Wetlands at Cape Lisburne LRRS are strongly dominated by moist areas, with few wetter areas of persistent standing water or seasonal flooding. In the mountains, Upland Dwarf Scrub habitats may be wetlands of various scrub types, but more often are likely to be NWI Uplands because of the preponderance of well-drained rocky substrates (Schick *et al*. 2004).

Wetlands occur at Cape Lisburne LRRS along the inland side of the runway and along lower elevations near Lower Camp (personal communication, Quakenbush 1994, in Woodward-Clyde 1995d).

The Woodward-Clyde (1995d) Cape Lisburne LRRS general vegetation map's wetland features were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). These sources are used to facilitate decisions regarding facility siting. Cape Lisburne LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (500.96 acres). Figure 5.5 shows wetlands on Cape Lisburne LRRS from 2011 data.

Figure 5.5 Cape Lisburne LRRS Wetlands, 2011



5.6 Other Natural Resource Information

5.6.1 Subsistence

Residents of Point Hope utilize an area along the coast from Cape Sabine to Kivalina and inland along the Kukpuk River and its associated drainages. Caribou and bowhead whale are staple subsistence items.

Seals (hair and bearded) are also important, as are beluga whales, walrus, birds and several fish species. Point Hope is one of 10 Alaska Eskimo Whaling Commission communities. Bowhead whaling represents one of the greatest concentrations of effort, time, money, group symbolism and significance. Subsistence harvest estimates are not available for Point Hope (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Recreational natural resources use at or near Cape Lisburne LRRS consists primarily of such activities as beachcombing, hunting, furbearer trapping, fishing, and ATV and snow machine riding along trails and beaches. Boating on the Chukchi Sea is an occasional recreational activity; however, this is limited by the presence of sea ice. When sea ice is not present, seas are often too rough for boating.

Recreational vehicle use on the gravel road and on the beach around Cape Lisburne LRRS is common. ATV users should be educated about the need to remain on the established road system, thereby minimizing impacts to the tundra vegetation.

While hunting is not allowed on Cape Lisburne LRRS property, DoD personnel may obtain authorization to fly private aircraft to Cape Lisburne on their own time and at their own cost, but this is not common. Apparently, distance and cost discourages recreational visits even though big game in the area occurs in abundance. Hunting is done during free time by BOS contract personnel assigned to the LRRS and temporary duty personnel (military, civilian, or contractor) working at the site. Primary big game species include brown/grizzly bear and caribou. LRRS personnel engage in a limited amount of furbearer trapping, primarily as a winter recreation. Species trapped include wolverines and red and Arctic foxes.

Cape Lisburne has only two roads, a 3-mile road connecting Lower Camp with Upper Camp, and a short section extending along the ocean near the main camp. These roads are used for commuting between work locations, for recreational walking/hiking, to hunt, and to set traps within a few feet of the road. This creates a situation where nonconsumptive users who use the roads may see large carcasses awaiting removal or animals caught in traps. Establishment of the policy to not allow hunting on LRRS property has reduced or eliminated this concern.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities at Cape Lisburne LRRS include the MAR, roads, grounds, and antenna structures. A tram was removed in 1988-89, and a road was built to access the towers; this road was contoured and has been used as supply rock for various construction projects since 1993. A landfill for demolition and debris waste was completed in 2000. Many abandoned structures at the LRRS were commonly damaged by severe winds, and debris was subsequently scattered throughout the site. Clean sweep of inactive buildings and structures was completed in 2001 and 2002. In 2003 inhouse personnel cleaned up debris, including discarded barrels south of Upper Camp and debris disposed of in the on-site landfill. Periodic repair and maintenance of the runway and seawalls occur on Cape Lisburne LRRS.

A non-directional beacon was installed at Cape Lisburne in 2006. A non-directional beacon is a tower about 110 feet tall with three anchors and a base and is comprised of a ground plain of surface run copper with some extending out 500 feet from the base.

Several management issues related to land use at Cape Lisburne LRRS were reported by Woodward-Clyde (1995d). They included revegetation of disturbed sites including the old landfill, tower-access road, and future demolition sites; preservation of wetlands; effects of quarry blasting; and encouragement of ATV use on established roads only. Most of these concerns were eliminated when Clean Sweep at Cape Lisburne removed about 65 items during 2001-2004. The old landfill was reseeded, but problems with the reseeding technique resulted in most seed being eaten by birds. Vegetation has re-established naturally. A tram was removed in 1988-89, and a road was built to access the towers; this road was contoured and has been used as supply rock for various construction projects since 1993.

Another concern is reinforcement of the seawall and runway, which require quarry blasting. In 1999 roughly a 10-year supply of material was blasted free on-site. Blasting is done in accordance with a permit issued by the USFWS. Seawall maintenance material is currently obtained from an off-site quarry on BLM land, which is purchased from BLM. Seawall maintenance has been an annual event.

The Air Force leases space to the USFWS, Federal Aviation Administration, and AT&T. In addition, the USAF has a Right-of-Way Permit from USFWS for USAF use of their quarry for road, runway, and seawall maintenance activities.

APPENDIX A: Natural Resources of Cape Lisburne, Kotzebue, and Tin City Long Range Radar Sites

Table A1: Vascular Plant Species Known to or Potentially Occurring on Cape Lisburne, Kotzebue, and Tin City Long Range Radar Sites

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Shrub	American green alder	*Alnus crispa*	X	X		OTZ	2
Shrub	Sitka alder	*Alnus sinuata*		X			2
Shrub	Bog-rosemary	*Andromeda polifolia*	X	X	X	OTZ	2
Shrub	Alpine bearberry	*Arctostaphylos alpina*	X	X	X	OTZ	2, 4
Shrub	Red-fruit bearberry	*Arctostaphylos rubra*	X	X	X	OTZ	2
Shrub	Dwarf Arctic birch	*Betula nana*	X	X	X	OTZ	2
Shrub	Four-angled cassiope	*Cassiope tetragona*	X	X	X	TNC, LUR	2, 3, 4
Shrub	Leatherleaf	*Chamaedaphne calyculata*		X		OTZ	2
Shrub	Bunchberry	*Cornus canadensis*	X	X	X		1, 2, 3
Shrub	Diapensia	*Diapensia lapponica*	X	X	X	LUR, TNC	2, 3
Shrub	Entire-leaf mountain avens	*Dryas integrifolia*	X	X	X	TNC	2
Shrub	White mountain avens	*Dryas octopetala*	X	X	X	LUR, TNC	1, 2, 3
Shrub	Crowberry	*Empetrum nigrum*	X	X	X	ALL	2
Shrub	Narrowleaf Labrador tea	*Ledum palustre*	X	X	X	ALL	2
Shrub	Twin-flower	*Linnaea borealis*	X	X	X		2
Shrub	Alpine-azalea	*Loiseleuria procumbens*	X	X	X	TNC	1, 2, 3
Shrub	Shrubby cinquefoil	*Pentaphylloides floribunda*	X	X			2, 3
Shrub	Blue mountain heath	*Phyllodoce coerulea*	X				2
Shrub	White spruce	*Picea glauca*		X		OTZ	2
Shrub	Kamchatka Rhododendrom	*Rhododendron camtschaticum*	X				1, 2
Shrub	Lapland rosebay	*Rhododendron lapponicum*	X	X	X		2, 3
Shrub	Currant	*Ribes* sp.	X	X		TNC	1, 4
Shrub	American red currant	*Ribes triste*		X		OTZ	2
Shrub	Prickly rose	*Rosa acicularis*	X	X			2, 3
Shrub	Nagoonberry	*Rubus arcticus*	X	X	X	OTZ, LUR	2
Shrub	Cloudberry	*Rubus chamaemorus*	X	X	X	ALL	2, 4
Shrub	Feltleaf willow	*Salix alaxensis*	X	X	X	ALL	2, 4
Shrub	Littletree willow	*Salix arbusculoides*		X			2
Shrub	Arctic willow	*Salix arctica*	X	X	X	LUR, TNC	2, 4

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Shrub	Barren-ground willow	*Salix brachycarpa*	X	X	X		2, 4
Shrub	Silver willow	*Salix candida*					2
Shrub	Chamisso willow	*Salix chamissonis*	X	X	X	TNC	2, 4
Shrub	Alaska bog willow	*Salix fuscescens*	X	X	X	OTZ, LUR	2
Shrub	Grayleaf (northern) willow	*Salix glauca*	X	X	X	TNC, OTZ	2
Shrub	Halberd willow	*Salix hastata*	X	X	X		2
Shrub	Willow	*Salix interior*	X			TNC	1
Shrub	Richardson willow	*Salix richardsonii*	X	X	X	ALL	2
Shrub	Oval-leafed willow	*Salix ovalifolia*	X	X	X	LUR, TNC	2
Shrub	Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X	X	X	TNC, LUR	2
Shrub	Polar willow	*Salix polaris*	X		X	TNC	2
Shrub	Diamond-leaf willow	*Salix pulchra*	X	X	X	ALL	1, 4
Shrub	Netleaf (net-veined) willow	*Salix reticulata*	X	X	X	ALL	2, 3
Shrub	Least (round-leaf) willow	*Salix rotundifolia*	X	X	X	LUR, TNC	2
Shrub	Buffalo berry (soapberry)	*Shepherdia canadensis*		X			1, 4
Shrub	Beauverd spirea	*Spiraea stevenii*	X	X		OTZ	2
Shrub	Bog cranberry	*Vaccinium oxycoccus*	X				2
Shrub	Bog blueberry	*Vaccinium uliginosum*	X	X	X	OTZ, TNC	2
Shrub	Mountain cranberry	*Vaccinium vitis-idaea*	X	X	X	ALL	2
Herbaceous	Monkshood	*Aconitium delphinifolium*	X	X	X	ALL	1, 3
Herbaceous	Musk root (moschatel)	*Adoxa moschatellina*	X	X			1, 4
Herbaceous	Wild chives	*Allium schoenoprasum*	X	X			1, 3
Herbaceous	Alpine foxtail	*Alopecurus alpinus*			X	LUR	
Herbaceous	Round leaf orchid	*Amerorchis rotundifolia*		X			1, 3
Herbaceous	Rock jasmine	*Androsace chamaejasme*	X	X	X	TNC	1, 3
Herbaceous	Northern jasmine	*Androsace septentrionalis*	X	X	X		1, 4
Herbaceous	Anemone	*Anemone multiceps*	X		X	TNC, LUR	
Herbaceous	Narcissus-flower anemone	*Anemone narcissiflora*	X	X	X	LUR, TNC	1, 3
Herbaceous	Northern anemone	*Anemone parviflora*	X	X	X	LUR, TNC	1, 3
Herbaceous	Yellow anemone	*Anemone richardsonii*	X	X	X	ALL	1, 3

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Anemone	*Anemone* sp.	X			TNC	1
Herbaceous	Wild celery	*Angelica lucida*	X	X		OTZ	1, 4
Herbaceous	Pussytoes	*Antennaria friesiana*	X	X	X	TNC, LUR	1, 4
Herbaceous	Cats paws	*Antennaria monocephala*	X		X	TNC	1, 4
Herbaceous	Lyre-leaf rockcress	*Arabis lyrata*	X				1, 4
Herbaceous	Polar grass	*Arctagrostis latifolia*	X	X	X	ALL	
Herbaceous	Pendent grass	*Arctophila fulva*	X	X	X	ALL	1, 4
Herbaceous	Tall sandwort	*Arenaria capillaris*			X		1, 4
Herbaceous	Thrift	*Armeria maritima*	X			TNC	
Herbaceous	Frigid arnica	*Arnica frigida*	X	X	X	TNC, LUR	1, 3
Herbaceous	Lessing’s arnica	*Arnica lessingii*	X	X	X	LUR, TNC	1, 4
Herbaceous	Alaska wormwood	*Artemisia alaskana*	X				1, 4
Herbaceous	Arctic wormwood	*Artemisia arctica*	X	X	X	ALL	1, 4
Herbaceous	Northern wormwood	*Artemisa borealis*	X	X	X	TNC	1, 4
Herbaceous	Furcated wormwood	*Artemisia furcata*	X			TNC	
Herbaceous	Purple wormwood	*Artemisa globularia*	X		X	LUR, TNC	1, 3
Herbaceous	Wormwood	*Artemisia glomerata*	X			TNC	
Herbaceous	Common wormwood	*Artemisa tilesii*	X	X	X	ALL	1, 4
Herbaceous	Bering Sea wormwood	*Artemisia senjavinensis*	X	X		TNC	1, 3
Herbaceous	Siberian aster	*Aster sibiricus*	X	X	X	OTZ	1, 3
Herbaceous	Milkvetch	*Astragalus aboriginum*	X			TNC	
Herbaceous	Alpine milkvetch	*Astragalus alpinus*	X	X	X	OTZ	1, 3, 4
Herbaceous	Polar milkvetch	*Astragalus polaris*			X	LUR	
Herbaceous	Hairy Arctic milkvetch	*Astragalus umbellatus*	X	X	X	TNC	1, 3
Herbaceous	Wintercress	*Barbarea orthoceras*	X	X		OTZ	1, 4
Herbaceous	Beckmannia	*Beckmannia erucaeformis*		X		OTZ	1, 4
Herbaceous	Broomrape	*Boschniakia rossica*	X	X			1, 3
Herbaceous	Moonwort	*Botrychium lunaria*	X	X	X		1, 4
Herbaceous	Alaska boykinia	*Boykinia richardsonii*	X				1, 3
Herbaceous	Braya	*Braya glabella*	X			TNC	
Herbaceous	Thoroughwax	*Bupleurum americanum*	X		X	TNC, LUR	

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Bluejoint grass	*Calamagrostis canadensis*	X	X	X	OTZ	1, 4
Herbaceous	Reed bent grass	*Calamagrostis* sp.	X	X	X	OTZ, TNC	1, 4
Herbaceous		*Caltha natans*			X	LUR	
Herbaceous	Marsh marigold	*Caltha palustris*	X	X	X	LUR, TNC	1, 3
Herbaceous	Bluebell	*Campanula lasiocarpa*	X	X	X	TNC, LUR	1, 3
Herbaceous	Bluebells of Scotland	*Campanula rotundifolia*	X				1, 3
Herbaceous	Single-flowered harebell	*Campanula uniflora*	X			TNC	
Herbaceous	Bittercress	*Cardamine bellidifolia*	X		X	TNC, LUR	
Herbaceous	Bittercress	*Cardamine digitata*	X	X	X	LUR	1, 3
Herbaceous		*Cardamine microphylla*	X		X	TNC, LUR	
Herbaceous	Cuckoo flower	*Cardamine pratensis*	X	X	X	OTZ	1, 4
Herbaceous		*Cardamine purpurea*	X		X	TNC, LUR	
Herbaceous	Sedge	*Carex aquatilis*	X	X	X	ALL	1, 4
Herbaceous	Sedge	*Carex atrofusca*	X	X	X	ALL	
Herbaceous	Sedge	*Carex bigelowii*	X	X	X	ALL	1, 4
Herbaceous	Sedge	*Carex glacialis*	X			TNC	
Herbaceous	Sedge	*Carex lachenalii*			X	LUR	
Herbaceous	Sedge	*Carex lyngbyaei*	X	X			1, 4
Herbaceous	Sedge	*Carex membranacea*	X			TNC	
Herbaceous	Sedge	*Carex microchaeta*	X		X	TNC, LUR	
Herbaceous	Sedge	*Carex misandra*	X		X	TNC, LUR	
Herbaceous	Sedge	*Carex podocarpa*	X			TNC	
Herbaceous	Sedge	*Carex rotundata*		X		OTZ	
Herbaceous	Sedge	*Carex rupestris*	X			TNC	
Herbaceous	Sedge	*Carex scirpoidea*	X		X	TNC, LUR	
Herbaceous	Elegant paintbrush	*Castilleja elegans*	X	X	X	TNC, LUR	1, 3
Herbaceous	Paintbrush	*Castilleja* sp.	X	X	X		1
Herbaceous	Beringian (Bering Sea) chickweed	*Cerastium beeringianum*	X	X	X	LUR, TNC	1, 4
Herbaceous	Chickweed	*Cerastium jenisejense*					1, 4
Herbaceous	Northern water carpet	*Chrysosplenium tetandrum*	X	X	X	ALL	
Herbaceous	Wright's water carpet	*Chrysosplenium wrightii*	X		X	TNC, LUR	

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous		*Claytonia acutifolia*	X		X	TNC, LUR	
Herbaceous	Arctic springbeauty	*Claytonia arctica*	X			TNC	
Herbaceous	Alaska spring beauty	*Claytonia sarmentosa*	X	X	X	TNC, LUR	1, 3
Herbaceous		*Claytonia scammaniana*			X	LUR	
Herbaceous	Marsh fivefinger	*Comarum palustre*	X	X	X	OTZ	1, 3
Herbaceous	Coral root	*Corallorrhiza trifida*	X	X			1, 3
Herbaceous	Cushion hawk's beard	*Crepis nana*	X		X		1, 3, 4
Herbaceous		*Cnidium cnidiifolium*		X		OTZ	
Herbaceous	Scurvy grass	*Cochlearia officinalis*	X		X	TNC, LUR	
Herbaceous	Few-flowered corydalis	*Corydalis pauciflora*			X	LUR	
Herbaceous	Northern lady's slipper	*Cypripedium passerinum*	X	X			1, 3
Herbaceous	Arctic daisy	*Dendranthema arcticum*	X	X	X	TNC	1, 3
Herbaceous	Dwarf larkspur	*Delphinium brachycentrum*			X	LUR	
Herbaceous		*Deschampsia caespitosa*	X			TNC	
Herbaceous	Tansy mustard	*Descurainia sophioides*		X		OTZ	
Herbaceous	Frigid shooting star	*Dodecatheon frigidum*	X	X	X	LUR, TNC	1, 3
Herbaceous	Ochotsk douglasia	*Douglasia ochotensis*	X		X	TNC, LUR	1, 3
Herbaceous		*Draba alpina*	X			TNC	
Herbaceous		*Draba corymbosa*	X		X	TNC, LUR	
Herbaceous	Smoothing whitlow-grass	*Draba hirta*	X		X		1, 3
Herbaceous		*Draba lactea*	X			TNC	
Herbaceous		*Draba longipes*			X	LUR	
Herbaceous		*Draba nivalis*	X			TNC	
Herbaceous		*Draba palanderiana*	X		X	TNC, LUR	
Herbaceous		*Dupontia fischeri*	X		X	TNC, LUR	
Herbaceous	Fireweed	*Epilobium angustifolium*	X	X	X	ALL	1, 3, 4
Herbaceous	River beauty (dwarf fireweed)	*Epilobium latifolium*	X	X	X	LUR, TNC	1, 3
Herbaceous	Horsetail	*Equisetum arvense*	X	X	X	ALL	
Herbaceous	Horsetail	*Equisetum variegatum*	X		X	ALL	
Herbaceous	Horsetail	*Equisetum* sp.	X	X	X	ALL	1
Herbaceous	Fleabane	*Erigeron humilis*	X	X	X	TNC	1, 3

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Arctic fleabane	*Erigeron hyperboreus*	X	X	X		1, 3
Herbaceous		*Eriophorum angustifolium*	X	X	X	ALL	
Herbaceous		*Eriophorum brachyantherum*			X	LUR	
Herbaceous		*Eriophorum russeolum*			X	LUR	
Herbaceous	Arctic cottongrass	*Eriophorum scheuchzeri*	X	X	X	ALL	1, 3
Herbaceous	Sheathed cottongrass	*Eriophorum vaginatum*	X	X	X	LUR, OTZ	1, 3, 4
Herbaceous	Arctic forget-me-not	*Eritichum aretioides*	X	X	X	TNC, LUR	1, 3
Herbaceous		*Eritrichium chamissonis*			X	LUR	
Herbaceous		*Eutrema edwardsii*			X	LUR	
Herbaceous		*Festuca baffinensis*	X			TNC	
Herbaceous		*Festuca brachyphylla*	X		X	TNC, LUR	
Herbaceous		*Festuca rubra*	X		X	TNC, LUR	
Herbaceous	Fescue grass	*Festuca* sp.	X	X	X		1, 4
Herbaceous	Northern bedstraw	*Galium boreale*	X	X	X		1, 3
Herbaceous	Whitish gentian	*Gentiana algida*	X	X			1, 3
Herbaceous	Glaucous gentian	*Gentiana glauca*	X	X	X	TNC	1, 3
Herbaceous		*Gentiana propinqua*	X	X	X	ALL	
Herbaceous	Glacier avens	*Geum glaciale*	X		X	LUR, TNC	1, 3
Herbaceous	Ross avens	*Geum rossii*	X			TNC	1, 3
Herbaceous	Alpine eskimo potato	*Hedysarum hedysaroides*	X	X	X		1, 4
Herbaceous	Cow parsnip	*Heracleum lanatum*	X	X	X	LUR	1, 3
Herbaceous		*Hierochloe alpina*	X		X	TNC, LUR	
Herbaceous		*Hierochloe odorata*		X		OTZ	
Herbaceous	Mare’s Tail	*Hippuris vulgaris*	X	X	X	ALL	
Herbaceous	Seabeach Sandwort	*Honckenya peploides*	X	X	X	ALL	
Herbaceous		*Huperzia haleakalae*	X			TNC	
Herbaceous		*Huperzia selago*	X		X	TNC, LUR	
Herbaceous	Wild iris	*Iris setosa*	X	X		OTZ, TNC	1, 3, 4
Herbaceous		*Juncus arcticus*			X	LUR	
Herbaceous		*Juncus biglumis*	X			TNC	
Herbaceous	Glaucous weaselsnout (lagotis)	*Lagotis glauca*	X	X	X	LUR, TNC	1, 3

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Vetchling	*Lathyrus palustris*	X	X			1, 4
Herbaceous	Alpine milk vetch	*Lathyrus maritimus*	X	X		OTZ, TNC	1
Herbaceous	Leatherleaved saxifrage	*Leptarrhena pyrolifolia*	X		X	LUR, TNC	
Herbaceous	Bladder pod	*Lesquerella arctica*	X	X	X		1, 4
Herbaceous	Entire-leaved chrysanthemum	*Leucanthemum integrifolium*	X	X	X	TNC	1, 3
Herbaceous	Lyme grass	*Leymus mollis*	X	X	X	ALL	
Herbaceous	Alp lily	*Lloydia serotina*	X	X	X	TNC, LUR	1, 3
Herbaceous	Arctic lupine	*Lupinus arcticus*	X	X	X	OTZ	1, 4
Herbaceous		*Luzula arctica*	X		X	TNC, LUR	
Herbaceous		*Luzula arcuata*			X	LUR	
Herbaceous		*Luzula confusa*		X	X	OTZ, LUR	
Herbaceous		*Luzula multiflora*	X			TNC	
Herbaceous		*Luzula parviflora*		X		OTZ	
Herbaceous		*Luzula wahlenbergii*	X			TNC	
Herbaceous	Alpine club moss	*Lycopodium alpinum*	X			TNC	1, 4
Herbaceous		*Lycopodium annotinum*		X		OTZ	
Herbaceous	Bogbean (buckbean)	*Menyanthes trifoliata*	X	X			1, 4
Herbaceous	Oysterleaf	*Mertensia maritima*	X		X	TNC, LUR	
Herbaceous	Chiming bells	*Mertensia paniculata*	X	X		OTZ	1, 3
Herbaceous	Arctic sandwort	*Minuartia arctica*	X		X	TNC, LUR	1, 4
Herbaceous		*Minuartia elegans*	X		X	TNC, LUR	
Herbaceous		*Minuartia macrocarpa*	X			TNC	
Herbaceous		*Minuartia obtusiloba*	X		X	LUR, TNC	
Herbaceous		*Minuartia rubella*	X			TNC	
Herbaceous	Water Blinks	*Montia fontana*			X	LUR	
Herbaceous	Alpine forget-me-not	*Myosotis alpestris*	X	X	X	LUR, TNC	1, 3
Herbaceous	Mountain Sorrel	*Oxyria dignya*	X		X	LUR, TNC	
Herbaceous		*Oxytropis arctica*			X	LUR	
Herbaceous	Barneby's milkvetch	*Oxytropis arctica var. barnebyana*		X		OTZ	
Herbaceous	Maydell's oxytrope	*Oxytropis maydelliana*	X	X		TNC, OTZ	
Herbaceous		*Oxytropis mertensiana*	X			TNC	

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Blackish oxytrope	*Oxytropis nigrescens ssp. bryophila*	X	X	X	ALL	1, 3
Herbaceous		*Oxytropis nigrescens ssp. gorodkovii*	X			TNC	
Herbaceous		*Packera cymbalaria*	X		X	LUR, TNC	
Herbaceous		*Papaver gorodkovii*			X	LUR	
Herbaceous	Arctic poppy	*Papaver hultenii*	X	X	X	LUR	1, 3
Herbaceous		*Papaver lapponicum*			X	LUR	
Herbaceous	Macoun’s poppy	*Papaver macounii*	X			TNC, LUR	1
Herbaceous	Walpole poppy	*Papaver walpolei*	X			TNC	1, 3
Herbaceous		*Parnassia kotzebuei*	X	X	X	ALL	
Herbaceous	Grass of Parnassus	*Parnassia palustris*	X	X	X	OTZ	1, 3, 4
Herbaceous	Parrya	*Parrya nudicaulis*	X	X	X	LUR, TNC	1, 3
Herbaceous	Capitate lousewort	*Pedicularis capitata*	X	X	X	ALL	1, 3
Herbaceous	Wooly lousewort	*Pedicularis kanei*	X	X	X	ALL	1
Herbaceous		*Pedicularis lanata*	X	X	X	ALL	
Herbaceous		*Pedicularis langsdorffii*	X		X	TNC, LUR	
Herbaceous		*Pedicularis lapponica*	X		X	TNC, LUR	
Herbaceous	Oeder’s lousewort	*Pedicularis oederi*	X	X	X	TNC, LUR	1, 3
Herbaceous	Fernweed	*Pedicularis sudetica*	X	X	X	ALL	1, 3
Herbaceous	Bumblebee flower	*Pedicularis verticillata*	X	X	X		1, 3
Herbaceous	Frigid Coltsfoot	*Petasites frigidus*	X	X	X	ALL	
Herbaceous	Snow Grass	*Phippsia algida*	X		X	TNC, LUR	
Herbaceous		*Phlox richardsonii*	X			TNC	
Herbaceous	Siberian phlox	*Phlox sibirica*	X		X		1, 3
Herbaceous	Butterwort	*Pinguicula vulgaris*	X	X			1, 3, 4
Herbaceous	Bog orchid	*Platanthera convallariaefolia*	X				1, 3
Herbaceous	Small northern bog orchid	*Platanthera obtusata*	X	X			1, 3
Herbaceous		*Poa abbreviata*			X	LUR	
Herbaceous	Alpine bluegrass	*Poa alpine*	X		X	TNC, LUR	1, 4
Herbaceous		*Poa arctica*	X		X	TNC, LUR	
Herbaceous		*Poa glauca*	X		X	TNC, LUR	
Herbaceous	Blue grass	*Poa* sp.	X	X	X	ALL	1, 4

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous	Tall Jacob' ladder	*Polemonium acutiflorum*	X	X	X	ALL	1, 3
Herbaceous		*Polemonium boreale*			X	LUR	
Herbaceous	Jacob's ladder	*Polemonium pulcherrimum*	X	X			1, 3, 4
Herbaceous	Bistort	*Polygonum bistorta*	X	X	X	TNC, LUR	1, 3
Herbaceous	Alpine meadow bistort	*Polygonum viviparum*	X	X	X	ALL	1, 4
Herbaceous	Two-flowered cinquefoil	*Potentilla biflora*	X	X	X	LUR, TNC	1, 3
Herbaceous		*Potentilla elegans*	X			TNC	
Herbaceous		*Potentilla hookeriana*	X		X	TNC, LUR	
Herbaceous		*Potentilla hyparctica*	X			TNC	
Herbaceous		*Potentilla norvegica*	X			NC	
Herbaceous		*Potentilla vahliana*	X			TNC	
Herbaceous		*Potentilla pulchella*		X		OTZ	
Herbaceous	One-flowered cinquefoil	*Potentilla uniflora*	X	X	X	TNC, LUR	1, 3
Herbaceous		*Primula anvilensis*	X			TNC	
Herbaceous	Northern primrose	*Primula borealis*	X	X	X	LUR, TNC	1, 3
Herbaceous	Wedge-leafed primrose	*Primula cuneifolia*	X	X			1, 3
Herbaceous	Chukchi primrose	*Primula tschuktschorum*	X		X	TNC, LUR	
Herbaceous	Pink pyrola	*Pyrola asarifolia*	X	X			1, 3
Herbaceous	Large-flowered wintergreen	*Pyrola grandiflora*	X	X	X	ALL	1, 3
Herbaceous		*Ranunculus glacialis*	X			TNC	
Herbaceous		*Ranunculus hyperboreus*	X			TNC	
Herbaceous		*Ranunculus kamchaticus*	X			TNC	
Herbaceous		*Ranunculus lapponicus*	X			LUR	
Herbaceous		*Ranunculus nivalis*	X	X	X	ALL	
Herbaceous		*Ranunculus pallasii*		X		OTZ	
Herbaceous		*Ranunculus sulphureus*			X	LUR	
Herbaceous	Buttercup	*Ranunculus* sp.	X	X	X	LUR	1, 4
Herbaceous	Roseroot	*Rhodiola integrifolia*	X	X		TNC	1, 3
Herbaceous	Arctic dock	*Rumex arcticus*	X	X	X	ALL	1, 4
Herbaceous	Dock	*Rumex graminifolius*	X	X	X		1, 4
Herbaceous	Rumex	*Rumex krassei*	X		X		

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous		*Sagina nivalis*	X			TNC	
Herbaceous	Burnet	*Sanguisorba officinalis*	X	X			1, 4
Herbaceous		*Saussurea angustifolia*	X		X	TNC, LUR	
Herbaceous	Narrow-leafed saussurea	*Saussurea viscida*	X	X	X		1, 3
Herbaceous	Spotted saxifrage	*Saxifraga bronchialis*	X	X	X	LUR, TNC	1, 3
Herbaceous		*Saxifraga caespitosa*	X		X	LUR, TNC	
Herbaceous	Bulbous (bulblet) saxifrage	*Saxifraga cernua*	X	X	X	LUR, TNC	1, 3
Herbaceous		*Saxifraga eschscholtzii*	X		X	LUR, TNC	
Herbaceous	Whiplash saxifrage	*Saxifraga flagellaris*	X		X	LUR, TNC	1, 3
Herbaceous		*Saxifraga foliolosa*	X		X	LUR, TNC	
Herbaceous	Rusty saxifrage	*Saxifraga hieracifolia*	X	X	X	LUR, TNC	1, 3
Herbaceous	Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	X	ALL	1, 3, 4
Herbaceous	Brook saxifage	*Saxifraga nelsoniana*	X	X	X	LUR, TNC	1, 3
Herbaceous		*Saxifraga nudicaulis*	X			TNC	
Herbaceous	Purple mountain saxifrage	*Saxifraga oppositifolia*	X		X	TNC, LUR	1, 3
Herbaceous		*Saxifraga razshivinii*			X	LUR	
Herbaceous		*Saxifraga reflexa*			X	LUR	
Herbaceous		*Saxifraga rivularis*	X		X	LUR, TNC	
Herbaceous	Thyme-leaved saxifrage	*Saxifraga serpyllifolia*	X		X	LUR, TNC	1, 3
Herbaceous		*Saxifraga sibirica*	X		X	LUR, TNC	
Herbaceous	Spiked saxifrage	*Saxifraga spicata*	X				1, 3
Herbaceous	Nodding saxifrage	*Saxifraga tenuis*	X			TNC	
Herbaceous		*Selaginella sibirica*	X			TNC	
Herbaceous	Marsh fleawort (mastodon flower)	*Senecio congestus*	X	X	X	TNC	1, 3
Herbaceous	Black-tipped groundsel	*Senecio lugens*	X	X	X	TNC	1, 3
Herbaceous	Seabeach scenecio	*Senecio pseudoarnica*	X	X			1, 3
Herbaceous		*Sibbaldia procumbens*	X			TNC	
Herbaceous	Moss campion	*Silene acaulis*	X	X	X	TNC, LUR	1, 3
Herbaceous	Arctic lychnis	*Silene involucrata*	X			TNC	1
Herbaceous		*Silene macrosperma*	X			TNC	
Herbaceous	Bladder campion	*Silene uralensis*	X	X	X	LUR, TNC	1, 4

Form	Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Occurrence	References
Herbaceous		*Smelowskia borealis*			X	LUR	
Herbaceous	Smelowskia	*Smelowskia calycina*	X	X	X	LUR	1, 3
Herbaceous	Goldenrod	*Solidago multiradiata*	X	X	X	TNC	1, 3
Herbaceous	Bur-reed	*Sparganium angustifolim*	X	X			1, 4
Herbaceous		*Stellaria dicranoides*	X		X	LUR, TNC	
Herbaceous		*Stellaria humifusa*			X	LUR	
Herbaceous		*Stellaria longipes*			X	LUR	
Herbaceous		*Taraxacum ceratophorum*	X		X	TNC, LUR	
Herbaceous		*Taraxacum hyparcticum*	X			TNC	
Herbaceous	Dandelion	*Taraxacum* sp.	X	X	X	LUR, OTZ	1, 3
Herbaceous		*Tephroseris atropurpurea ssp. frigidus*	X		X	LUR, TNC	
Herbaceous		*Tephroseris atropurpurea ssp. tomentosa*	X		X	LUR, TNC	
Herbaceous		*Thalictrum alpinum*	X			TNC	
Herbaceous		*Tofieldia coccinea*	X	X	X	ALL	
Herbaceous		*Tripleurospermum phaeocephalum*	X			TNC	
Herbaceous	Trisetum	*Trisetum sibircum*	X			TNC	1
Herbaceous		*Trisetum spicatum*	X	X	X	ALL	
Herbaceous	Arrow grass	*Triglochin maritimum*	X	X			1, 4
Herbaceous	Bladderwort	*Utricularia intermedia*	X	X			1, 4
Herbaceous	Capitate valerian	*Valeriana capitata*	X	X	X	ALL	1, 3
Herbaceous	Two-flowered violet	*Viola biflora*	X				1, 3
Herbaceous	Alaska violet	*Viola langsdorffii*	X				1, 3
Herbaceous		*Wilhelmsia physodes*	X			TNC	
Herbaceous	Death Camass	*Zygadenus elegans*	X	X		TNC	1, 3

Codes: TNC - Tin City, OTZ - Kotzebue, LUR - Lisbur

Data for Potentially-Occurring Plants From: Hulten (1968), Viereck and Little (1972), White (1974), Pratt (1991), and Lipkin (1999).

Observed: Identified during June 1993 site visits (Woodward-Clyde 1995d), 1996 site visits (to LUR & TNC only; Lipkin 1999), and July 2002 site visits by ABR, Inc.

Note: Species listed alphabetically by scientific name.

Table A2: Fish Species Potentially Occurring on or near Cape Lisburne, Kotzebue, and Tin City Long Range Radar Sites

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne
Sockeye (red) salmon	*Oncorhynchus nerka*	X	X	X
Chinook (king) salmon	*Oncorhynchus tshaytscha*	X	X	X
Coho (silver) salmon	*Oncorhynchus kisutcyh*	X	X	X
Chum salmon	*Oncorhynchus keta*	X	X	X
Pink salmon	*Oncorhynchus gorbuscha*	X	X	X
Pacific herring	*Clupea pallasi*	X	X	
Whitefish	*Coregonus sp.*	X		X
Arctic char	*Salvelinus alpinus*	X		X
Dolly Varden	*Salvelinus malma*	X	X	X
Arctic grayling	*Thymallus arcticus*			X
Pacific tomcod	*Microgadus proximus*	X	X	
Pacific cod	*Gadus macrocephalus*			X
Saffron cod	*Eleginus gracilis*			X
Arctic cod	*Boreogadus saida*	X	X	
Yellow-fin sole	*Pleuronectes asper*			X
Arctic flounder	*Liopsetta glacialis*	X	X	
Bering flounder	*Hippoglossoides robustus*			X
Starry flounder	*Platichthys stellatus*			X
Pollock	*Theragra chalcogramma*			X
Walleye pollock	*Theragra calcogrammus*			X
Bering cisco	*Coregonus laurettae*			X
Arctic cisco	*Coregonus autumnalis*			X
Least cisco	*Dallis pectoralis*			X
Slimy sculpin	*Cottus cognatus*			X
Fourhorn sculpin	*Myoxocephalus quadricor*			X

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne
Shorthorn sculpin	*Myoxocephalus scorpius*			X
Arctic staghorn sculpin	*Gymnocanthus tricuspis*			X
Twohorn sculpin	*Icelus bicornis*			X
Rainbow smelt	*Osmerus mordax*	X	X	X
Nine-spined stickleback	*Pungitus pungitus*	X	X	X
Arctic lamprey	*Lampetra japonica*			X
Halibut	*Hippoglossus stenolepis*			X
Canadian eelpout	*Lycodes polaris*			X
Capelin	*Mallotus villosus*			X

Sources:
Flock and Hubbard 1979
Morrow 1980
U. S. Department of the Interior 1987b
USFWS 1988
Robbins *et al*. 1991
Woodward-Clyde 1995d

Table A3: Mammal Species Potentially Occurring on or near Cape Lisburne, Kotzebue, and Tin City Long Range Radar Sites

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
Terrestrial					
Musk ox	*Ovibos moschatus*	X		X	TNC
Barren-ground caribou	*Rangifer tarandus*	X	X	X	LUR
Reindeer	*Rangifer arcticus*	X		X	TNC
Brown/grizzly bear	*Ursus arctos*	X		X	LUR
Arctic fox	*Alopex lagopus*	X	X	X	LUR
Red fox	*Vulpes vulpes*	X	X	X	
River otter	*Lutra canadensis*	X	X	X	
Mink	*Mustela vison*	X	X	X	
Wolverine	*Gulo gulo*	X	X	X	
Short-tailed weasel (ermine)	*Mustela erminea*	X	X	X	
Least weasel	*Mustela rixosa*	X	X	X	
Wolf	*Canis lupus*	X		X	
North American lynx	*Felis lynx*	X	X	X	
Porcupine	*Erethizon dorsatum*	X	X	X	
Muskrat	*Ondantra zibethicus*	X	X		
Tundra hare	*Lepus othus*	X	X	X	
Snowshoe hare	*Lepus americanus*	X	X		
Arctic ground squirrel	*Spermophilus paryi*	X	X	X	
Northern red-backed vole	*Clethrionomys rutilus*	X	X	X	
Tundra vole	*Microtus oeconomus*	X	X	X	
Meadow vole	*Microtus pennsylvanicus*	X	X		
Alaska vole	*Microtus miurus*	X	X		
Brown lemming	*Lemmus trimucronatus*	X	X	X	
Collared lemming	*Dicrostonyx*	X	X		

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
	groenlandicus				
Masked shrew	*Sorex cinereus*		X	X	
Tundra shrew	*Sorex tundrensis*		X	X	
Marine					
Polar bear	*Ursus maritimus*	X	X	X	
Spotted seal	*Phoca larga*	X	X	X	
Ribbon seal	*Phoca fasciata*	X	X	X	
Ringed seal	*Phoca hispida*	X	X	X	
Bearded seal	*Erignathus barbatus*	X	X	X	
Steller sea lion	*Eumetopias jubatus*	X			
Pacific walrus	*Odobenus rosmarus*	X		X	TNC, LUR
Beluga whale	*Delphinapterus leucas*	X	X	X	
Fin whale	*Balaenoptera physalus*	X	X	X	
Minke whale	*Balaenoptera acutorostrata*	X	X	X	
Humpback whale	*Megaptera novaeangliae*	X	X		
Bowhead whale	*Balaenoptera mysticetus*	X	X	X	
Gray whale	*Eschrichtius robustus*	X	X	X	TNC
Northern right whale	*Balena glacialis*	X			
Killer whale	*Orcinus orca*	X	X	X	
Harbor porpoise	*Phocoena phocoena*	X	X	X	

Sources:
USFWS undated (b)
Flock and Hubbard 1979
Wynne 1993
Woodward-Clyde 1995d
Code:
TNC - Tin City
OTZ - Kotzebue
LUR - Cape Lisburne
Note:
Observed species identified during June 1993 site visit (Woodward-Clyde, 1995d) and 2002 site visits by ABR, Inc.

Table A4: Bird Species Potentially Occurring on or near Cape Lisburne, Kotzebue, and Tin City Long Range Radar Sites

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	ALL
Arctic Loon	*Gavia arctica*	X	X	X	TNC
Pacific Loon	*Gavia pacifica*	X	X	X	TNC, OTZ
Common Loon	*Gavia immer*	X	X	X	TNC
Yellow-billed Loon	*Gavia adamsii*	X	X	X	TNC
Horned Grebe	*Podiceps auritus*	X	X	X	
Red-necked Grebe	*Podiceps grisegena*	X	X	X	OTZ, TNC
Short-tailed Shearwater	*Puffinus tenuirostris*	X	X		
Pelagic Cormorant	*Phalacrocorax pelagicus*	X	X	X	TNC, LUR
Greater White-fronted Goose	*Anser albifrons*	X	X	X	TNC
Emperor Goose	*Chen canagica*	X	X	X	TNC
Snow Goose	*Chen caerulescens*	X	X	X	TNC, LUR
Canada Goose	*Branta Canadensis*	X	X	X	OTZ
Brant	*Branta bernicla*	X	X	X	ALL
Tundra Swan	*Cygnus columbianus*	X	X	X	TNC
American Wigeon	*Anas Americana*	X	X	X	OTZ
Mallard	*Anas platyrhynchos*	X	X	X	OTZ
Northern Shoveler	*Anas clypeata*	X	X	X	
Northern Pintail	*Anas acuta*	X	X	X	ALL
Green-winged Teal	*Anas crecca*		X		OTZ
Canvasback	*Aythya valisineria*	X	X	X	OTZ
Redhead	*Aythya Americana*	X	X	X	
Greater Scaup	*Aythya marila*	X	X	X	OTZ
Lesser Scaup	*Aythya affinis*		X		
Steller's Eider	*Polysticta stelleri*	X	X	X	LUR
Spectacled Eider	*Somateria fischeri*	X	X	X	TNC
King Eider	*Somateria spectabilis*	X	X	X	TNC
Common Eider	*Somateria mollissima*	X	X	X	TNC, LUR
Harlequin Duck	*Histrionicus histrionicus*	X	X	X	TNC
Surf Scoter	*Melanitta perspicillata*	X	X	X	TNC
White-winged Scoter	*Melanitta fusca*	X	X	X	
Black Scoter	*Melanitta nigra*	X	X	X	LUR
Long-tailed Duck	*Clangula hyemalis*	X	X	X	ALL
Red-breasted Merganser	*Mergus serrator*	X	X	X	
Northern Harrier	*Circus cyaneus*	X	X		
Northern Goshawk	*Accipiter gentiles*	X	X		
Rough-legged Hawk	*Buteo lagopus*	X	X	X	TNC
Golden Eagle	*Aquila chrysaetos*	X	X	X	LUR, TNC
Merlin	*Falco columbarius*		X		TNC
Gyrfalcon	*Falco rusticolus*	X	X	X	OTZ, LUR, TNC

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
Peregrine Falcon	*Falco peregrines*	X	X	X	OTZ, TNC
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	
Rock Ptarmigan	*Lagopus mutus*	X	X	X	LUR, TNC
Sandhill Crane	*Grus Canadensis*	X	X	X	TNC, OTZ
Black-bellied Plover	*Pluvialis squatarola*	X	X	X	
American Golden-Plover	*Pluvialis dominica*	X	X	X	LUR
Pacific Golden-Plover	*Pluvialis fulva*	X	X	X	OTZ
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	TNC, OTZ, LUR
Killdeer	*Charadrius vociferus*			X	
Wandering Tattler	*Heteroscelus incanus*			X	LUR
Spotted Sandpiper	*Actitis macularia*	X	X	X	
Whimbrel	*Numenius phaeopus*		X		OTZ
Bristle-thighed Curlew	*Numenius tahitiensis*	X	X	X	
Hudsonian Godwit	*Limosa haemastica*	X	X	X	OTZ
Bar-tailed Godwit	*Limosa lapponica*	X	X	X	
Ruddy Turnstone	*Arenaria interpres*	X	X	X	OTZ
Black Turnstone	*Arenaria melanocephala*	X	X	X	OTZ
Red Knot	*Calidris canutus*	X	X	X	
Sanderling	*Calidris alba*	X	X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	ALL
Western Sandpiper	*Calidris mauri*	X	X	X	ALL
Red-necked Stint	*Calidris ruficollis*	X			
Least Sandpiper	*Calidris minutilla*	X	X	X	
Baird's Sandpiper	*Calidris bairdii*	X	X	X	TNC
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	OTZ, LUR
Sharp-tailed Sandpiper	*Calidris acuminata*	X	X	X	
Rock Sandpiper	*Calidris ptilocnemis*	X	X	X	TNC
Dunlin	*Calidris alpina*	X	X	X	TNC
Wilson’s Snipe	*Gallinago delicata*	X			TNC
Curlew Sandpiper	*Calidris ferruginea*	X	X	X	TNC
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	OTZ
Common Snipe	*Gallinago gallinago*	X	X	X	OTZ
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	LUR, OTZ
Red Phalarope	*Phalaropus fulicaria*	X	X	X	
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	X	TNC, LUR
Parasitic Jaeger	*Stercorarius parasiticus*	X	X	X	ALL
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	ALL
Black-tailed Gull	*Larus crassirostris*			X	LUR
Mew Gull	*Larus canus*	X	X	X	OTZ
Herring Gull	*Larus argentatus*		X		
Slaty-backed Gull	*Larus schistisagus*	X	X		TNC
Glaucous-winged Gull	*Larus glaucescens*		X	X	LUR

Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
Glaucous Gull	*Larus hyperboreus*	X	X	X	ALL
Sabine's Gull	*Xema sabini*	X	X		TNC
Black-legged Kittiwake	*Rissa tridactyla*	X	X	X	ALL
Ross's Gull	*Rhodostethia rosea*		X		
Ivory Gull	*Pagophila eburnea*		X		
Arctic Tern	*Sterna paradisaea*	X	X	X	OTZ, TNC
Aleutian Tern	*Sterna aleutica*	X	X		
Common Murre	*Uria aalge*	X	X	X	TNC, LUR
Thick-billed Murre	*Uria lomvia*	X	X	X	LUR
Black Guillemot	*Cepphus grylle*	X	X	X	LUR
Pigeon Guillemot	*Cepphus columba*	X		X	LUR, TNC
Kittlitz's Murrelet	*Brachyramphus brevirostris*	X	X	X	TNC, LUR
Ancient Murrelet	*Synthliboramphus antiquus*	X			
Parakeet Auklet	*Aethia psittacula*	X	X	X	
Least Auklet	*Aethia pusilla*	X	X	X	
Crested Auklet	*Aethia cristatella*	X	X	X	
Horned Puffin	*Fratercula corniculata*	X	X	X	TNC, LUR
Tufted Puffin	*Fratercula cirrhata*	X	X	X	LUR
Snowy Owl	*Nyctea scandiaca*	X	X	X	TNC, LUR
Short-eared Owl	*Asio flammeus*	X	X		OTZ
Boreal Owl	*Aegolius funereus*		X		
Alder Flycatcher	*Empidonax alnorum*		X		OTZ
Say's Phoebe	*Sayornis saya*	X			
Northern Shrike	*Lanius excubitor*	X	X	X	TNC
Common Raven	*Corvus corax*	X	X	X	ALL
Horned Lark	*Eremophila alpestris*	X	X	X	TNC
Tree Swallow	*Tachycineta bicolor*	X	X		
Bank Swallow	*Riparia riparia*	X	X		OTZ
Cliff Swallow	*Petrochelidon pyrrhonota*	X	X		
Barn Swallow	*Hirundo rustica*		X	X	
Arctic Warbler	*Phylloscopus borealis*	X	X		TNC
Bluethroat	*Luscinia svecica*	X	X	X	
Northern Wheatear	*Oenanthe oenanthe*	X	X	X	TNC, LUR
Gray-cheeked Thrush	*Catharus minimus*		X		
American Robin	*Turdus migratorius*		X		OTZ
Varied Thrush	*Ixoreus naevius*	X	X		TNC
Yellow Wagtail	*Motacilla flava*	X	X	X	ALL
White Wagtail	*Motacilla alba*	X	X	X	TNC
Red-throated Pipit	*Anthus cervinus*	X		X	
American Pipit	*Anthus rubescens*	X	X	X	ALL
Orange-crowned Warbler	*Vermivora celata*		X		TNC
Yellow Warbler	*Dendroica petechia*		X		OTZ
Yellow-rumped Warbler	*Dendroica coronata*		X		

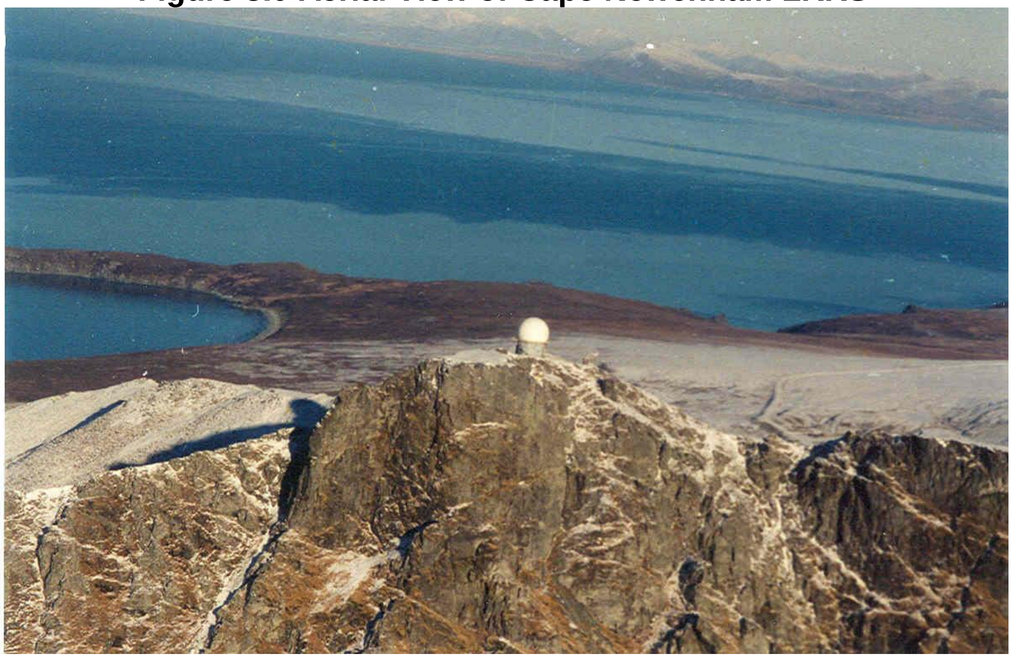
Common Name	Scientific Name	Tin City	Kotzebue	Cape Lisburne	Observed
Blackpoll Warbler	*Dendroica striata*		X		
Northern Waterthrush	*Seiurus noveboracensis*		X		
Wilson's Warbler	*Wilsonia pusilla*	X	X	X	
American Tree Sparrow	*Spizella arborea*	X	X	X	OTZ
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	ALL
Fox Sparrow	*Passerella iliaca*	X	X	X	OTZ, TNC
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	OTZ, LUR, TNC
Golden-crowned Sparrow	*Zonotrichia atricapilla*				TNC
Dark-eyed Junco	*Junco hyemalis*				TNC
Lapland Longspur	*Calcarius lapponicus*	X	X	X	ALL
Snow Bunting	*Plectrophenax nivalis*	X	X	X	TNC, LUR
Rusty Blackbird	*Euphagus carolinus*		X		OTZ
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*			X	LUR
Common Redpoll	*Carduelis flammea*	X	X	X	OTZ, LUR, TNC
Hoary Redpoll	*Carduelis hornemanni*		X	X	LUR, TNC

Codes: TNC - Tin City, OTZ - Kotzebue, LUR – Lisburne
Data for Potentially-Occurring Species From: Childs (1969), Flock and Hubbard (1979), Armstrong (1991), Gibson (1993), Woodward-Clyde (1995d), Day *et al*. (1995), Day and Stickney (1996), Andres *et al*. (1999).
Observed: Seen by Woodward-Clyde and USAF in 1993 (OTZ on 19 June, TNC from 19-20 June, LUR from 20-21 June; Woodward-Clyde [1995d]); ABR, Inc. in 1994 (TNC on 21 June, OTZ on 22 June and 5 August, LUR on 22 June; Day *et al*. [1995]); ABR, Inc. in 1995 (TNC from 14-18 July, LUR from 18-20 July; Day and Stickney [1996]); USFWS in 1996 (OTZ in June; Andres and Brann [1997]); ABR, Inc. in 2002 (LUR from 19-21 July, OTZ from 22-23 July, TNC from 25-26 July); Boisvert, Schick, and Day 2004; Boisvert and Day 2006.
Notes: Species listed in phylogenetic order.

Appendix 3.0 - Newenham. Cape Newenham Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Cape Newenham LRRS



3.1 Location and Area

Cape Newenham LRRS is located 460 miles southwest of Anchorage with Kuskokwim Bay to the north and Bristol Bay to the south (INRMP Figure 3.1). The 2,359-acre installation (Figure 3.1) is located on a peninsula within the Togiak NWR. Cape Newenham LRRS is accessible only by air or sea. Cape Newenham has an upper and lower camp configured site. The two camps are connected by a 3,845-foot tram system.

3.2 Installation History

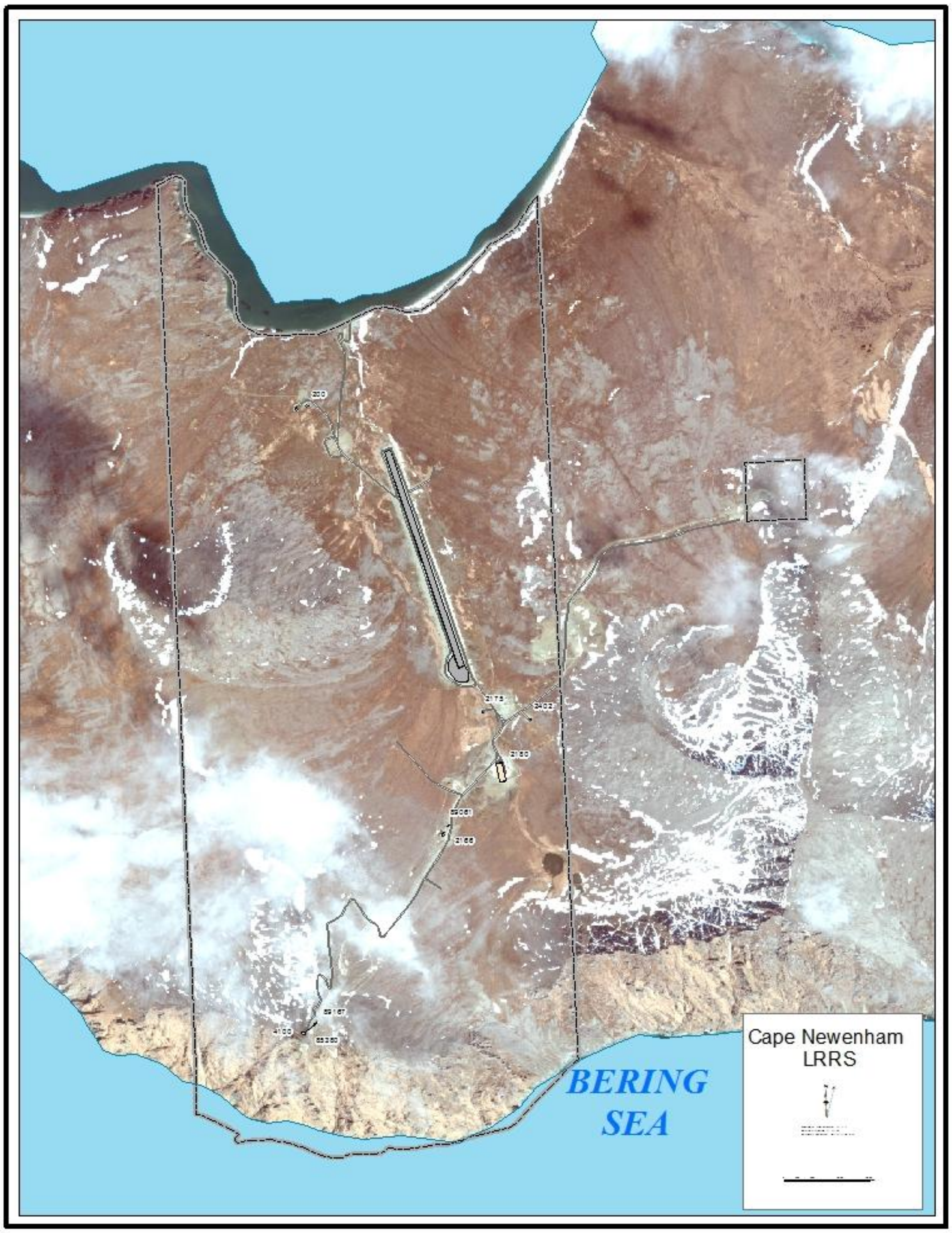
Cape Newenham LRRS is one of 12 original AC&W sites constructed as a part of the air defense system in Alaska. Construction of the facility was completed in 1952. Radar was installed at Upper Camp in 1954 when the installation became operational. Communications were originally provided by a high frequency radio system, which was replaced by WACS. By 1979 WACS was obsolete and was replaced by a commercial satellite earth terminal system.

In 1977, 80 military personnel were replaced when support services were contracted. Fourteen military personnel remained on site. A MAR system was installed in 1982, which remains active today, and other modifications were made to remotely operate and maintain the radar from Elmendorf Region Operations Control Center. This allowed all military positions to be eliminated and permitted total operation by a contractor. The MAR is operated under BOS contracts for operation and maintenance. Four contract personnel occupy the LRRS. Clean Sweep removed inactive structures at the LRRS in 2011 and 2012.

3.3 Surrounding Communities

Platinum (27 miles northeast) and Goodnews Bay (37 miles northeast) are the nearest communities to the installation. Other communities in the area include Togiak (67 miles northeast), Twin Hills (70 miles northeast), Quinhagak (77 miles north), and Manokotak (110 miles west) (Braund and Associates 2004). Platinum is on the south spit of Goodnews Bay. The community has a mixed economy dependent on commercial fishing and subsistence resources. A mining boom occurred in the area in 1936. However, platinum mines were closed in 1990, leaving government, commercial fishing, and subsistence as the main economic activities (Braund and Associates 2004).

Figure 3.1 Cape Newenham LRRS



The village of Goodnews Bay is on the north shore of Goodnews Bay at the mouth of the Goodnews River. Goodnews Bay is a traditional Yup'ik Eskimo village, formerly known as Mumtraq. Goodnews Bay relies on subsistence products for its existence. Eighty-three percent of jobs are with the city government and school (Braund and Associates 2004). 2010 population estimates for these communities are Platinum (61), Goodnews Bay (243), Togiak (817), Twin Hills (74), Quinhagak (669), and Manokotak (442) (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Archeological evidence indicates that the Togiak NWR has been continuously occupied by Eskimos for at least 2,000 years. One site on Cape Newenham LRRS shows evidence of possible human occupancy dating 4,000 to 5,000 years ago (USFWS 1986a).

Three different groups of aboriginal people lived within the Togiak Refuge area: the Algemiut Eskimos, who lived in the Nushagak Bay area; the Kuskowogamiut Eskimos, who occupied the area from Chagvan Bay north to the Kuskokwim River; and the Togiagmiut Eskimos, who lived in the area from Nanvak Bay east to Cape Constantine (USFWS 1986a).

The Kuskowogamiut, who occupied the area to the west and north of the Togiagamiut, relied on resources of the sea for subsistence. People living in the vicinity of Cape Newenham LRRS harvested walrus, seals, and beluga whales for meat, blubber, and oil. Walrus was also prized for ivory and used in trade and the manufacture of tools. In addition to marine mammals, salmon and Dolly Varden were important parts of the diet. Caribou were taken when available. Seabirds and waterfowl were harvested for meat, eggs, and clothing (USFWS 1986a).

Captain James Cook and his crew were probably the first white men to see the area, reaching Cape Newenham on July 16, 1778. Somewhere to the north of Cape Newenham LRRS, probably in the vicinity of Goodnews Bay, Captain Cook was visited by a group of Eskimos in kayaks. He was of the opinion these people had no previous contact with whites, as they had no tobacco or foreign articles other than ivory knives in their possession (USFWS 1986a).

Russian explorers reached Bristol Bay in the 1790s, but the first contact probably did not occur until 1818 when a party of Russian American Company traders established a redoubt on Nushagak Bay. The area was rich in furs, and the post soon handled as many as 4,000 pelts annually (USFWS 1986a).

Around the turn of the century, a major change occurred in the primary industry of the area. About the time the fur industry was beginning to decline, two new industries began operating in the area, mining and commercial fishing. Both industries have continued to the present time. Commercial fishing began in Bristol Bay in the late 1800s and within a short time became the area's dominant industry (USFWS 1986a).

At the turn of the century, placer gold was discovered in the Arolik River Basin. Several placer gold mines began operating. Most mines had closed by the outbreak of World War II. Platinum was first discovered in Fox Gulch on the flank of Red Mountain in the Salmon River Valley in 1926. This discovery produced what was Alaska's last big prospecting stampede, with more than 150 claims being staked in the valley. By 1934 the Goodnews Bay Company had acquired nearly all of these claims. The company is now Hanson Properties, Inc. and primarily mines platinum (USFWS 1986a).

The invasion of the Aleutian Islands by the Japanese initiated a large-scale government involvement in the region during the early days of World War II. The upgrading and construction of existing and new airfields and communication sites were principal goals of this early military construction. The mission of these facilities was to support the Aleutian Islands campaign by providing advance staging installations, fuel stops, and communications for aircraft deploying to and from the islands (Guteleber 1986).

3.5 Local and Regional Natural Areas

Cape Newenham LRRS falls within Togiak Refuge Unit 7, comprised of the Kinegnak and Slug River drainages and the Cape Pierce/Cape Newenham subunit. Togiak NWR was established in 1980. Management direction for the refuge is provided in the *Togiak National Wildlife Refuge Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review* (USFWS 1986a).

The coastal zone in the Cape Pierce/Cape Newenham subunit consists of sand and gravel beaches, sea cliffs, estuaries, and littoral and pelagic waters (USFWS 1991a). The Cape Pierce/Cape Newenham subunit lies within a wildlife sensitive zone designated on the Kodiak Sectional Aeronautical Chart published for pilots. This designation emphasizes the importance of the area for wildlife, and pilots are *requested to avoid flight below 2,000 feet AGL (above ground level) from April 1 through October 31* (USFWS 1991a).

Cape Newenham LRRS, a 2,359-acre installation is within the Cape Pierce/Cape Newenham Wilderness Review Unit. This wilderness review unit covers approximately 242,000 acres on the southwestern tip of the refuge, encompassing the former Cape Newenham Refuge on the Kuskokwin Bay side. The coastline in this area extends from just east of Pyrite Point on the Bristol Bay side to just north of the mouth of the Salmon River. The area possesses diverse fish and wildlife resources and habitats of national and international significance. Cape Newenham and Cape Pierce were recommended by Young and Walters (1982) as part of a potential national natural landmark. In addition to the unit’s high biological values, the Cape Pierce/Cape Newenham area also has unusual scenic qualities. Cape Pierce/Cape Newenham is recognized as one of the outstanding scenic complexes in Alaska (USFWS 1986a).

Tidal and submerged lands of Chagvan Bay constitute the Cape Newenham State Game Refuge, a legislatively-designated special area established to protect and preserve natural habitat and game populations (especially waterfowl). The refuge is managed by the ADFG (Dolezal 1993).

4.0 Physical Environment

4.1 Climate

Cape Newenham is located in a Maritime Climatic Zone. Both the maritime climate of Bristol and Kuskokwim bays and the continental climate of interior Alaska affect the area. Varying topography also affects local temperatures, types of precipitation, and wind conditions. Temperatures at the LRRS range from an average minimum of 12ºF in January to an average maximum of 35º-54ºF in summer (July). Temperature variations increase while cloudiness, humidity, and precipitation tend to decrease with increasing distance from the coast. The average frost-free period is about 120 days for the region, although there is wide local variation (Boyer 1987).

Fall is the wettest season, and the least precipitation occurs in spring (www.weather.com). Total annual precipitation averages 36.5 inches, which includes 76 inches of snow (Legare 1998).
Prevailing winds are from the north and northeast during October through March and from the south and west during April through September. Winds blow almost constantly along the coast, frequently reaching gale force velocities in the Cape Newenham area (Boyer 1987).

The community of Platinum (27 miles northeast of the LRRS) has a marine climate. Summer high temperatures range from 53º to 57ºF and winter high temperatures average 6º-9ºF. Extreme temperatures recorded at Platinum are from 82º to -34ºF. Average annual precipitation is 22 inches, with 43 inches of snowfall (www.dced.state.ak.us 2012).

4.2 Landforms

Cape Newenham is a small peninsula at the southern terminus of the Ahklun Mountains between Bristol Bay and Kuskokwim Bay. The topography of Cape Newenham is steep, rugged, and rocky. The southern shore consists of high rocky escarpments, which plunge from 500 to 2,000 feet above msl directly into Bristol Bay. All streams on the peninsula flow north through steep-sided, U-shaped valleys into Kuskokwim Bay. Elevations at Cape Newenham LRRS range from 2,000 feet above msl at Upper Camp, to 750 feet above msl at Lower Camp, to 250 feet above msl at the lower end of the landing strip.

4.3 Geology and Soils

A variety of events, including tectonism, volcanism, sedimentation, and erosion, have shaped the landscape, rocks, soils, and minerals of the area. Continental and oceanic crust of uncertain origin apparently came together to form the Kuskokwim Bay region. In the Jurassic period, about 150 million years ago, a drifting continental platform ascended over the Pacific Ocean floor, marked by the Aleutian Trench. Movements of these plates caused mountains and volcanoes to form. Subducting plates carried and scraped ocean-deposit sediments into the crust, and abducting plates dragged up ultramafic rock (*i.e.*, rock rich in iron and magnesium). After Jurassic subduction, uplift occurred in the area of the present day Kuskokwim Mountains and the Alaskan-Aleutian Range (Boyer 1987).

The Precambrian and early Paleozoic history of the Southwest Alaska Region is virtually unknown. During late Paleozoic and early Mesozoic times, seas occupied this widespread area where sediments were deposited in deep basins adjacent to volcanic islands. Older rocks in the Bristol Bay and Kuskokwim subregions are characteristically rich in volcanic material. This long period of deposition was phased out in early to mid-Jurassic time by the intrusion of a large mass of igneous material, called a batholith, which now forms the backbone of the southern Alaska Range and northern part of the Aleutian Range. Uplift and deformation accompanied and followed this Jurassic intrusive activity, producing mountainous uplands approximately where the Kuskokwim Mountains and Alaskan-Aleutian Range now stand. These uplifted regions were eroded and produced sediments that were deposited on adjoining shallow marine shelves and in adjacent basins. These deep basin sediments were cut by igneous intrusions and uplifted near the end of Cretaceous time, forming a younger continental margin which extends from Kodiak to the Sanak Islands and possibly even further westward (Boyer 1987).

During Tertiary times, many of the Bristol and Kuskokwim areas were slowly eroded, and thick sequences of sediments were deposited on the adjacent Bering Sea lowland. In time the area was reduced to an extensive surface of low relief, upon which terrigenous sediments derived from the Alaska mainland were deposited. The development of much of the present landscape took place in Quaternary times when extensive ice fields and large glaciers scoured and modified the existing landscape (Boyer 1987).

Unconsolidated materials comprise surficial deposits that have accumulated on the land surface above the bedrock. In lowland areas these materials are thick and are composed of clay, silt, sand, and gravel. Most of this material is of glacial origin, deposited during the Pleistocene. As glaciers advanced and retreated, a complex interrelated series of deposits was produced by the interplay of three main agents: glacial ice, flowing water in streams or on deltas, and still water in ponds, lakes, and marine estuaries. The most common glacial deposits found in the region are moraines, which are composed of glacial till (gravel, sand, silt, and clay) laid down at the sides and in front of glaciers (Boyer 1987).

Cape Newenham, a large basalt promontory topped by the 2,300-foot Jagged Mountain thrusts out into the Bering Sea. The coastline is dominated by volcanic rock cliffs reaching elevations of 1,100 feet and is interspersed with sandy, dune-lined beaches and bays. The cliffs have been sculpted by wind and sea, resulting in spectacular arches and pinnacles. Extensive ponds and lakes are found throughout the entire area.

The geology of Cape Newenham LRRS Upper Camp is dominated by a thin accumulation of residual sand, gravel, cobbles, and boulders that have developed due to the weathering of underlying bedrock. Bedrock outcrops are common, especially on eroded surfaces and along steeply sloping valley walls and escarpments. The local bedrock is a dense, fractured volcanic greenstone. A mixture of talus and alluvium has washed downslope, forming a moderately thick accumulation of poorly stratified sediments on the steeply sloping valley floor where the Lower Camp, stream channel, and barge landing area are situated.

Permafrost is discontinuous in this area. Lower Camp is underlain by predominantly fine-grained deposits and contains isolated masses of permafrost. Permafrost is probably absent at Upper Camp.

Soils on the site are Pergelic Cryumbrepts. These soils are thin, well-drained sands, gravels, or stony loams overlying bedrock (HQ AAC/DEPV 1988).

4.4 Hydrology

4.4.1 General

The valley above Lower Camp is the principal recharge zone of groundwater for the installation. The Lower Camp valley consists of a thick zone (approximately 100 feet) of consolidated, highly permeable, coarse-grained talus and alluvium. This material generally contains groundwater at shallow depths (3-6 feet). The talus/alluvial material receive upslope recharge and discharges downslope. It is reported that groundwater in bedrock flows under artesian conditions at the Lower Camp area.

The Upper Camp area is underlain by poorly-sorted coarse talus, which occurs primarily on steep slopes which overlie bedrock. Groundwater may occur in these sediments seasonally as perched water, but discharge of runoff into bedrock or downslope is more likely.

Drainage at Cape Newenham LRRS flows into an unnamed drainage within boundaries of the installation. The headwaters are a small lake at 750-foot above msl. The creek flows through the valley, past the airstrip and into Kuskokwim Bay.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Surface runoff is contained within ditches and natural drainages; thus, both camps are well-drained and do not flood. Upper reaches of the creek would probably contain a 100-year flood, and lower reaches would certainly contain such a flood. Flow depth in lower reaches of the creek would be less than six feet. Coastal flooding was estimated to reach 15 feet msl, based on regional storm levels.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Cape Newenham LRRS. Much information included in INRMP Chapter 5.0 that includes Cape Newenham LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Cape Newenham LRRS and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at Cape Newenham LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M126 Ahklun Mountains Tundra-Meadow Province
Description: The province's landscape varies from rugged mountains separated by broad flat valleys and lowlands with glacial lakes in U-shaped canyons. Winters are cold, and summers are cool and short. Annual precipitation ranges from 39 inches to over 78 inches. Predominant vegetation in the mountains is alpine tundra, with moist tundra occupying valley bottoms. Black spruce is found on some hills and ridges; along low hills near major rivers are forests of white spruce, paper birch, and alder. Inceptisols are predominant soils; permafrost is sporadic.

5.2 Vegetation

Viereck and Little (1972) show much of the region covered by moist tundra, alpine tundra, and shrub thickets. The Togiak NWR includes plants common to both Arctic and subarctic regions. A total of 211 species, representing 66 families, have been collected in or adjacent to the Cape Newenham LRRS area, an area classified as alpine tundra (dwarf shrubland) and barren ground. The vegetation type found here is characteristic of an area with a thin layer of organic soils and exposure to wind (Gutleber 1986).

The Cape Newenham area is characterized by dwarf shrubland less than 1.6 feet in height and includes heath and crowberry. An abundance of mosses and lichens grow amidst dwarf shrubs. Two major types of communities may occur here, creeping dwarf shrub fellfield and dwarf shrub-lichen heath. Creeping dwarf shrub fellfield refers to relatively bare, elevated communities with stony soil. This type is dominated by matted dwarf shrubs, such as white mountain avens, is rich in lichens, and often includes netleaf willow, crowberry, alpine azalea, and alpine bearberry. Dwarf shrub-lichen heath is also a low-growing formation, but in contrast to creeping dwarf shrub fellfield, it is closed (crowns or peripheries of the plants touch or overlap) and there are usually humus accumulations in the soil. Dominant dwarf shrubs include crowberry, narrow leaf Labrador tea, spirea, dwarf Arctic birch, and dwarf willows. The bryoid understory is well developed with lichens and mosses (USFWS 1986a). Other minor plant communities occurring on the installation include wetland and beach communities and sea cliffs/bluffs.

A general vegetation map of Cape Newenham LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995e). Schick *et al*. (2004) made significant improvements in vegetation mapping at Cape Newenham LRRS (using 2002 QuickBird pan-sharpened natural color imagery) with the preparation of a wildlife habitat map (map, acreages, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Cape Newenham LRRS in 2001 and 2009. This project used 2001 National Land Cover Database data (http://www.mrlc. gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth for each site. Table 5.2 shows these acreages and changes over this 3-year period. Figure 5.2a shows habitat classes for 2004, and Figure 5.2b shows changes in habitat classes between 2001through 2004.

Table 5.2 Habitat Class Differences between 2001 and 2004, Cape Newenham LRRS

Habitat Class	Acres 2001	Acres 2004	Acreage Change
Barren Land	324.7	350.5	25.8
Dwarf Shrub	592.8	581.4	-11.4
Open Water	24.2	24.2	0.0
Shrub/Scrub	1,158.9	1,144.5	-14.4
Totals	**2,100.6**	**2,100.6**	**0.0**

Schick *et al*. (2004) described the Cape Newenham area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

The Cape Newenham LRRS area encompasses about 2,359 acres[1]of gently sloping tundra and rocky mountainous terrain. The most common wildlife habitats at the LRRS are variants of dwarf scrub and partly barren rock in the mountains. The area is well-drained to moderately well-drained, and there are relatively few wet tundra habitats. The LRRS is strongly dominated by Upland Dwarf Scrub and Upland Dwarf Shrub–Graminoid–Herb Scrub, which occur primarily on mountain slopes and well-drained bluffs and are used primarily by ground-nesting passerines and perhaps some breeding shorebirds and Ptarmigan. Other mountainous habitats, which tend to occur on steeper and better-drained slopes, are Upland Rock and Upland Rock–Graminoid–Herb Complex. Facing the Bering Sea on the south side of the LRRS are steep and partially vegetated cliffs, classified as Coastal Cliffs–Graminoid–Herb Complex. These cliffs are used by breeding seabirds, and surprisingly, nesting Hermit Thrushes.

Although a few scattered low willows occur along the stream at the northern end of the property, there are no habitats dominated by low or tall shrubs. Hence the diversity of breeding passerines is low at Cape Newenham LRRS. It should be noted that the only small sandpiper found at the LRRS (in the small patches of Upland Nonpatterned Wet Tundra was the Least Sandpiper. This is in contrast to Cape Romanzof LRRS where the only small sandpiper found in similar habitats was the Western Sandpiper (Schick *et a*l. 2004).

Extensive eelgrass beds in Chagvan and Nanvak bays, combined with numerous ponds and tidal flat wetlands in the area, provide important staging and feeding habitat in spring and fall for migrating shorebirds and waterfowl. The bays are usually ice-free relatively early in spring, and large rafts of waterfowl hold in the area prior to moving north to Arctic nesting grounds.

5.3 Fish and Wildlife

5.3.1 Fish

All five species of Pacific salmon are abundant in the Kuskokwim drainage. Chum, king (chinook), and sockeye (red) salmon are the most abundant. In general, these salmon species pass through marine waters offshore of the LRRS during the spring to early summer as juveniles on their way to open ocean, then again in the summer-fall period as adults on their way to their natal streams for spawning. Important

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

Figure 5.2a Cape Newenham LRRS Habitat Map, 2004

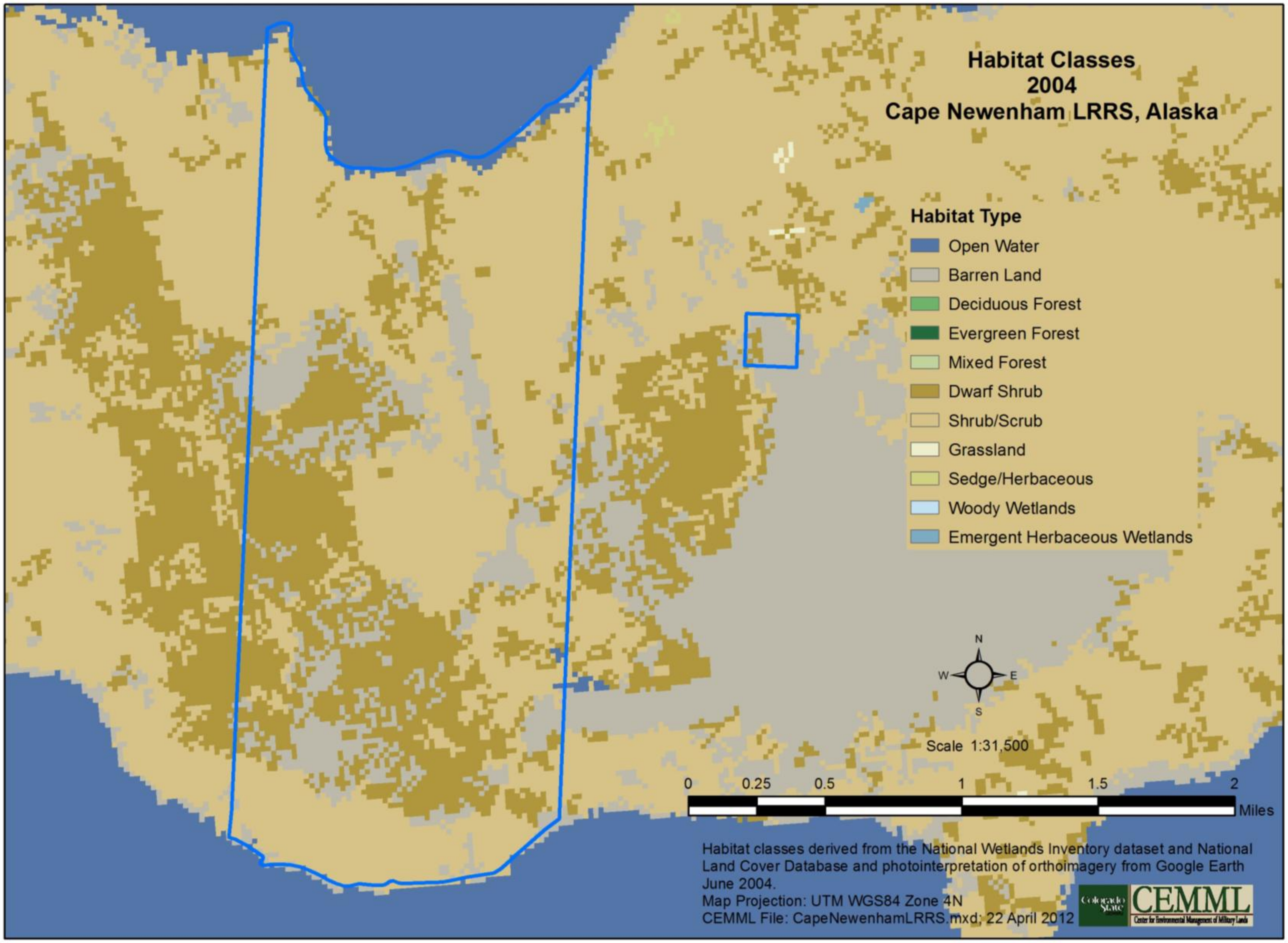


Figure 5.2b Changes in Habitat Classes at Cape Newenham LRRS between 2001 and 2004

drainages near Cape Newenham LRRS include Kinegnak and Slug rivers. The atlas to the catalog of waters important for spawning (ADFG 1990a) indicate that king, chum, coho (silver), pink, and sockeye salmon, and char use both drainages. Arctic grayling also use the Kinegnak River.

Several unnamed streams occur on or near the LRRS property. None have been catalogued in the ADFG stream catalog program. The major drainage of the site is a single stream that is bisected by the runway and empties into Kuskokwim Bay. No fish are believed to occupy this stream.

The closest fishery activities occur at Security Cove, located east of the site, where herring are harvested in May. Chum salmon are present in most coastal streams, including the stream that empties into Security Cove. Other freshwater and anadromous species in the area include whitefish, rainbow trout, Arctic char, and Dolly Varden. Arctic grayling, least cisco, Alaska blackfish, and coastrange sculpin are found dispersed throughout the region.

5.3.2 Mammals

A wide variety of mammals occupy the terrestrial environment of this region. Large mammals of Togiak NWR include bears, caribou, wolves, and wolverines (USFWS 1986a). The bear population is primarily represented by the brown bear, which is common in upland and mountainous areas. Wolves and wolverines are also occasionally sighted in the Cape Newenham area (Gutleber 1986).

The area in and around Cape Newenham LRRS supports a variety of fur-bearing and small mammals. Red and Arctic foxes, porcupines, and short-tailed weasels prefer brushy areas in broken terrain. Open areas attract least weasels, lemmings, shrews, voles, Arctic ground squirrels, and snowshoe and Alaskan hares. Mink, beavers, muskrats, and river otters are found in or near various freshwater systems of the subregion (Gutleber 1986). Marmots are reported by site personnel.

The Cape Newenham LRRS and Nanvak Bay coastline serve as a haul-out or resting area for walruses and Steller (northern) sea lions. The sea lion haulout at the tip of Cape Newenham hosts an estimated 600-800 animals during late June. In 1991 this number peaked at 1,295 sea lions on May 16. Harbor seals and spotted seals haulout on rocks just off the Cape Newenham coast and in Nanuak Bay (Jemison 1992). Ringed and bearded seals occur in the Cape Newenham LRRS area in winter where ice is present (Wynne 1993).

Although most marine mammals are under the jurisdiction of the NMFS, walrus, polar bear, and sea otter are under the jurisdiction of the USFWS. Walruses have historically hauled out on Cape Pierce (located two miles south of Nanavak Bay), but the sites were abandoned sometime during the first half of the 20th Century. Walruses have recolonized some of their traditional haulouts and began using the haulouts in 1981 and returning every summer since. The annual peak number of walrus hauled out at Cape Pierce during a single day has ranged from 284 to 12,500, with peak numbers occurring between June 10 and October 6. The number of walrus using the Cape Pierce haulouts increased during 1981 to 1985, when the high count of 12,500 walrus was recorded. Walrus numbers at the haulouts at Cape Pierce generally declined from 1986-1990 and have been rising, but variable, in ensuing years. Walrus haulouts at Cape Newenham have been censused since 1986. The annual peak number of walrus hauled out at Cape Newenham during a single day has ranged from 4 to 5,444 and has occurred between June 30 and July 21. During the four years of regular censusing, 1991-1993 and 1996, annual peaks ranged from 870 to 5,444. The Togiak National Wildlife Refuge's walrus monitoring program focuses on monitoring the abundance and distribution of Pacific walrus at selected haulouts at Cape Pierce and Cape Newenham (http://togiak.fws.gov/walrusmon.htm).

Several whale species may be seen in waters near Cape Newenham LRRS. Gray whales may occur in pods of up to 300 animals in Hagemeister Strait and in pods of 25 near Cape Newenham LRRS. Less abundant but still common are beluga and killer whales; beluga whales calve in and around the mouth of the Igushik River. Minke whales have been seen occasionally in coastal waters (USFWS 1986a). Harbor and Dall’s porpoise commonly occur in these coastal waters (Wynne 1993).

5.3.3 Birds

Bristol Bay is an important stopover for waterfowl and shorebirds coming from wintering areas throughout the Pacific. Birds from the North American Pacific Flyway and several Asiatic routes funnel through this area. Bays and lagoons along the Togiak NWR coastline are heavily used as staging grounds in spring and fall. Rugged coastal cliffs, particularly in the Cape Newenham/Cape Pierce area, provide excellent habitat for nesting seabirds and raptors (USFWS 1986a).

The Cape Newenham/Cape Pierce area supports one of the largest mainland seabird colonies in the Bering Sea (USFWS 1991a). Prime seabird habitat is provided by cliffs associated with Cape Newenham. The area also provides coastal and shoreline habitat for marine birds and shorebirds, and moist and alpine tundra habitats support several species of passerines. Hundreds of thousands of cliff-nesting seabirds occupy coastal areas around Cape Newenham LRRS and Cape Pierce (USFWS 1989b). Raptors and passerines are also found in the area.

The saltwater lagoon in Nanvak Bay (approximately 20 miles east of Cape Newenham LRRS) is rich with eelgrass which provides food and protected rest areas for sea ducks and geese. Most of the North American West Coast population of Red-throated Loons, Emperor Geese, King Eiders, and Steller’s Eiders migrate through Nanvak Bay. As many as 50,000 Brant feed or rest on Nanvak and Chagvan bays during migration (USFWS 1986a).

Studies conducted by Petersen *et al*. (1991) determined the distribution and abundance of breeding and suspected breeding birds in the Ahklun Mountains and sea cliffs that border Cape Newenham LRRS. Common birds from the Ahklun Mountains include the Red-throated Loon, Harlequin Duck, Green-winged Teal, Northern Pintail, Long-tailed Duck, Common Goldeneye, Red-breasted Merganser, Golden Eagle, Common Snipe, Red-necked Phalarope, Red Phalarope, Mew Gull, Semipalmated Plover, Greater Yellowlegs, Spotted Sandpiper, Western Sandpiper, Arctic Tern, American Robin, Golden-crowned Sparrow, Rosy Finch, Lapland Longspur, Rock Sandpiper, and Snow Bunting.

Cape Newenham, Cape Pierce, Bird Rock, and Shaiak Island support several hundred thousand cliff nesting seabirds, one of the largest populations in the eastern Bering Sea. The birds nest and roost on ledges and in cracks of cliff faces, thereby reducing the chances of predation and forage at sea. They travel up to 50 miles daily to feed themselves and their young. The two most common nesting species on cliff faces are Common Murres and Black-legged Kittiwakes. The USFWS has conducted seabird surveys on Cape Newenham peninsula since 1990 and at Cape Pierce since 1989.

Population estimates for kittiwakes and murres during 1998 were among the lowest since 1987 for all four colonies studied by USFWS at Cape Newenham, Cape Pierce, Bird Rock, and Shaiak Island. These four colonies support up to 1.5 million seabirds comprising the largest mainland seabird colonies in the Bering Sea, which also include Double-crested Cormorants, Red-faced Cormorants, Glaucous-winged Gulls, Pigeon Guillemots, Horned Puffins, Tufted Puffins, and Parakeet Auklets along with other breeding species. Pelagic Cormorants were the highest recorded during 1998 but were not significantly higher than some past years (MacDonald 1999).

Upper Camp is located along Radar Mountain, which rises as a steep-walled promontory 2,100 above msl. Cliffs of this mountain provide nesting habitat for thousands of seabirds, including Kittiwakes. The composite facility is located approximately 500 feet west of two ponds at the base of Jagged Mountain. Kittiwakes from the entire peninsula use these ponds to collect nest material and to bathe throughout the breeding season (Wheeler 1993).

Raptor species sighted and/or nesting along the coastal cliffs in the Cape Pierce/Cape Newenham area include Bald Eagles, Rough-legged Hawks, Peregrine Falcons, and Gyrfalcons. A pair of Bald Eagles nested on one promontory (known as Eagle Point) west of Radar Mountain from 1990 to 1992. In 1993 one pair of Rough-legged Hawks nested on another promontory (known as DC Point) west of Radar Mountain, and a second pair nested on a promontory on the northern side of the Cape Newenham peninsula, east of the runway. A Peregrine Falcon was sighted from the composite facility in July 1993, and Peregrine Falcons have been nesting at Cape Pierce since at least 1989 (Wheeler 1993).

Twenty-six bird species were observed at Cape Newenham LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included species, such as Double-crested and Pelagic Cormorants; Surf, White-winged, and Black Scoters; Rough-legged Hawk; Peregrine Falcon; Least Sandpiper; Black-legged Kittiwake; Common Murre; Gray-cheeked and Hermit Thrush; and American Pipit.

5.4 Threatened and Endangered Species

The endangered Steller sea lion is found at Cape Newenham. Several Steller sea lion haulout areas have been designated as critical habitat pursuant to the Endangered Species Act (50 CFR 226 vol. 58, no. 61, page 17181, 1 Apr 93). Critical habitat includes all Steller sea lion rookeries and major haulouts (*i.e*., greater than 200 sea lions) located within state- and federal-managed waters, including a zone that extends 3,000 feet landward and seaward of each rookery and major haulout boundary. This designation includes a portion of Cape Newenham LRRS and the Walrus Islands east of Cape Newenham.

The threatened Steller’s Eider migrates through the area, and wintering and molting areas occur approximately 12 miles east and 14 miles northeast of Cape Newenham LRRS (USFWS 2004b). The Kittlitz’s Murrelet, listed as a candidate species (personal communication, C. Sterne, USFWS 2004b), possibly occur near the LRRS. The Pacific walrus (candidate) is confirmed at Cape Newenham. Threatened ringed and bearded seals are known to be in the area. The candidate Yellow-billed Loon may use the site.

Several formerly listed or former Category 2 species (Harlequin Duck, American Peregrine Falcon, Bristled-thighed Curlew, northern fur seal, and gray whale) are either confirmed or possible near Cape Newenham LRRS. One former Category 2 candidate plant species, *Artemisia glomerata* var. *subglabra*, once occurred in the Cape Newenham area. This species occurs on sandy slopes and was found at two locations but has not been relocated since the original collections were made (Alaska Natural Heritage Program 1993).

There is a large concentration of a former plant species of concern, Chukchi primrose (*Primula tschuktschorum*), at Cape Newenham LRRS. The 200 plants are similar to the population size found at Tin City LRRS (Lipkin 1999).

5.5 Wetlands

The most common wetland type at Cape Newenham LRRS is palustrine, broad-leaved deciduous and evergreen scrub-shrub, which can be mixed with emergent vegetation and/or lichens. These areas are moist dwarf scrub habitats and can be saturated, moderately well-drained, or well-drained, depending primarily on soil type, microtopography, and landscape position. Portions of these areas, when very well-drained, are likely to be jurisdictional uplands. These wetlands and possible uplands occur within the Upland Dwarf Scrub wildlife habitat type. Dominant shrub species in these areas include *Empetrum nigrum*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Ledum decumbens*, *Dryas octopetala*, *Arctostaphylos alpina*, and *Salix rotundifolia* (Schick *et a*l. 2004).

Wetlands at Cape Newenham LRRS are strongly dominated by moist sloping areas with fewer wetter areas of seasonal flooding. On mountain slopes and ridges, many well-drained rocky areas are likely to be NWI Uplands. The very few freshwater habitats at Cape Newenham LRRS are classified as palustrine, unconsolidated bottom, permanently flooded (pond) (Schick *et a*l. 2004).

The general Cape Newenham LRRS vegetation map's wetland features (Woodward-Clyde 1995e) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). These sources are used to facilitate decisions regarding facility siting. Cape Newenham LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (380.90 acres). Figure 5.5 shows wetlands on Cape Newenham LRRS from 2011 data.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Demands for natural resources within or near the LRRS include hunting, fishing, and other outdoor recreational activities. People from Togiak, Twin Hills, and Manokotak use the coast as far north as Platinum but do not often use the terrestrial environment beyond the beach. The primary subsistence resource for these three communities is fish, but caribou, seals, land mammals, and firewood are also harvested. Quinhagak residents rely heavily on fish, land mammals, and marine mammals. Subsistence harvest by residents of Goodnews Bay and Platinum includes primarily fish but also land mammals, birds, and waterfowl (Braund and Associates 2004).

Traditional subsistence activates in the Cape Newenham area varies depending on the particular community. Togiak residents rely heavily on such fish as char, Dolly Varden, smelt, and pike. 1994 data show that smelt and Dolly Varden are the most commonly used, harvested, and gifted resource. Twin Hills subsistence activities are similar to that of Togiak. Quinhagak residents rely heavily on fish, land mammals, and marine mammals. Four fish species, chinook, chum, and coho salmon, and char accounted for about 54 percent of the annual subsistence harvest in terms of edible pounds in 1982. Subsistence activities for residents of Goodnews Bay require an intense effort at specific times. Much of the community participates in subsistence activities. Freshwater fish are intensively harvested, migrating birds and bird eggs along the rocky coastline are harvested. Residents harvest salmon both for commercial and subsistence purposes. Hunters make long trips up the Goodnews River and along the coast looking for moose, caribou, seals, and resident waterfowl. Platinum subsistence activities are similar to that of Goodnews Bay (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation at or near Cape Newenham LRRS primarily consists of non-organized activities, such as hunting, and fishing, hiking, and wildlife viewing. Hunting is restricted due to the USAF policy. Recreational fishing occasionally takes place in streams and rivers near the site.

BOS contract personnel stationed at Cape Newenham, temporary duty personnel during free time, and subsistence gatherers from neighboring areas hunt or fish in the general area. No interest exists by DoD personnel to travel to the site for recreational purposes. Personnel assigned to the site may do some hiking and wildlife viewing, and some recreational fishing may also occur at the old fish camp east of the site. Personnel have sea kayaked in the cove at Cape Newenham as well as several other coastal sites (personal communication, P. Cooley 2007). These activities are not likely to impact the resources, provided there is minimal disturbance to the tundra and to bird nesting and marine mammal haul-out sites.

Figure 5.5 Cape Newenham LRRS Wetlands, 2011

Activities, such as beachcombing and exploring, can harm wildlife when care is not taken to avoid disturbance. Over-enthusiastic explorers have caused walruses to move off beaches into the water, particularly in the Bird Rock Cove area (Jemison 1992). ATVs used in the past by personnel have left permanent trails where none existed before.

Personnel and visitors should not explore beaches in the vicinity of seabird nesting areas from the beginning of May to the end of August since they can cause adults to flush from nests, exposing eggs or young to predation, chilling, or falling from nests (USFWS 1991a). USFWS personnel provide talks, maps, and reading material on how to hike in the area without disturbing wildlife during summer monitoring seasons.

In accordance with NWR policy, ATV use must be restricted to established roads (Wheeler 1993). These roads include those maintained by USAF staff but do not include past ATV trails.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Lower Camp has a runway, power plant, living quarters, and other facilities in support of the LRRS mission. Upper Camp, which is connected to Lower Camp by a road and tramway, houses radar facilities. A composite building constructed in 1980 replaced numerous old industrial and housing structures. In recent years a new landfill has been established; a non-directional beacon was installed in 2006; and some demolition of inactive buildings has occurred. Clean Sweep occurred in 2011 and 2012.

LRRS personnel identified problems (Gene Stout and Associates and Blythe & Trousil, Inc. 2007a) with stockpiled materials (such as gravel) that cause snow drifts to occur downwind of the material, making it difficult to keep snow off the roads. Future stockpiling activities should, therefore, be performed with consideration to drifting snow.

USAF has two outgrants to the Federal Aviation Administration. One is for an Alaskan National Airspace System Interfacility Communications System, and the other is for the Remote Communications Outlet and Remote Communications Air-to-Ground services. A third permit is in the works for support of the CAPSTONE safety-enhancement project for the safety of aircraft operations in Alaska.

APPENDIX A: Natural Resources of Cape Newenham, Cape Romanzof, and Cold Bay Long Range Radar Sites

Table A1: Vascular Plant Species Known to or Potentially Occurring on Cape Newenham, Cape Romanzof, and Cold Bay Long Range Radar Sites

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Shrubs						
Sitka alder	*Alnus sinuata*		X	X	CB, CN	2, 9, 10
Bog-rosemary	*Andromeda polifolia*	X	X	X	CR	1, 2, 3
Alpine bearberry	*Arctostaphylos alpina*	X	X	X	ALL	2, 4, 8, 9, 10
Red bearberry	*Arctostaphylos rubra*	X		X	CR	2, 9
Bearberry (kinninnik)	*Arctostaphylos uva-ursi*			X		2
Dwarf Arctic birch	*Betula nana*	X	X	X	ALL	2, 9
Alaska cassiope	*Cassiope lycopodiodes*		X	X	CN	2, 9
Starry cassiope	*Cassiope stelleriana*		X	X	CN	1, 2, 3, 9
Four-angled cassiope	*Cassiope tetragona*	X				2, 3, 4
Leatherleaf	*Chamaedaphne calyculata*	X	X			2
Bunchberry	*Cornus canadensis*	X	X	X		1, 2, 3
Lapland cornel	*Cornus suecica*	X	X	X	ALL	2, 9, 10
Diapensia	*Diapensia lapponica*	X	X		CN, CR	2, 3, 9
Entire-leaved mountain avens	*Dryas integrifolia*			X	CB	10
White mountain avens	*Dryas octopetala*	X	X	X	ALL	2, 9
Crowberry	*Empetrum hermaphroditum*	X	X	X	ALL	2, 9, 10
Narrowleaf Labrador tea	*Ledum decumbens*	X	X	X	ALL	2, 9, 10
Twin-flower	*Linnaea borealis*	X	X		CR	2, 9
Alpine-azalea	*Loiseleuria procumbens*	X	X	X	ALL	1, 2, 3, 8, 9, 10
Sweet gale	*Myrica gale*	X	X			2
Shrubby cinquefoil	*Pentaphylloides floribunda = Potentilla fruiticosa*		X			2, 3

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Aleutian (mountain) heather	*Phyllodoce aleutica*	X	X	X	CR, CN	1, 2, 3, 9
Aleutian (mountain) heather	*Phyllodoce aleutica*	X	X	X	CR, CN	1, 2, 3, 9
Blue mountain heath	*Phyllodoce coerulea*	X	X		CR	2, 8, 9
Kamchatka rhododendron	*Rhododendron camtshaticum*			X	CB, CN	2, 3, 9, 10
Currant	*Ribes* sp.	X	X			1, 4
Nagoonberry	*Rubus arcticus*	X	X	X	ALL	2, 8, 9, 10
Cloudberry	*Rubus chamaemorus*	X	X	X	CN, CR	2, 4, 8, 9
Salmonberry	*Rubus spectabilis*			X	CB	2, 10
Feltleaf willow	*Salix alaxensis*	X	X	X	CN, CR	2, 4, 9
Littletree willow	*Salix arbusculoides*		X		CN	2, 9
Arctic willow	*Salix arctica*	X	X	X	ALL	2, 4, 9, 10
Barclay willow	*Salix barclayi*	X	X	X	ALL	2, 4, 9, 10
Barren-ground willow	*Salix brachycarpa*			X		2, 4
Undergreen willow	*Salix commutata*			X		2
Alaska bog willow	*Salix fuscescens*	X	X	X	CN, CR	2, 9
Grayleaf (northern) willow	*Salix glauca*	X	X	X	ALL	2, 8, 9, 10
Halberd willow	*Salix hastata*		X			2
Oval-leafed willow	*Salix ovalifolia*	X	X	X	CN	2, 9
Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X				2, 9
Polar willow	*Salix polaris*	X				2
Diamond-leaf willow	*Salix pulchra*	X	X	X	ALL	1, 4, 9, 10
Netleaf (net-veined) willow	*Salix reticulata*	X	X	X	ALL	2, 3, 9, 10
Richardson willow	*Salix richardsonii = Salix lanata richardsonii*	X	X		CN	2, 9

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Least (round-leaf) willow	*Salix rotundifolia*	X	X	X	ALL	2
Sprouting willow	*Salix stolonifera*			X		2
Pacific red-elder	*Sambucus racemosa*		X	X	CB	2, 10
Spirea	*Spiraea stevenii = Spiraea beauverdiana*	X	X		CN, CR	2, 8, 9
Early blueberry	*Vaccinium ovalifolium*		X	X		2
Bog cranberry	*Vaccinium oxycoccus*	X	X	X		2
Bog blueberry	*Vaccinium uliginosum*	X	X	X	CN, CR	2, 9
Lowbush (mountain) cranberry	*Vaccinium vitis-idaea*	X	X	X	ALL	2, 9, 10
Highbush cranberry	*Viburnum edule*		X			2
Herbaceous Plants						
Northern yarrow	*Achillea millefolium*	X	X	X	ALL	1, 9, 10
Monkshood	*Aconitum delphinifolium*	X	X		CN, CR	1, 9
Greater monkshood	*Aconitum maximum*			X	CB	1, 10
Alaskan bent grass	*Agrostis alaskana*			X	CB	1, 10
Bent grass	*Agrostis geminata*			X	CB	1, 10
Bent grass	*Agrostis scabra*	X			CR	1
Shortawn foxtail	*Alopecurus aequalis*			X	CB	1, 10
Rock jasmine	*Androsace chamaejasme*		X	X		1, 3
Narcissus-flower anemone	*Anemone narcissiflora*	X	X	X	ALL	1, 3, 9, 10
Northern anemone	*Anemone parviflora*	X	X	X	CR	1, 3, 9
Yellow anemone	*Anemone richardsonii*	X	X	X	CR	1, 3, 9
Wild celery	*Angelica lucida*	X	X	X	ALL	1, 4, 9, 10
Cats paws	*Antennaria monocephala*		X		ALL	1, 4, 9, 10

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Pussytoe	*Antennaria rosea*			X	CB	1, 10
Lyre-leaf rockcress	*Arabis lyrata, Arabis hirsuta*	X	X	X	CB, CN	1, 4, 9
Polar grass	*Arctogrostis latifolia*	X	X	X	ALL	1, 9, 10
Pendent grass	*Arctophila fulva*	X	X	X	CN	1, 4, 9
Thrift	*Armeria maritimum*			X	CB	1, 10
Tall meadow arnica	*Arnica chamissonis*			X		1, 4
Frigid arnica	*Arnica frigida*	X	X		CR	1, 3, 9
Lessing's arnica	*Arnica lessingii*	X	X	X	CN, CR	1, 4, 9
Arctic wormwood	*Artemisia arctica*	X	X	X	CN, CR	1, 9
Arctic wormwood	*Artemisia comata*	X	X	X		1, 4
Wormwood	*Artemisia glomerata subglabra*	X				5
Purple wormwood	*Artemisia globularia*		X	X	CN, CB	1, 3, 9, 10
Common wormwood	*Artemisa tilesii*	X	X	X	CN, CR	1, 4, 9
Goatsbeard	*Aruncus sylvester*			X		1, 3
Siberian aster	*Aster sibiricus*	X	X	X		1, 3
Northern aster	*Aster subspicatus*			X		1, 4
Alpine milkvetch	*Astragalus alpinus*	X	X	X		1, 3, 4
Hairy arctic milkvetch	*Astragalus umbellatus*	X	X	X	CR	1, 3, 9
Lady fern	*Athyrium filix-femina*	X	X	X	ALL	1, 4, 9, 10
Wintercress	*Barbarea orthoceras*	X	X	X	CN, CB	1, 4, 9
Broomrape	*Boschniakia rossica*			X		1, 3
Moonwort	*Botrychium boreale*			X		1, 4
Moonwort	*Botrychium lanceolatum*			X		1, 4
Moonwort	*Botrychium lunaria*	X	X	X		1, 4

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Rattlesnake fern	*Botrychium virginianum*			X		1, 4
Smooth brome	*Bromus inermis*			X	CB	1
Alaska brome	*Bromus sitchensis*			X	CB	1, 10
Thorough-wort	*Bupleurum americanum = Bupleurum triradiatum*	X			CR	1, 9
Bluejoint	*Calamagrostis canadensis*	X	X	X	ALL	1, 4, 9 ,10
Reed bent grass	*Calamagrostis* sp.	X	X	X	CN, CB	1, 4
Mountain marigold	*Caltha leptosepala*			X		1, 3
Marsh marigold	*Caltha palustris*	X	X	X	CN, CR	1, 3, 9
Bluebell	*Campanula lasiocarpa*	X	X	X	ALL	1, 3, 9 ,10
Bittercress	*Cardamine purpurea*	X				1, 3
Cuckoo flower	*Cardamine pratensis*	X	X	X		1, 4
Water sedge	*Carex aquatilis*	X	X	X	ALL	1, 4, 9, 10
Sedge	*Carex atheroides*					1, 4
Bigelow’s sedge	*Carex bigelowii*	X	X		CN, CR	1, 4, 9
Mud sedge	*Carex limosa*				CB	1, 10
Lyngbye edge	*Carex lyngbyaei*	X	X	X		1, 4
Longawn sedge	*Carex macrochaeta*			X	CB	1, 10
Fragile sedge	*Carex membranacea*		X		CN	1, 9
Smallawned sedge	*Carex microchaeta*	X	X	X	ALL	1, 9, 10
Shortstalk sedge	*Carex podocarpa*	X			CR	1, 9
Looseflower alpine sedge	*Carex rariflora*		X		CN	1, 9
Rock sedge	*Carex saxatalis*			X	CB	1, 10
Showy sedge	*Carex spectabilis*			X	CB	1, 10
Paintbrush	*Castilleja* sp.	X	X	X		1

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Coastal paintbrush	*Castilleja unalaschensis*	X		X	CB, CR	1, 3, 6, 10
Aleutian chickweed	*Cerastium aleuticum*			X	CB	1, 10
Beringian (Bering Sea) chickweed	*Cerastium beeringianum*	X	X	X	CN, CR	1, 4, 9
Chickweed	*Cerastium fischerianum*		X	X		1, 4
Fireweed	*Chamerion angustifolium = Epilobium angustifolium*	X	X	X	ALL	1, 3, 4, 6, 8, 9 ,10
River beauty (dwarf fireweed)	*Chamerion latifolium = Epilobium latifolium*	X	X	X	CN, CR	1, 3, 8, 9
Northern water carpet	*Chrysosplenium wrightii*		X	X		1, 4, 9, 10
Enchanter's nightshade	*Circaea alpina*			X	CB	1, 10
Spring beauty	*Claytonia chamissoi*			X		1, 4
Alaska spring beauty	*Claytonia sarmentosa*	X	X	X	CN, CR	1, 3, 9
Marsh fivefinger	*Comarum palustre = Potentilla palustris*	X	X	X	CN, CB	1, 3, 9
Parsley fern	*Cryptogramma crispa*			X	CB	1, 3, 10
Pink lady's slipper	*Cypripedium guttatum*			X		1, 3
Rose-purple orchis	*Dactylorhiza aristata*			X		1, 3
Arctic daisy	*Dendranthema arcticum = Chrysanthemum arcticum*		X		CN	1, 3, 9
Deschampsia (tufted-hair grass)	*Deschampsia beringensis*			X	CB	1, 10
Deschampsia (tufted-hair grass)	*Deschampsia caespitosa*	X	X	X	ALL	1, 9, 10
Frigid shooting star	*Dodecatheon frigidum*	X				1, 3
Alpine willowherb	*Epilobium anagallidifolium*	X	X		CN, CR	1, 9
Purple-leaved willowherb	*Epilobium glandulosum*			X	CB	1, 10
Field horsetail	*Equisetum arvense*	X	X	X	ALL	1, 9, 10

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Dwarf scouringrush	*Equisetum scirpoides*		X		CN	1, 9
Woodland horsetail	*Equisetum sylvaticum*	X	X	X	CN, CR	1, 9
Fleabane	*Erigeron humilis*		X	X		1, 3
Arctic fleabane	*Erigeron hyperboreus*	X	X	X		1, 3
Tall cottongrass	*Eriophorum angustifolium*	X	X		CN, CR	1, 9
Red cottongrass	*Eriophorum russeolum*	X	X		CN, CR	1, 9
White cottongrass	*Eriophorum scheuchzeri*	X	X	X		1, 3
Arctic eyebright	*Euphrasia mollis*			X	CB	1, 4, 10
Fescue grass	*Festuca altaica*	X	X	X	ALL	1, 4, 9 , 10
Sheep fescue	*Festuca brachyphylla.*			X	CB	1, 10
Red fescue	*Festuca rubra.*			X	CB	1, 10
Coastal strawberry	*Fragaria chiloensis.*			X	CB	1, 10
Indian rice	*Fritillaria camschatcensis*		X	X	CN, CB	1, 3, 9, 10
Northern bedstraw	*Galium boreale*	X	X	X	CR	1, 3, 9
Whitish gentian	*Gentiana algida*	X	X	X		1, 3
Glaucous gentian	*Gentiana glauca*	X	X		CN, CR	1, 3, 9
Wild geranium	*Geranium erianthum*	X	X	X	CN, CB	1, 3, 9, 10
Large-leaved avens	*Geum macrophyllum macrophyllum*			X	CB	1, 10
Ross avens	*Geum rossii*	X	X	X	CN, CB	1, 3, 9, 10
Oak fern	*Gymnocarpium dryopteris*	X	X	X	ALL	1, 9, 10
Cow parsnip	*Heracleum lanatum*	X	X	X	CR, CB	1, 3, 9 ,10
Alpine holy-grass	*Hierochloe alpina*	X	X		CN, CR	1, 9
Common marestail	*Hippuris vulgaris*		X		CN	1, 9
	Honckenya peploides		X		CN	1, 9

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Seabeach sandwort						
Meadow barley	*Hordeum brachyantherum*			X	CB	1, 10
Fir club moss	*Huperzia selago*	X	X	X	ALL	1, 9, 10
Wild iris	*Iris setosa*	X	X	X	CN, CR	1, 3, 4, 8, 9
Northern green rush	*Juncus alpinus*			X	CB	1, 10
Chestnut rush	*Juncus castaneus*	X			CR	1
Thread rush	*Juncus filiformis*			X	CB	1, 10
Glaucous weaselsnout (lagotis)	*Lagotis glauca*	X	X	X	ALL	1, 3, 9, 10
Beach pea	*Lathyrus maritimus*	X			CR	1, 9
Marsh pea	*Lathyrus palustris*	X	X	X		1, 4
Leatherleaved saxifrage	*Leptarrhena pyrolifolia = Saxifraga unalaschensis*		X		CN	1, 9
Beach ryegrass	*Leymus mollis = Elymus mollis*	X	X	X	ALL	1, 9, 10
Beach lovage	*Ligusticum scoticum*	X	X		CN, CR	1, 9
Heart-leaf tway blade	*Listera cordata*	X	X			1, 3, 9
Alp lily	*Lloydia serotina*	X	X	X		1, 3
Partridgefoot	*Luetkea pectinata*			X		1, 3
Arctic lupine	*Lupinus arcticus*	X		X	CR, CB	1, 4, 8
Nootka lupine	*Lupinus nootkatensis*	X	X	X	CR	1, 3, 9
Arctic wood rush	*Luzula arctica*	X	X		CN, CR	1, 9
Curved wood rush	*Luzula arcuata*	X	X		CN, CR	1, 9
Common wood rush	*Luzula multiflora*	X	X		CN, CR	1, 9
Small-flowered wood rush	*Luzula parviflora*	X	X		CN, CR	1, 9
Spiked ood rush	*Luzula spicata*			X	CB	1, 10

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Alpine club moss	*Lycopodium alpinum*	X	X	X	CN, CR	1, 4, 9
Stiff club moss	*Lycopodium annotinum*			X	CB	1, 10
Running club moss	*Lycopodium clavatum*	X			CR	1, 9
Bogbean (buckbean)	*Menyanthes trifoliata*			X		1, 4
Seaside chiming bells	*Mertensia maritima*	X	X		CN, CR	1, 9
Chiming bells	*Mertensia paniculata*	X	X		CR	1, 3, 9
Wild snapdragon	*Mimulus guttatus*		X	X		1, 3
Arctic sandwort	*Minuartia arctica*	X	X	X	CN	1, 4, 9
Arctic sandwort	*Minuartia macrocarpa*	X	X	X	CN, CR	1, 9
Alpine mitrewort	*Mitella pentandra*			X		1, 4
Blunt-leaved sandwort	*Moehringia lateriflora*			X	CB	1, 10
Alpine forget-me-not	*Myosotis alpestris*	X	X	X		1, 3
Yellow pond lily	*Nuphar polysepalum*			X		1, 4
Mountain sorrel	*Oxyria digyna*	X	X		CN, CR	1, 9
Maydell's oxytrope	*Oxytropis maydelliana*			X	CB	1, 10
Blackish oxytrope	*Oxytropis nigrescens*	X	X	X		1, 3
Fleabane	*Packera cymbalaria = Senecio resedifolius*		X			1, 9
Alaska poppy	*Papaver radicatum alaskanum = Papaver alaskanum*		X	X	CN	1, 3, 9
Kotzebue's grass of Parnassus	*Parnassia kotzebuei*	X	X		CN, CR	1, 9
Grass of Parnassus	*Parnassia palustris*	X	X		CN	1, 3, 4, 9
Parrya	*Parrya nudicaulis*	X		X		1, 3
Capitate lousewort	*Pedicularis capitata*	X	X	X	ALL	1, 3, 10
Wooley Lousewort	*Pedicularis kanei*	X	X	X	ALL	1, 9, 10

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Langsdorff's lousewort	*Pedicularis langsdorffii*	X			CR	1, 9
Oeder's lousewort	*Pedicularis oederi*	X	X	X	CN	1, 3, 9
Fernweed	*Pedicularis sudetica pacifica*	X	X		CN, CR	1, 9
Bumblebee flower	*Pedicularis verticillata*	X	X	X	CN, CR	1, 9
Frigid coltsfoot	*Petasites frigidus*	X	X	X	ALL	1, 9, 10
Timothy grass	*Phleum commutatum americanum*			X	CB	1, 10
Butterwort	*Pinguicila vulgaris*			X		1, 3, 4
Bog orchid	*Platanthera convallariaefolia*			X		1, 3
Small northern bog orchid	*Platanthera obtusata*	X	X	X		1, 3
Alpine blue grass	*Poa alpina.*	X			CR	1, 9
Arctic blue grass	*Poa arctica*	X		X	CR, CB	1, 9, 10
Blue grass	*Poa* sp.	X	X	X	ALL	1, 4
Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	X	CN, CR	1, 3, 9
Jacob's ladder	*Polemonium pulcherrimum*			X		1, 3, 4
Bistort	*Polygonum bistorta*	X	X		CN, CR	1, 3, 9
Alpine meadow bistort	*Polygonum viviparum*	X	X	X	ALL	1, 4, 9, 10
Silverweed	*Potentilla anserina*			X	CB	1, 10
Two-flowered cinquefoil	*Potentilla biflora*		X			1, 3
One-flowered cinquefoil	*Potentilla uniflora*	X	X		CN	1, 3
Villous cinquefoil	*Potentilla villosa*		X		CN	1, 9
Northern primrose	*Primula borealis*	X	X			1, 3
Wedge-leafed primrose	*Primula cuneifolia*	X	X	X	CN, CR	1, 3, 9
Primrose	*Primula tschuktschorum*	X	X		CN	1, 9
Pink pyrola	*Pyrola asarifolia*	X	X	X	ALL	1, 3, 9, 10

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
Large-flowered wintergreen	*Pyrola grandiflora*	X				1, 3
Least wintergreen	*Pyrola minor*	X	X	X	ALL	1, 3, 9 ,10
Woodland buttercup	*Ranunculus bongardi*			X	CB	1, 10
Mountain buttercup	*Ranunculus eschscholtzii*		X	X	CN	1, 3, 9
Creeping buttercup	*Ranunculus reptans*		X	X	CB	1, 10
Buttercup	*Ranunculus* sp.	X	X	X	ALL	1, 4
Roseroot	*Rhodiola integrifolia = Sedum rosea*	X	X	X	CR, CN	1, 3, 8, 9
Arctic dock	*Rumex arcticus*	X	X	X	CN, CR	1, 4, 9
Dock	*Rumex fenestratus*			X	CB	1, 10
Dock	*Rumex graminifolius*	X	X	X	ALL	1, 4
Sitka burnet	*Sanguisorba canadensis = Sanguisorba stipulata*	X	X	X	ALL	1, 9, 10
Narrowleaf saw-wort	*Saussurea angustifolium*	X	X		CN, CR	1, 9
Spotted saxifrage	*Saxifraga bronchialis*	X	X	X	CN, CB	1, 3, 9, 10
Whiplash saxifrage	*Saxifraga flagellaris*	X	X	X		1, 3
Rusty saxifrage	*Saxifraga foliolosa*	X	X		CN, CR	1, 9
Rusty saxifrage	*Saxifraga hieracifolia*	X	X		CN	1, 3, 9
Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	X	CN	1, 3, 4, 9
Brook saxifage	*Saxifraga nelsoniana*	X	X	X	ALL	1, 3, 9, 10
Red stemmed saxifrage	*Saxifraga lyalii*			X		1, 3
Purple mountain saxifrage	*Saxifraga oppositifolia*		X	X	CN, CB	1, 3, 9, 10
Heart-leaf saxifrage	*Saxifraga punctata*		X	X		1, 3
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*	X	X	X	CN	1, 3, 9
Spiked saxifrage	*Saxifraga spicata*	X				1, 3
Marsh fleawort (mastodon	*Senecio congestus*	X	X	X		1, 3

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed	Reference
flower)						
Seabeach scenecio	*Senecio pseudo-arnica*	X	X	X	CN	1, 3, 9
Sibbaldia	*Sibbaldia procumbens*	X	X		CN, CR	1, 9
Moss campion	*Silene acaulis*	X	X	X	CN, CB	1, 3, 9, 10
Bladder campion	*Silene uralensis = Melandrium apetalum*	X	X	X		1, 4
Goldenrod	*Solidago multiradiata*	X	X	X	ALL	1, 3, 9, 10
Goldenrod	*Solidago multiradiata*	X	X	X	ALL	1, 3, 9, 10
Ladies' tresses	*Spiranthes romanzoffiana*		X	X		1, 3
Clasping twistedstalk	*Streptopus amplexifolius*.	X			CR	1, 3, 9
Dandelion	*Taraxacum* sp.	X	X	X		1, 3
Frigid fleabane	*Tephroseris atropurpurea frigidus = Senecio atropurpureus frigidus*	X			CR	1, 4, 9
Long beechfern	*Thelypteris phegopteris*	X	X	X	CN, CR	1, 9
Northern asphodel	*Tofieldia coccinea*	X	X	X	ALL	1, 9, 10
Scotch false asphodel	*Tofieldia pusilla*	X			CN	1, 9
Starflower	*Trientalis europea*	X	X	X	ALL	1, 9, 10
Downy oatgrass	*Trisetum spicatum*	X	X	X	ALL	1, 9, 10
Arrow grass	*Triglochin maritimum*			X		1, 4
Capitate valerian	*Valeriana capitata*	X	X	X	ALL	1, 3, 9, 10
Mountain hare-grass	*Valholdea atropurpurea*	X	X		CN, CR	1, 9
Two-flowered violet	*Viola biflora*	X	X	X		1, 3
Two-flowered violet	*Viola epipsila*	X			CR	1, 9
Alaska violet	*Viola langsdorffii*	X	X	X	ALL	1, 3, 9, 10

Codes: CB - Cold Bay, CR - Cape Romanzof, CN - Cape Newenham

References: 1 - Hulten (1968), 2 - Viereck and Little (1972), 3 - White (1974), 4 - Pratt (1991), 5 - Alaska Natural Heritage Program (1993), 6 - Woodward-Clyde (1995e), 7 - Lipkin (1999), 8 - McCaffery (2000), 9 - Schick and Frost (ABR, Inc. 2004 site visit), 10 - Roth (ABR, Inc. 2004 site visit).
Observed: Identified during a spring 1993 site visit (Woodward-Clyde 1995e) and by Schick, Frost, and Roth (ABR, Inc.) during 2004 site visits.
Note: Species listed alphabetically by scientific name.

Table A2: Fish Species Potentially Occurring on or near Cape Newenham, Cape Romanzof, and Cold Bay Long Range Radar Sites

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay
Sockeye (red) salmon	*Oncorhynchus nerka*		X	X
Chinook (king) salmon	*Oncorhynchus tshaytscha*		X	X
Coho (silver) salmon	*Oncorhynchus kisutcyh*		X	X
Chum salmon	*Oncorhynchus keta*	X	X	X
Pink salmon	*Oncorhynchus gorbuscha*	X	X	X
Arctic char	*Salvelinus alpinus*		X	X
Dolly Varden	*Salvelinus malma*	X	X	X
Steelhead trout	*Salmo gairdneri*			X
Arctic grayling	*Thymallus arcticus*		X	
Alaska blackfish	*Dallia pectoralis*		X	
Pacific ocean perch	*Sebastes alutus*			X
Pacific cod	*Gadus macrocephalus*			X
Tomcod	*Urophycis floridana*	X		
Yellow-fin sole	*Pleuronectes asper*			X
Pollock	*Theragra chalcogramma*			X
Pacific herring	*Clupea pallasi*	X	X	X
Humpback whitefish	*Coregonus* sp.		X	
Sheefish	*Stenodus leucichthys*	X		
Arctic cisco	*Coregonus autumnalis*	X		
Least cisco	*Dallis pectoralis*		X	
Irish lord	*Hemilepidotus* sp.	X	X	X
Coastrange sculpin	*Cottus aleuticus*		X	
Starry flounder	*Platichthys stellatus*	X		
Arctic smelt	*Osmerus dentex*			X
Surf smelt	*Hypomeous pretious*			X
Borealis smelt	*Osmerus* sp.	X		
Walleye pollock	*Theragra calcogrammus*			X
Saffron cod	*Eleginus gracilis*			X
Three-spine stickleback	*Gasterosteous aculeatus*	X		X
Nine-spined stickleback	*Pungitus pungitus*	X		X
Masked greenling	*Hexagrammos octagrannus*			X

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay
Whitespotted greenling	*Hexagrammos stelleri*			X

References:
Tack 1970
Morrow 1980
USFWS 1986a
USFWS 1989a
Robbins *et al*. 1991
Woodward-Clyde 1995e

Table A3: Mammal Species Potentially Occurring on or near Cape Newenham, Cape Romanzof, and Cold Bay Long Range Radar Sites

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay
Terrestrial Mammals				
Shrew	*Sorex* sp.		X	
Dusky shrew	*Sorex vagrans*			X
Masked shrew	*Sorex cinereus*	X*		X
Brown/grizzly bear	*Ursus arctos*		X**	X**
Black bear	*Ursus americanus*		X	
Arctic fox	*Alopex lagopus*	X	X	
Red fox	*Vulpes vulpes*	X**	X**	X
Wolf	*Canis lupus*		X	X
North American lynx	*Felis lynx*		X	
River otter	*Lutra canadensis*	X*	X	X
Mink	*Mustela vison*	X	X	X
Wolverine	*Gulo gulo*	X	X	X
Short-tailed weasel (ermine)	*Mustela erminea*	X*		X
Least weasel	*Mustela rixosa*		X	
Porcupine	*Erethizon dorsatum*		X	X
Snowshoe hare	*Lepus americanus*		X	
Alaska hare	*Lepus othus*	X*	X	X
Arctic ground squirrel	*Spermophilus paryi*		X	X
Hoary marmot	*Marmota caligata*		X**	
Beaver	*Castor canadensis*	X**	X	
Muskrat	*Ondantra zibethicus*	X	X	
Northern red-backed vole	*Clethrionomys rutilus*	X*		X
Tundra vole	*Microtus oeconomus*	X*	X	
Brown lemming	*Lemmus trimucronatus*	X*	X	X
Collared lemming	*Lemmus sibricus*	X*		
Meadow jumping mouse	*Zapus hudsonias*	X*		X
Caribou	*Rangifer tarandus*		X**	X
Musk ox	*Ovibos moschatus*	X		

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay
Marine Mammals				
Harbor seal	*Phoca vitulina*		X	
Ribbon seal	*Phoca fasciata*	X		
Spotted seal	*Phoca larga*	X*	X	
Ringed seal	*Phoca hispida*	X	X	
Bearded seal	*Erignathus barbatus*	X	X	
Alaska (northern) fur seal	*Callorhinus ursinus*		X	
Steller sea lion	*Eumetopias jubatus*	X*	X*	
Pacific walrus	*Odobenus rosmarus*	X	X	
Killer whale	*Orcinus orca*	X	X	
Minke whale	*Balaenoptera acutorostrata*	X	X	
Bowhead whale	*Balaenoptera mysticetus*	X		
Beluga whale	*Delphinapterus leucas*	X*	X	
Gray whale	*Eschrichtius robustus*	X	X	
Harbor porpoise	*Phocoena phocoena*	X*	X	
Dall porpoise	*Phocoenoides dalli*	X	X	

Sources:
* Confirmed at Cape Romanzof (McCaffery 2000)
** Confirmed at SCLRRSs (Schick-Frost-Roth (ABR, Inc.)) during 2004 site visits
USFWS undated (a)
USFWS 1986a
USFWS 1989b
Wynne 1993
Woodward-Clyde 1995e
Note:
Species listed by phylogenetic order.

Table A4: Bird Species Potentially Occurring on or near Cape Newenham, Cape Romanzof, and Cold Bay Long Range Radar Sites

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	CR
Pacific Loon	*Gavia pacifica*	X	X	X	CR
Common Loon	*Gavia immer*	X	X	X	CR
Yellow-billed Loon	*Gavia adamsii*	X	X	X	CR
Horned Grebe	*Podiceps auritus*	X	X	X	
Red-necked Grebe	*Podiceps grisegena*	X	X	X	CR
Sooty Shearwater	*Puffinus griseus*		X		
Short-tailed Shearwater	*Puffinus tenuirostris*	X	X	X	CR
Fork-tailed Storm-petrel	*Oceanodroma furcata*		X	X	CN
Leach's Storm-petrel	*Oceanodroma leucorhoa*			X	
Double-crested Cormorant	*Phalacrocorax auritus*	X	X	X	CR, CN
Pelagic Cormorant	*Phalacrocorax pelagicus*	X	X	X	CR, CN
Red-faced Cormorant	*Phalacrocorax urile*	X	X	X	CR
Tundra Swan	*Cygnus columbianus*	X	X	X	CR, CB
Greater White-fronted Goose	*Anser albifrons*	X	X	X	CR
Snow Goose	*Chen caerulescens*		X	X	
Emperor Goose	*Chen canagica*	X	X	X	CR, CN
Brant	*Branta bernicla*	X	X	X	CR
Canada Goose	*Branta canadensis*	X	X	X	CR
Green-winged Teal	*Anas crecca*	X	X	X	CR, CB
Baikal Teal	*Anas formosa*		X		
Mallard	*Anas platyrhynchos*	X	X	X	CR, CB
Northern Pintail	*Anas acuta*	X	X	X	CR, CN
Northern Shoveler	*Anas clypeata*	X	X	X	CR
Gadwall	*Anas strepera*		X	X	
Eurasian Wigeon	*Anas penelope*		X	X	
American Wigeon	*Anas americana*	X	X	X	CR
Canvasback	*Aythya valisineria*	X		X	

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Redhead	*Aythya americana*			X	
Tufted Duck	*Aythya fuligula*			X	
Greater Scaup	*Aythya marila*	X	X	X	ALL
Common Eider	*Somateria mollissima*	X	X	X	CR
King Eider	*Somateria spectabilis*	X	X	X	CR, CN
Spectacled Eider	*Somateria fischeri*	X	X		CR
Steller's Eider	*Polysticta stelleri*	X	X	X	CR, CN, CB
Harlequin Duck	*Histrionicus histrionicus*	X	X	X	CR, CN
Long-tailed Duck	*Clangula hyemalis*	X	X	X	CR
Black Scoter	*Melanitta nigra*	X	X	X	CR, CN
Surf Scoter	*Melanitta perspicillata*	X	X	X	CR, CN
White-winged Scoter	*Melanitta fusca*	X	X	X	CR, CN
Common Goldeneye	*Bucephala clangula*	X	X	X	CR
Barrow's Goldeneye	*Bucephala islandica*	X	X	X	CR
Bufflehead	*Bucephala albeola*	X	X	X	CR
Common Merganser	*Mergus merganser*	X	X	X	CR
Red-breasted Merganser	*Mergus serrator*	X	X	X	CR, CN
Osprey	*Pandion haliaetus*	X	X		CR
Bald Eagle	*Haliaeetus leucocephalus*	X	X	X	ALL
Northern Harrier	*Circus cyaneus*	X	X	X	CR
Northern Goshawk	*Accipiter gentilis*	X	X		
Red-tailed Hawk	*Buteo jamaicensis*	X	X		
Rough-legged Hawk	*Buteo lagopus*	X	X	X	ALL
Golden Eagle	*Aquila chrysaetos*	X	X	X	CR
American Kestrel	*Falco sparverius*	X		X	CR
Merlin	*Falco columbarius*	X	X	X	CR
Peregrine Falcon	*Falco peregrinus*	X	X	X	CR, CN
Gyrfalcon	*Falco rusticolus*	X	X	X	CR
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	CR, CB
Rock Ptarmigan	*Lagopus mutus*	X	X	X	CR

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Sandhill Crane	*Grus canadensis*	X	X	X	CR
Black-bellied Plover	*Pluvialis squatarola*	X	X	X	CR
American Golden-plover	*Pluvialis dominica*	X			CR
Pacific Golden-plover	*Pluvialis fulva*	X	X	X	CR
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	ALL
Black Oystercatcher	*Haematopus bachmani*			X	
Greater Yellowlegs	*Tringa mela*	X	X	X	CR
Lesser Yellowlegs	*Tringa flavipes*	X	X	X	CR
Common Sandpiper	*Actitis hypoleucos*	X			CR
Spotted Sandpiper	*Actitis macularia*	X	X		CR
Wandering Tattler	*Heteroscelus incanus*	X	X	X	CR
Whimbrel	*Numenius phaeopus*	X	X	X	CR
Bristle-thighed Curlew	*Numenius tahitiensis*	X	X		CR
Hudsonian Godwit	*Limosa haemastica*	X	X		
Bar-tailed Godwit	*Limosa lapponica*	X	X	X	CR
Ruddy Turnstone	*Arenaria interpres*	X	X	X	CR
Black Turnstone	*Arenaria melanocephala*	X	X	X	CR
Surfbird	*Aphriza virgata*	X	X		CR
Red Knot	*Calidris canutus*		X		
Sanderling	*Calidris alba*		X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	CR
Western Sandpiper	*Calidris mauri*	X	X	X	CR, CN
Least Sandpiper	*Calidris minutilla*		X	X	CN
Baird's Sandpiper	*Calidris bairdii*	X	X		CR, CN
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	CR, CN
Sharp-tailed Sandpiper	*Calidris acuminata*		X	X	
Rock Sandpiper	*Calidris ptilocnemis*	X	X	X	ALL
Dunlin	*Calidris alpina*	X	X	X	CR
Short-billed Dowitcher	*Limnodromus griseus*	X	X	X	
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	CR

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Wilson's Snipe	*Gallinago delicata*	X	X	X	ALL
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	CR
Red Phalarope	*Phalaropus fulicaria*	X	X	X	CR
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	X	CR
Parasitic Jaeger	*Stercorarius parasiticus*	X	X	X	CR, CN
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	CR, CN
Little Gull	*Larus minutus*	X			CR
Black-headed Gull	*Larus ridibundus*	X			CR
Bonaparte's Gull	*Larus philadelphia*	X	X		CR
Mew Gull	*Larus canus*	X	X	X	CR, CB
Herring Gull	*Larus argentatus*	X	X	X	CR
Slaty-backed Gull	*Larus schistisagus*	X		X	CR
Glaucous-winged Gull	*Larus glaucescens*	X	X	X	ALL
Glaucous Gull	*Larus hyperboreus*	X	X	X	CR
Black-legged Kittiwake	*Rissa tridactyla*	X	X	X	CR, CN
Red-legged Kittiwake	*Rissa brevirostris*		X		
Sabine's Gull	*Xema sabini*	X	X		CR
Arctic Tern	*Sterna paradisaea*	X	X	X	CR
Caspian Tern	*Sterna caspia*	X			CR
Aleutian Tern	*Sterna aleutica*	X	X	X	CR
Common Murre	*Uria aalge*	X	X	X	CR, CN
Thick-billed Murre	*Uria lomvia*	X	X		CR
Pigeon Guillemot	*Cepphus columba*	X	X	X	CR, CN
Marbled Murrelet	*Brachyramphus marmoratus*	X	X	X	CR
Kittlitz's Murrelet	*Brachyramphus brevirostris*		X	X	
Ancient Murrelet	*Synthliboramphus antiquus*			X	
Cassin's Auklet	*Ptychoramphus aleuticus*			X	
Parakeet Auklet	*Aethia psittacula*	X	X	X	CR, CN
Least Auklet	*Aethia pusilla*		X	X	

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Crested Auklet	*Aethia cristatella*		X	X	
Tufted Puffin	*Fratercula cirrhata*	X	X	X	CR, CN
Horned Puffin	*Fratercula corniculata*	X	X	X	CR, CN
Snowy Owl	*Nyctea scandiaca*	X	X	X	CR
Northern Hawk Owl	*Surnia ulula*	X	X		
Short-eared Owl	*Asio flammeus*	X	X	X	CR, CB
Rufous Hummingbird	*Selasphorus rufus*	X			CR
Belted Kingfisher	*Ceryle alcyon*	X	X	X	
Northern Flicker	*Colaptes auratus*	X			CR
Downy Woodpecker	*Picoides pubescens*	X	X		
Olive-sided Flycatcher	*Contopus borealis*	X	X		CR
Alder Flycatcher	*Empidonax alnorum*	X	X		CR
Horned Lark	*Eremophila alpestris*	X	X		CR
Tree Swallow	*Tachycineta bicolor*	X	X	X	CR, CN
Violet-green Swallow	*Tachycineta thalassina*		X		CN
Bank Swallow	*Riparia riparia*	X	X	X	CR, CN
Cliff Swallow	*Petrochelidon pyrrhonota*	X	X		CR
Gray Jay	*Perisoreus canadensis*		X		
Black-billed Magpie	*Pica pica*		X	X	
Common Raven	*Corvus corax*	X	X	X	CR, CN
Black-capped Chickadee	*Poecile atricapillus*	X	X	X	CR
Red-breasted Nuthatch	*Sitta canadensis*	X			CR
Winter Wren	*Troglogytes troglodytes*			X	
American Dipper	*Cinclus mexicanus*		X	X	
Arctic Warbler	*Phylloscopus borealis*	X	X		CR
Northern Wheatear	*Oenanthe oenanthe*	X	X		CR
Gray-cheeked Thrush	*Catharus minimus*	X	X	X	CR, CN
Swainson's Thrush	*Catharus ustulatus*		X		
Hermit Thrush	*Catharus guttatus*	X	X	X	CR, CN
Eyebrowed Thrush	*Turdus obscurus*	X			CR
American Robin	*Turdus migratorius*	X	X	X	CR

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Bluethroat	*Luscinia svecica*	X			CR
Varied Thrush	*Ixoreus naevius*	X	X		CR
Golden-crown Kinglet	*Regulus satrapa*	X			CR
Ruby-crowned Kinglet	*Regulus calendula*	X			CR
Eastern Yellow Wagtail	*Motacilla tschutschensis*	X	X	X	CR, CN
White Wagtail	*Motacilla alba*	X	X		CR
Black-backed Wagtail	*Motacilla cinerea*	X			CR
Red-throated Pipit	*Anthus cervinus*	X	X		CR, CN
American Pipit	*Anthus rubescens*	X	X	X	CR, CN
Bohemian Waxwing	*Bombycilla garrulus*	X			CR
Northern Shrike	*Lanius excubitor*	X	X	X	
Orange-crowned Warbler	*Vermivora celata*	X		X	CR
Yellow Warbler	*Dendroica petechia*	X	X	X	CR, CB
Yellow-rumped Warbler	*Dendroica coronata*	X	X		CR
Blackpoll Warbler	*Dendroica striata*	X	X		CR
Northern Waterthrush	*Seiurus noveboracensis*	X	X	X	CR
Wilson's Warbler	*Wilsonia pusilla*	X	X	X	CR
American Tree Sparrow	*Spizella arborea*	X	X	X	CR
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	ALL
Fox Sparrow	*Passerella iliaca*	X	X	X	CR
Song Sparrow	*Melospiza melodia*		X	X	
Lincoln's Sparrow	*Melospiza lincolnii*	X			CR
Golden-crowned Sparrow	*Zonotrichia atricapilla*	X	X	X	ALL
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	CR
Dark-eyed Junco	*Junco hyemalis*	X	X		CR
Lapland Longspur	*Calcarius lapponicus*	X	X	X	ALL
Snow Bunting	*Plectrophenax nivalis*	X	X	X	ALL
McKay's Bunting	*Plectrophenax hyperboreus*	X	X	X	ALL

Common Name	Scientific Name	Cape Romanzof	Cape Newenham	Cold Bay	Observed
Rusty Blackbird	*Euphagus carolinus*	X	X		
Common Rosefinch	*Carpodacus erythrinus*	X			CR
Purple Finch	*Carpodacus purpureus*	X			CR
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	X	X	X	ALL
Pine Grosbeak	*Pinicola enucleator*	X	X		
White-winged Crossbill	*Loxia leucoptera*	X	X		CR
Common Redpoll	*Carduelis flammea*	X	X	X	CR, CN
Hoary Redpoll	*Carduelis hornemanni*	X	X	X	CR

Codes: CR - Cape Romanzof, CN - Cape Newenham, CB - Cold Bay
References: USFWS (undated (c)), Bethel Bird Checklist, Holmes and Black (1973), Cooper and Pogson (1983), USFWS (1986a), Kinckloe *et al*. (1988), USFWS (1989b), Petersen *et al*. (1991), Gibson (1993), Woodward-Clyde (1995e), USFWS (1997b), McCaffery and Harwood (1997), Day and Stickney (1996), McCaffery (2000)
Observed: Species observed by Woodward-Clyde and USAF in 1993, Day and Sticknet (1996), McCaffery and Harwood (1997), and Schick and Frost (ABR Inc.) during 2004 site visits.
Notes: Species listed by phylogenic order.

Appendix 3.0 - Romanzof. Cape Romanzof Long Range Radar Site

3.0 Installation Overview

Figures 3.0a and 3.0b Aerial Views, of Cape Romanzof LRRS Upper and Lower Camps, Respectively

3.1 Location and Area

Cape Romanzof LRRS is 540 miles west of Anchorage on a small peninsula that extends into the Bering Sea (INRMP Figure 3.1). The installation consists of two camps, which are connected by a road and a tramway. The 4,900-acre installation is located within the Yukon Delta NWR. The installation is accessible only by air or boat. The LRRS is centrally located in the western Askinuk Mountains and is bordered by native corporation lands (McCaffery 1994).

3.2 Installation History

Cape Romanzof LRRS was one of 12 original AC&W sites built as part of the air defense system constructed in Alaska during the early 1950s. Installation construction was finished in 1952, and operations began in 1953. Communications were initially provided by high frequency radio. A WACS was activated at the site in 1958 to replace the high frequency radio system.

Cape Romanzof LRRS has been operated by a government contractor since 1977. In 1979 the WACS was replaced with a satellite system. A MAR system was installed in the mid 1980s, which remains active today, and other modifications were made to remotely operate and maintain the radar from Elmendorf Region Operations Control Center. These improvements resulted in a reduction in staff, which at one time included 95 military personnel, to four operations and maintenance contracts personnel at present. Inactive structures were demolished in 2003.

3.3 Surrounding Communities

The nearest towns to Cape Romanzof LRRS are Scammon Bay (population 474, 2010 estimate) and Hooper Bay (population 1,093, 2010 estimate) (www.dced.state.ak.us 2012), which are located 15 miles to the east and south, respectively. These communities are not accessible to Cape Romanzof by road. However, winter access by snowmachine is possible.

The populations of Scammon Bay and Hooper Bay are primarily Native Alaskan. Commercial fishing and subsistence activities are the primary means of support. Salmon, walrus, beluga whale, and waterfowl are utilized. Employment is seasonal with peak economic activity in summer. Sources of employment are BLM fire-fighting programs and commercial fishing and associated canneries. Residents also earn money from the sale of grass baskets and ivory handicrafts (www.dced.state.ak.us 2007).

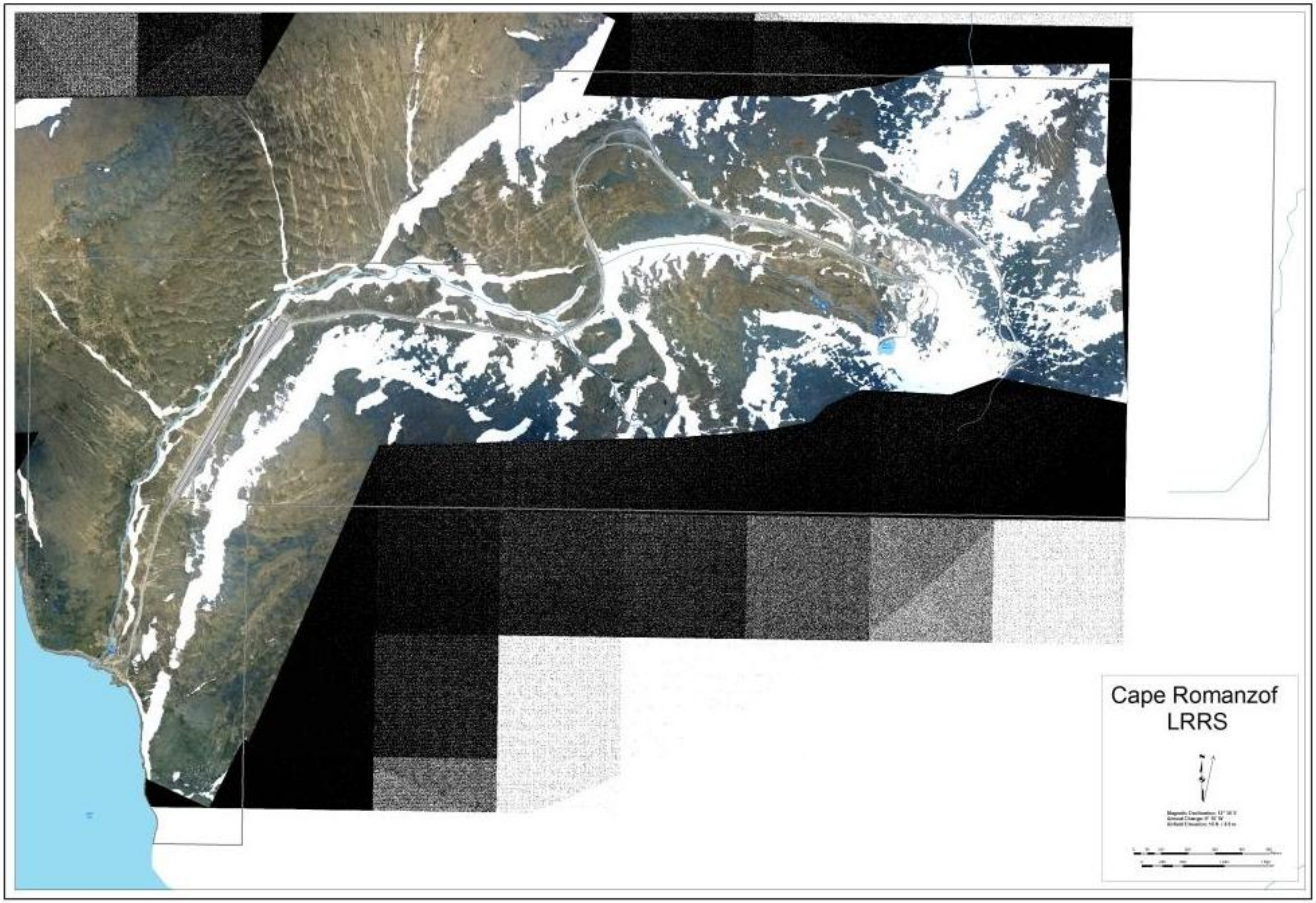
3.4 Regional Land Use

The 4,900-acre installation is located within the Yukon Delta NWR. The LRRS is bordered by native corporation lands (McCaffery 1994).

3.5 Local and Regional Natural Areas

Cape Romanzof LRRS lies within the Yukon Delta NWR. Waters of the Yukon and Kuskokwim rivers flow through the Yukon Delta NWR. Almost 70% of this 19 million acre refuge is below 100 feet in elevation and consists of a broad, flat delta stitched through with rivers and streams and dotted with countless lakes, sloughs, and ponds. Bordering this expanse of tundra and wetlands are forest and shrub habitat and uplands with mountains more than 4,000 feet high. The refuge also includes two large islands; Nelson and Nunivak. Yukon Delta NWR supports one of the largest aggregations of water birds in the world, and it supports one of the most important shorebird nesting areas in the United States. Spawning and rearing habitat for 44 species of fish is provided by the hundreds of miles of rivers and streams. Along the coast of the refuge, the waters of the Bering Sea host a variety of marine mammals, including whales which pass during migration (USFWS 2007a).

Figure 3.1 Cape Romanzof LRRS



4.0 Physical Environment

4.1 Climate

Cape Romanzof LRRS has a maritime climate. Temperatures recorded at Hooper Bay range from -25° to 79°F. Total precipitation is 16 inches, with a mean annual snowfall of 75 inches. Winter ice pack and winds often promote severe conditions. The Bering Sea is ice-free from June through October. Annual precipitation for Scammon Bay is 14 inches, with a mean annual snowfall of 65 inches (www.dced.state.ak.us 2012).

4.2 Landforms

Cape Romanzof LRRS is located in the Yukon-Kuskowin Coastal Lowland section of the Bering Shelf, an Alaskan physiographic province. Cape Romanzof LRRS is in an upland area near the Bering Sea on an isolated linear mountain mass that rises abruptly out of the Yukon-Kuskowin Delta to a maximum elevation of 2,342 feet above msl. Surrounding delta lowlands consist of a lake-dotted marshy plain that rises from sea level eastward to a maximum elevation of 300 feet above msl. The lowland is crossed by meandering streams of extremely low gradient that flow west into the Bering Sea. The lowland is underlain by a discontinuous layer of permafrost.

Upper Camp is situated at the top of a ridge which overlooks a steep-sided valley, probably carved in part by a glacier. The longitudinal profile of this valley (containing Fowler Creek - name on Air Force drawings; officially named Nilumat Creek on U.S. Geographic Survey topographic maps) is irregular and stepped, with steep segments followed by flat segments (as at Lower Camp).

4.3 Geology and Soils

Cape Romanzof LRRS is located in the Askinuk Mountains, surrounded by the Yukon-Kuskowin lowlands, a marshy, lake-dotted deltaic plain surrounded by low rounded hills with locally steep slopes. The Askinuk Mountains rise from delta lowlands between Scammon and Kokechik bays, extends about 50 kilometers from the coast (McCaffery 1994), and is dominated by Towak Mountain (Moore 1998) where Upper Camp and the radome are located. The LRRS is situated at the western end of the Askinuk Mountains.

Cape Romanzof LRRS is located within the valley of Fowler (Nilumat) Creek; the upper part of this valley has very steep sides and a relatively shallow-sloped valley floor. The U-shaped valley cross-section and the stepped longitudinal profile of Fowler (Nilumat) Creek are typical of glaciated valleys.

The geology of Upper Camp facilities (located on the narrow ridge above the valley) is characterized by a thin accumulation of angular sand and block residues overlying granitoid bedrock of Towak Mountain. The granitoid rocks appear to have a composition of quartz-monzonite to granodiorite, although no system sampling or analysis for detailed chemical composition has been conducted. Two major joint sets are apparent in the granitoid bedrock. The dominant set shows a general strike orientation that ranges from Township North Section 55 Range E to Township North Section 85 Range West with an average dip of about 80 degrees northwest.

Lower Camp and adjacent facilities at the valley margin are underlain by deposits of talus and other colluvial materials that have moved down the steep valley side slopes toward Fowler Creek, largely under the influence of gravity. This colluvium consists of granitoid material of a wide range of material sizes, from large granite blocks (1-2 feet, minimum dimension) to fine-to-coarse grained sand, silt, and minor clay. At the base of the steep slope, colluvium forms an apron that extends across part of the low-angle slope on the valley floor adjacent to Fowler (Nilumat) Creek. Lower Camp and the main access road are located at the uphill margin of this apron, near the beginning of the northern steep slope.

The central low-slope-angle part of the U-shaped valley is underlain by alluvial and glacial deposits. The Cape Romanzof LRRS water supply well located near the valley axis is 154 feet deep and penetrates a sequence of gravelly clay with boulders (0-43-foot depth) overlying sand and boulders (43-57-foot depth). This sequence, in turn, overlies weathered bedrock (93 feet thick) and then probably fresh granitoid bedrock at a depth of 150 feet. Alluvial/glacial material underlying the valley floor probably interfingers in the subsurface with the colluvial apron along a zone downslope and towards Fowler Creek from Lower Camp.

Cape Romanzof LRRS is located in a section of western coastal Alaska where thin to moderately thick (to 600 feet) permafrost zones may occur in predominately fine-grained sediments. However, permafrost may be generally absent in glacial cirques and protected hollows at such locations as Cape Romanzof. Permafrost is not known to exist at this installation.

Soils of the region formed in essentially unglaciated residuum. They are very gravelly and stony but occasionally have inclusions of a thin silty mantle on flatter slopes. They are normally well-drained and have discontinuous permafrost. Soils are classified as a complex, Pergelic Cryumbrepts-Histic Pergelic Cryaquepts. On steep upper slopes, the mantle of weathered material is usually shallow, and bedrock outcrops are quite common (HQ AAC/DEPV 1988).

4.4 Hydrology

4.4.1 General

Surface water drainage is accomplished chiefly by overland flow to Fowler (Nilumat) Creek. Some Upper Camp drainage is directed north and eastward to Kawiakpak Creek and Ekashluak Creek; some drainage may flow south and southwestward to Ekasluktuli River and the unnamed creek referred to as “South Creek” in McCaffery’s reports (McCaffery 2000). Surface waters of the Cape Romanzof area generally occur as ephemeral streams that drain to Kokechik Bay, a major surface water feature of the Yukon Delta NWR.

The Cape Romanzof watershed boundary is defined as the continuous line of highest elevation. All surface water and groundwater flow only within the watershed. There is one small lake in the watershed, located about 0.3 miles south of Lower Camp. The lake was formed by a small dam constructed at the head of the valley, upstream of Fowler (Nilumat) Creek.

The most significant groundwater resources are present mostly in unconsolidated alluvial and glacial deposits and in weathered bedrock that underlies the flanks and valley floor of the upper part of Fowler (Nilumat) Creek Valley. Minor amounts of groundwater are available on high valley slopes as local perched water.

Water-bearing geologic units at Cape Romanzof LRRS include: (1) granitoid-rich colluvium on steep valley sides and adjacent parts of the valley floor, (2) alluvium/glacial deposits underlying the central part of the valley floor, and (3) weathered granitoid bedrock that underlies surficial deposits of colluvium and alluvial/glacial deposits.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Surface runoff exits the land quickly by a well-defined drainage pattern. Drainage ditches, natural swales, and Fowler Creek would contain the 100-year flood. Upper reaches would flow full, but lower reaches would not flow full with a maximum depth of eight feet. Coastal flooding was estimated to reach 15 feet msl, based on regional storm levels.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Cape Romanzof LRRS. Much information included in INRMP Chapter 5.0 that includes Cape Romanzof LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Cape Romanzof LRRS and the surrounding area. ***Appendix 3.0-Newenham***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Cape Romanzof LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 125 Bering Tundra (Northern) Province
Description: As a western extension of the arctic coastal plain, the Bering Tundra is a broad lowland area rising gradually to the east. Winters are cold, and summers are generally cool. Annual precipitation is 17 inches. Along coastal areas the vegetation is mainly sedge and cottongrass; on higher sites are woody plants. In transition areas between beach and forest are birch-willow-alder thickets. Inceptisols over silt, sand, and marine sediments are found along the coast; in the lower Yukon and Kuskokwim Valley bottoms are pockets of Entisols. In most of the area, the permafrost is continuous.

5.2 Vegetation

Vegetation at Upper Camp is characteristic of alpine tundra/barren ground communities. Dwarf Shrub meadows with abundant sedges are widespread and dominate the vegetation at Lower Camp. Pockets of mountain avens, lichens, and low-growing herbs, shrubs, and grasses are also found at Lower Camp. Trees are absent. Willow-dominated areas along the streams support lush growths of herbs (*i.e.*, forbs and graminoids) (McCaffery 2000).

Vegetation at Cape Romanzof LRRS is characterized by low-growing plants that can withstand the extreme wind conditions that predominate over the area. Cape Romanzof LRRS is characterized by cover types generally described as prostrate dwarf shrub heath, intermixed with areas of dwarf shrub boulder fields. Prostrate dwarf shrub heath is found on alpine tundra in relatively dry sites and is characterized by decumbent dwarf shrubs, such as alpine bearberry, Arctic willow, crowberry, alpine azalea, Labrador tea, and lowbush cranberry. Dwarf shrub boulder field is dominated by boulders covered with numerous crustose lichens and bryophytes. Patches of crowberry, narrowleaf Labrador tea, spiraea, and roseroot grow between boulders (USFWS 1989a).

A general vegetation map of Cape Romanzof LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995e). Schick *et al*. (2004) further refined habitat mapping at Cape Romanzof LRRS (using 2001 digital aerial photography and Landsat imagery). This map (72% complete) and detailed methodology are shown in Gene Stout and Associates and Blythe & Trousil (2007a).

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Cape Romanzof LRRS in 2001 and 2009. This project used 2001 National Land Cover Database data (http://www.mrlc. gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth and, if available, 2009-2010 SPOT-5 satellite imagery (http://www. alaskamapped.org/ortho). Table 5.2 shows these acreages and changes over this 8-year period. Figure 5.2a shows habitat classes for 2009, and Figure 5.2b shows changes in habitat classes between 2001through 2009.

Table 5.2 Habitat Class Differences between 2001 and 2009, Cape Romanzof LRRS

Habitat Class	Acres 2001	Acres 2009	Acreage Change
Barren Land	1,478.8	1,472.4	-6.4
Deciduous Forest	7.1	7.1	0.0
Developed, High Intensity	1.1	1.1	0.0
Developed, Low Intensity	130.8	151.3	20.5
Developed, Medium Intensity	34.2	34.2	0.0
Dwarf Shrub	1,314.2	1,306.7	-7.4
Evergreen Forest	10.2	8.1	-2.2
Mixed Forest	7.6	7.6	0.0
Open Water	13.4	13.4	0.0
Perennial Ice/Snow	0.0	2.7	2.7
Shrub/Scrub	1,864.8	1,858.3	-6.6
Totals	**4,862.2**	**4,863.0**	**0.8**

Schick *et al*. (2004) described the Cape Romanzof area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

The Cape Romanzof LRRS area encompasses about 4,900 acres. Most common wildlife habitats at the LRRS, by far, are dwarf scrub and barren and partly barren rock in the mountains. Overall, the area is well-drained to moderately well-drained; there are relatively few wet tundra habitats. The LRRS is strongly dominated by Upland Dwarf Scrub, which occurs primarily on mountain slopes and occasionally on better-drained flats. These areas are used primarily by ground-nesting passerines and perhaps some shorebirds (*e.g*., American and Pacific Golden-Plovers, Rock Sandpiper) and Ptarmigan. Associated mountainous habitat types, which tend to occur on better-drained and convex slopes, are Upland Rock and Upland Rock–Dwarf Scrub Complex.

The next most common habitat is developed land (*e.g*., excavated gravel, gravel fill, structures, and impounded water). Lowland types (Lowland Moist Graminoid–Herb Tundra and Lowland Nonpatterned Wet Tundra) are poorly represented. These habitats, especially Lowland Nonpatterned Wet Tundra, are used by nesting passerines and perhaps other nesting shorebirds, such as the commonly observed Western Sandpiper. All low and tall scrub habitats considered together, which are used by a greater diversity of nesting passerines, comprise a very small percentage of Cape Romanzof LRRS.

5.3 Fish and Wildlife

5.3.1 Fish

Few fishery resources are found on the installation. Fowler (Nilumat) Creek provides habitat for resident Dolly Varden and spawning pink and chum salmon. Fowler (Nilumat) Creek empties into Kokechik Bay, an important area for subsistence gathering of clams and herring spawn associated with a small commercial herring fishery. Herring are caught by both commercial and subsistence fishermen (personal communication, Menard 1993 in Woodward-Clyde 1995e; Braund and Associates 2004).

During a 1993 site visit (Woodward-Clyde 1995e), USAF Natural Resource personnel accompanied ADFG on a sampling trip in nearshore waters. A set net was sampled, and the following species were

Figure 5.2a Cape Romanzof LRRS Wildlife Habitat Map, 2009

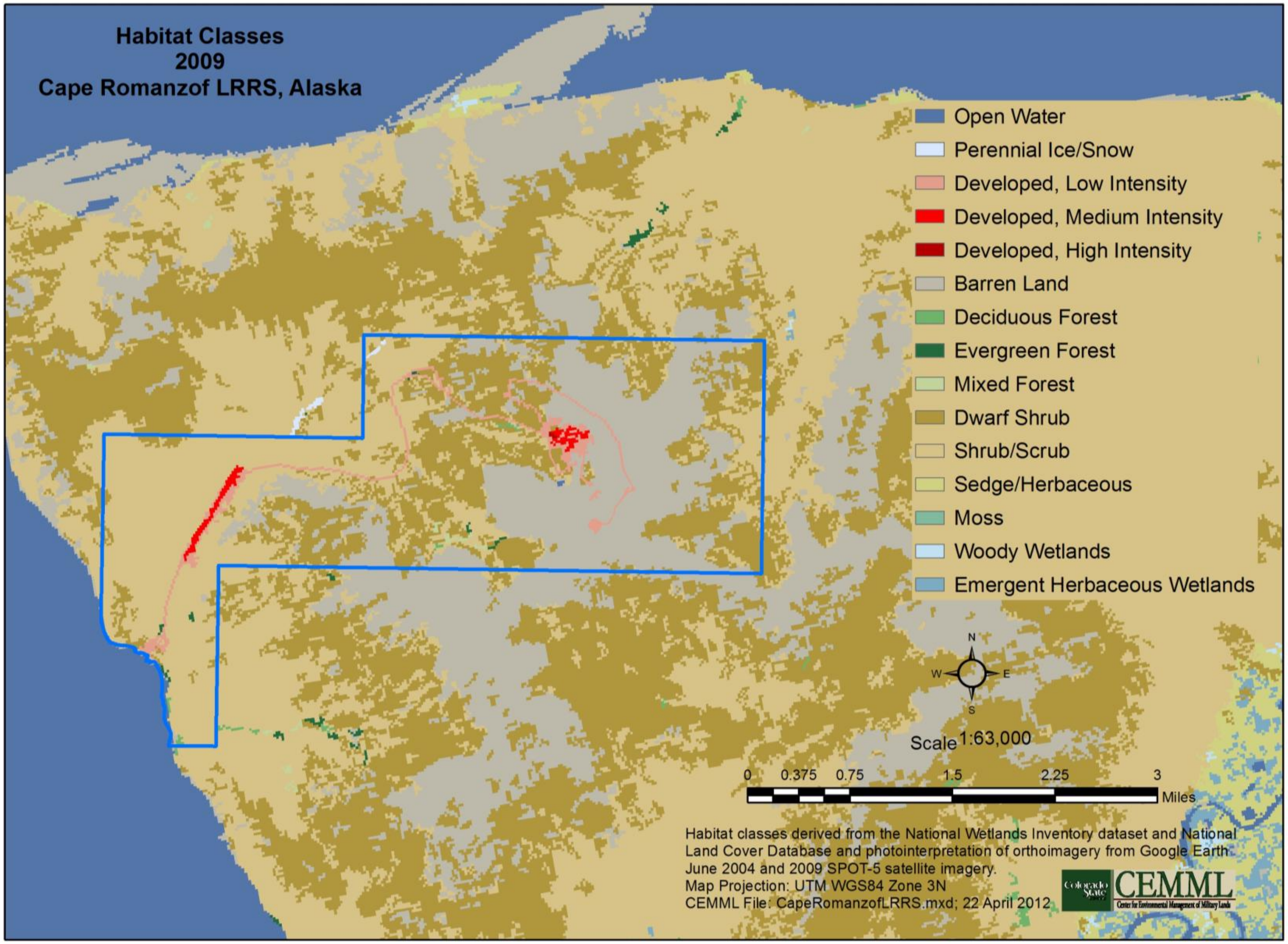
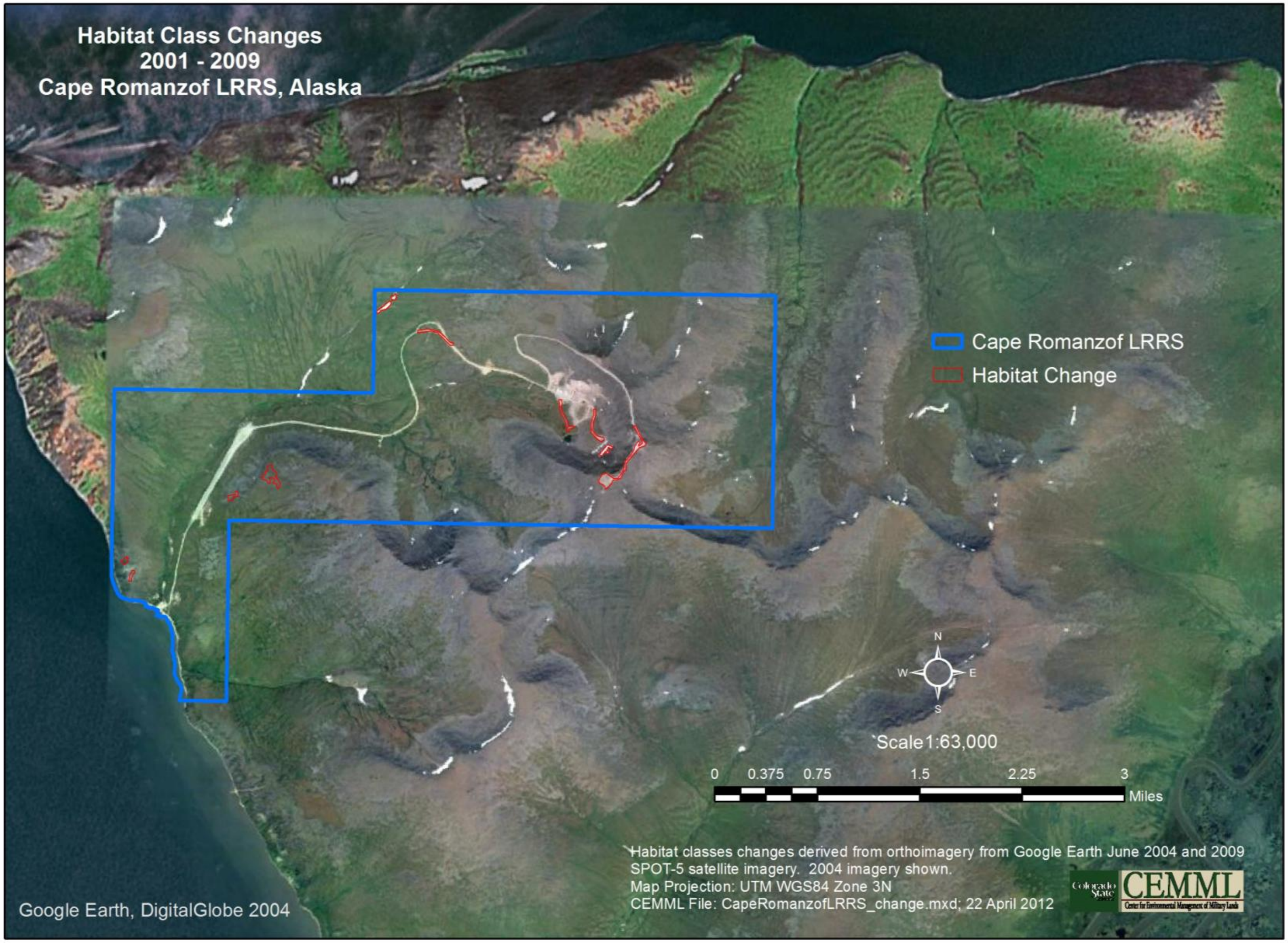


Figure 5.2b Changes in Habitat Classes at Cape Romanzof LRRS between 2001 and 2009



caught: tomcat, sculpin, starry flounder, yellow-fin sole, and borealis smelt (personal communication, Menard 1993 in Woodward-Clyde 1995e).

5.3.2 Mammals

Terrestrial mammals expected to occur in the region include the beaver, otter, Arctic and red fox, vole, mink, muskrat, and wolverine. Beaver and muskrat are common throughout most of the Yukon Delta NWR. Mink of the Yukon-Kuskowin Delta are among the largest in the world. River otter are abundant along lowland streams and rivers of the refuge. Wolverine are uncommon throughout the refuge (USFWS 1989a).

The most common carnivore at the site is the short-tailed weasel. Confirmed species include the masked shrew, river otter, short-tailed weasel, Alaska (tundra) hare, northern (tundra) red-backed vole, tundra vole, brown lemming, collared lemming, and meadow jumping mouse. Voles have been sighted around the LRRS facilities. Beavers regularly use the dam and complex on lower Fowler (Nilumat) Creek (McCaffery 2000).

Musk oxen are sometimes observed on mountains surrounding the camp. A small group (fewer than 10) of musk oxen were seen during a 1993 site visit on steep terrain several miles south of the Cape Romanzof LRRS (Woodward-Clyde 1995e). In 1996 the musk-ox herd included at least 14 individuals; at least three died prior to spring 1999; two were apparently poached on LRRS property (McCaffery 2000).

Several species of whales pass along the coast during migration. Seals, walruses, and beluga whales are the key sea mammals using coastal and marine habitats of the Yukon Delta NWR (USFWS 1989a). Beluga whales are found along the coast from Kuskokwim Bay to the mouth of the Yukon River from spring through autumn. Beluga whales are also found around Nunivak Island in ice-free months, moving into rivers and bays on the refuge during spring and early summer to feed on fish migrating to spawning grounds, particularly salmon and herring (USFWS 1989a). Minke, bowhead, and killer whales are also found in Bering Sea waters, as are Dall’s and harbor porpoises (Wynne 1993). McCaffery (2000) has documented the spotted seal, very rare Steller sea lion, very rare Pacific walrus, and very rare harbor porpoise. A spring population of greater than 150 beluga whales regularly use inshore waters around the cape itself, often within a dozen meters of the shoreline; later in the season they are occasionally found within Kokechik Bay (McCaffery 2000).

Although most marine mammals are under the jurisdiction of the NMFS, walrus, polar bear, and sea otter are under the jurisdiction of the USFWS. Pacific walruses range with the pack ice in the Bering Sea, west of the Yukon Delta NWR. They forage for clams and other benthic organisms off the coast of the refuge (USFWS 1989a). Bearded, spotted, ribbon, and ringed seals and Steller sea lions are found in the Bering Sea near Cape Romanzof LRRS (Wynne 1993).

5.3.3 Birds

While the LRRS has mostly landbirds using the areas, the surrounding Yukon Delta NWR hosts millions of waterfowl that migrate through the area or breed in the refuge. More than half of the North American population of Black Brant are hatched in the Delta’s coastal habitat. All of North America’s Cackling Canada Geese are produced in the coastal lowlands. Large populations of Emperor Geese, Pacific White-fronted Geese, and Tundra Swans nest near the coast and on the inland tundra. Duck species that occur on the Delta include the Greater Scaup, Long-tailed Duck, Northern Pintail, Black Scoter, Green-winged Teal, Mallard, and American Wigeon (USFWS 1984).

A sizable fraction of the Spectacled Eiders that breed on the Delta migrate south past Cape Romanzof in spring (McCaffery *et al*. 1999, 1998). The first North American breeding records of Slaty-backed Gulls and first nests of Caspian Terns for Alaska and the Bering Sea were found near the LRRS (McCaffery et al. 1997a, 1997b).

Cape Romanzof LRRS is a unique habitat that supports a different avifauna, particularly for landbirds, than the rest of Yukon Delta NWR. Important species that are at or near the edge of their range at Cape Romanzof LRRS include Golden Eagles, Surfbirds, Baird Sandpipers, Bluethroats, Caspian Terns, White Wagtails, Yellow Wagtails, Red-throated Pipits, Orange-crowned Warblers, Wilson's Warblers, Northern Waterthrushes, and other species (McCaffery 2000, McCaffery *et al*. 1998, McCaffery and Harwood 1997).

Shorebirds and seabirds that use the Delta include gulls, jaegars, cranes, loons, grebes, plovers, snipes, godwits, sandpipers, and the rare Bristle-thighed Curlew. Horned Puffins, Pelagic Cormorants, and Tufted Puffins are found in rookeries along the shores of Cape Romanzof LRRS (Sowls *et al*. 1978, McCaffery and Harwood 1997).

Rocky hillsides of Cape Romanzof LRRS provide perching and hunting areas for the Rough-legged Hawk, Golden Eagle, and Gyrfalcon. The Rock Ptarmigan and Willow Ptarmigan occur throughout the area (Holmes and Black 1973). The occurrence of White Wagtails at the Cape Romanzof LRRS is significant, as is the occurrence of Red-throated Pipits. Orange-crowned Warblers, Wilson's Warblers, and Northern Waterthrushes may reach their westernmost point of distribution in North America in willow thickets along Fowler (Nilumat) Creek (personal communication, McCaffery 1993 in Woodward-Clyde 1995e).

McCaffery and Harwood (1997) conducted major bird surveys at Cape Romanzof on 1 May- 24 July and 7 August-1 September 1996. They found 12 species of sea ducks, but only the Common Eider and Red-breasted Merganser nested on the LRRS. Rough-legged Hawks were abundant, but no other species of cliff-nesting raptors was found breeding. A small breeding colony of Horned Puffins and Tufted Puffins was located on the cliff and spires. Forty species of neotropical migrants, including 22 species of passerines, were found. Of the 10 species of paleotropical migrants, the Bluethroat, Northern Wheatear, and Yellow Wagtail nested at Cape Romanzof, and the White Wagtail and Red-throated Pipit may nest in or near the Cape in other years. The authors concluded that, Cape Romanzof is an oasis of habitat for a surprising diversity and abundance of paleotropical species.

In early June 1996, 500 to 1,000 gulls were reported on the coast associated with herring fishing (personal communication, B. McCaffery, USFWS 1996 with G. Augustine). On 19 Aug 97 about 200 Canada Geese and a small number of Tundra Swans were reported foraging on wild berries in the vicinity of the Cape Romanzof LRRS airfield (personal communication, G. Augustine with site personnel).

Thirty-three bird species were observed at Cape Romanzof LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included species, such as Pacific Loon; Pelagic Cormorant; Harlequin Duck; Peregrine Falcon; American Golden-plover; Surfbird; Western Sandpiper; Tree and Bank Swallows; Yellow and Wilson's Warblers; and Savannah, Fox, White-crowned, and Golden-crowned Sparrows.

5.4 Threatened and Endangered Species

Nearly half the world's population of threatened Steller's Eiders may have migrated past Cape Romanzof during 3½ weeks in August. Smaller numbers of threatened Spectacled Eiders flew south past the Cape in early May (McCaffery and Harwood 1997). Cape Romanzof LRRS is in the migration route of Steller's Eiders and in the current breeding range of Spectacled Eiders. Steller's Eider critical habitat occurs about 10 miles south of Cape Romanzof (USFWS 2004b). The candidate Kittlitz's Murrelet winter range may include mid-shelf waters offshore of Cape Romanzof. Other federally-protected species may occur in the

Cape Romanzof area, including the endangered Steller sea lion and endangered bowhead whale (Woodward-Clyde 1995e). McCaffery (2000) confirmed the Steller sea lion and threatened Pacific walrus at Cape Romanzof. Threatened ringed and bearded seals are potentially in the area. The candidate Yellow-billed Loon is confirmed on or near the site.

Several formerly listed or former Category 2 species (Harlequin Duck, Arctic Peregrine Falcon, Bristle-thighed Curlew, and gray whale) are either confirmed or possible near Cape Romanzof LRRS. Harlequin Ducks were observed in Kokechik Bay during a 1993 site visit (Woodward-Clyde 1995e). The delisted American Peregrine Falcon nests within 10 miles of Cape Romanzof LRRS and has been observed using the area. The Alaska Natural Heritage Program surveyed Cape Romanzof LRRS on 2-7 August 1996; no rare plants were noted during the survey (Lipkin 1999).

5.5 Wetlands

The most common wetland type at Cape Romanzof LRRS is palustrine, broad-leaved deciduous and evergreen scrub-shrub, which can be mixed with emergent vegetation and/or lichens. These areas are moist dwarf scrub habitats and can be saturated, moderately well-drained, or well-drained, depending primarily on soil type, microtopography, and landscape position. Portions of these areas, when very well-drained, are likely to be jurisdictional uplands. These wetlands and possible uplands occur within the Upland Dwarf Scrub wildlife habitat type. Dominant shrub species in these areas include *Empetrum nigrum*, *Vaccinium uliginosum, V. vitis-idaea*, *Ledum decumbens*, *Dryas octopetala*, *Arctostaphylos alpina,* and *Salix rotundifolia* (Schick *et al*. 2004).

Wetlands at Cape Romanzof LRRS are strongly dominated by moist sloping areas with fewer wetter areas of seasonal flooding and very few areas of persistent standing water. On mountain slopes and ridges, many well-drained rocky areas are likely to be NWI Uplands. The very few freshwater habitats at Cape Romanzof LRRS are classified as palustrine, unconsolidated bottom, permanently flooded (pond) (Schick *et al*. 2004).

The general Cape Romanzof LRRS vegetation map's wetland features (Woodward-Clyde 1995e) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). These sources are used to facilitate decisions regarding facility siting. Cape Romanzof LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (1,952.10 acres). Figure 5.5 shows wetlands on Cape Romanzof LRRS from 2011 data.

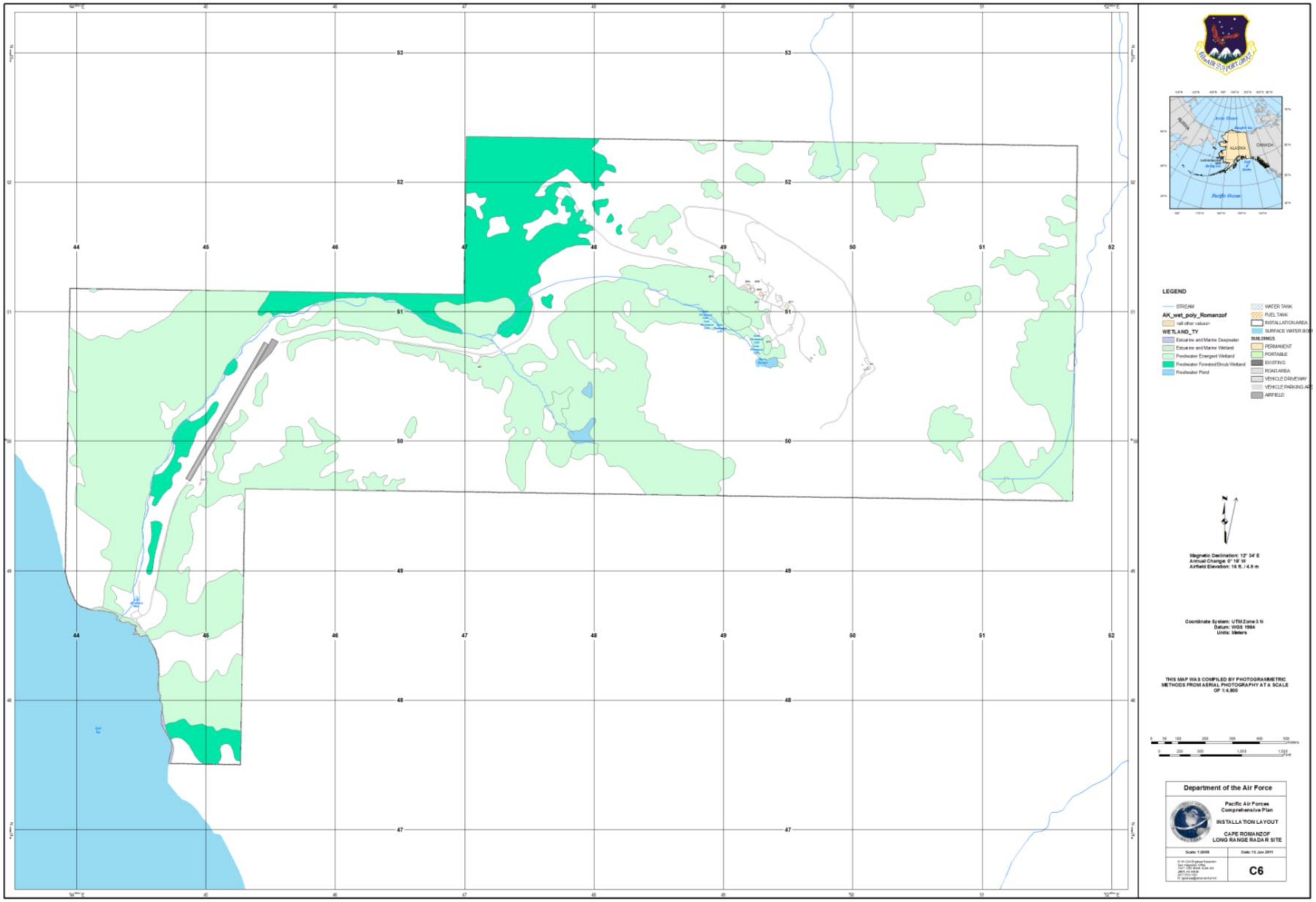
5.6 Other Natural Resource Information

5.6.1 Subsistence

Subsistence gathering, including subsistence hunting, but particularly subsistence fishing, occurs in the vicinity of Cape Romanzof by residents of Hooper Bay, Chevak, and Scammon Bay. Subsistence use in the vicinity of the LRRS includes bearded, ringed, and spotted seals; numerous fish species; small mammals; and greens and berries (Braund and Associates 2004).

Residents of Hooper Bay use coastal waters, nearshore environment, and beaches extensively. Sea mammal hunting is carried out mainly to the north, beyond Cape Romanzof and into the Bering Sea. Residents harvest anadromous and freshwater fish in the Kashunuk, Ninglikfak, and Kokechik rivers. Terrestrial resources are harvested in river-accessible areas that include montane environments in the Askinuk Mountains as well as wet tundra, lake, and slough environments. These areas significantly overlap among the four villages (Hooper Bay, Scammon Bay, Chevak, and Paimiut) of the region (Braund and Associates 2004).

Figure 5.5 Cape Romanzof LRRS Wetlands, 2011



The array of available resources in the Cape Romanzof area is similar to that of villages further south, such as Togiak and Goodnews Bay. Spring is the most active period for seal hunting. The spring hunt coincides with the most intensive seal migrations, and a great number and diversity of seals are encountered (Braund and Associates 2004). Braund and Associates (2004) presents the annual cycle of subsistence activities for Hooper Bay, which is also applicable for the other three villages in the area.

Subsistence fishing for herring roe occurs annually (depending upon the availability of a tender) in early June by residents of rural villages in the area, primarily Scammon and Hooper bays. ADFG also sets up a camp nearby and adjacent to the installation's barge landing area to regulate the annual fishing activity.

Local Natives use the area for subsistence gathering while engaging in the small commercial herring fishery. Between 150 to 250 helpers and families of fishermen are from the villages of Chevak, Hooper Bay, and Scammon Bay. This temporary population camps along the Kokechik Bay coast, mostly on adjoining Yukon Delta NWR property. During many past years 50-80 individuals camped for up to two weeks on USAF property along the shore of Kokechik, near ADFG personnel. Camp sites were sparse and typically left surprisingly clean, as waste is removed or burned, and human waste is disposed in temporary outhouse/pits.

Between the sporadic commercial fish openings, usually a one to two-week period, subsistence gathering of herring spawn collections and clamming occurs along the coast (personal communication, Menard 1993 in Woodward-Clyde 1995a).

5.6.2 Outdoor Recreation

Local Natives use the area adjacent to the barge-landing area for camping while engaging in a small commercial herring fishery. Three ADFG personnel typically camp for a one-month period in spring to gather information prior to, during, and following the herring fishing season. Three to five additional ADFG personnel usually join them for up to one week.

Outdoor recreation at Cape Romanzof LRRS consists primarily of non-organized activities, such as hunting, hiking, bird watching, boating, and ATV riding. A certain amount of commercial fishing in the waters off of Cape Romanzof LRRS has occurred in the past but is dependent upon the availability of a tender type fishing boat. Commercial tenders have not been coming and buying from the area; thus, there has not been much activity (personal communication, T. Vania 2007).

The site provides limited recreational opportunities for personnel assigned to the site and for local inhabitants. Although the region provides ample commercial and subsistence fishing opportunities, particularly for herring, little recreation fishing is expected to occur. Most recreation at the site is limited to hiking, boating along the coast in inflatable boats, and wildlife viewing. The USAF cooperated with the USFWS in establishing an observation point for Eiders at Cape Romanzof LRRS in 1997 (McCaffery, *et. al*. 1998).

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities include buildings, roads, grounds, airfield, antenna structures, utility plants, and systems of supply, generation, or disposition of electricity, water, sewage, and refuse. The Upper Camp contains radar equipment, and Lower Camp provides support facilities, including housing, the power plant, and bulk fuel storage. The two camps are connected by a road and a tramway. A runway serving the installation is located approximately four miles south of Lower Camp. The LRRS received a new, self-contained sewage treatment system in 1998. This system is similar to those used on large ships and improves the quality of the effluent, which reduces pollution. In recent years the power plant has been replaced and a lift to the landfill has occurred.

In the past, barges bringing supplies to the LRRS have docked at the beach near the ADFG field camp, using a jetty to support this barge traffic. During the late 1980s, the jetty was expanded using boulders from the beach area near the jetty. Jetty construction affected herring spawning where boulders were removed; however, herring now spawn along the entire length of the jetty (Dolezal 1993). Therefore, further construction or disruption of the intertidal zone should be discouraged.

Camp garbage and waste from herring fishery participants in the vicinity of the barge landing has been a concern, and USFWS-recommended guidelines given by McCaffery (2000). Biodegradable wastes must be buried, and non-biodegradable wastes and equipment are to be removed along with personal gear upon breaking camp.

USAF has outgrants to the Federal Aviation Administration for an Alaskan National Airspace System Interfacility Communications System, one for the Remote Communications Outlet and Remote Communications Air-to-Ground services, and one for support of the CAPSTONE safety-enhancement project for the safety of aircraft operations in Alaska.

Appendix 3.0 – Cold. Cold Bay Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Cold Bay LRRS

3.1 Location and Area

Cold Bay is an 208-acre LRRS located near the tip of the Alaska Peninsula (INRMP Figure 3.1). The installation is within the Pavlof Unit of Alaska Peninsula NWR. This facility is located five miles northwest of the community of Cold Bay. A petroleum, oils, and lubricants (POL) terminal and a warehouse also support the LRRS (Figure 3.1).

The previous installation at Grant Point was located 11 miles west of the community of Cold Bay within the Izembek NWR. This facility was abandoned and demolished. The total land area at Grant Point consists of 208 acres, which was deactivated and turned over to the USFWS. This INRMP is concerned with the current LRRS.

3.2 Installation History

Cold Bay LRRS was constructed at Grant Point in 1958-59 as part of the extension of the DEW Line into the Aleutians. In 1969 Cold Bay LRRS was converted to a NORAD surveillance installation. Communications were provided by the WACS from 1969 until 1978 when the WACS at Cold Bay was deactivated and replaced by a commercial satellite earth terminal.

In 1977 a site support contract eliminated 66 military positions in operations. Installation of Joint Surveillance System equipment was completed in 1982, enabling radar and beacon data to be transmitted via satellite to the Elmendorf Region Operations Control Center. In early 1985 a minimally attended radar was installed at the current LRRS south of Blinn Lake. The Grant Point site was demolished in 1987. Woodward-Clyde (1996a) describes remediation completed and planned for three parcels of land associated with the former site. The electronics building consists of the radar tower, CW-396A/GPS rigid radome, AN/FPS-117 minimally attended radar, other electronic equipment, and a two bedroom apartment with a kitchenette, living room, and dinette combination to house the single contract maintenance person.

3.3 Surrounding Communities

Access to the facility is by road from Cold Bay. The community of Cold Bay can be reached only by sea or air. Cold Bay has a population of 108 (2010 estimate) (www.dced.state.ak.us 2012). King Cove is 23 miles southeast, and False Pass is 37 miles southwest of the Cold Bay LRRS (Braund and Associates 2004).

Cold Bay services the fishing industry and houses a number of federal offices with services focused on Aleutian transportation and wildlife protection. Subsistence and recreational fishing and hunting are a part of the local culture. Up to 70,000 Canada geese migrate through Cold Bay in the fall. Izembeck Lagoon offers the world's largest eelgrass beds, feeding grounds for more than 100,000 brant during their spring and fall migrations.

State and federal government and airline support services provide most local employment. Cold Bay serves as the regional center for air transportation on the Alaska Peninsula and is an international hub for private aircraft. Cold Bay also provides services and fuel for the fishing industry. In 2010, two residents held commercial fishing permits (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Native people have harvested fishery resources of Izembek NWR for thousands of years. Today, many people living in the area depend seasonally on commercial fishing for their livelihood. Residents of nearby communities obtain a significant proportion of protein in their diet from subsistence resources on Izembek NWR. The Air Force and civilians use the site for fishing (personal communication, P. Cooley 2007).

3.5 Local and Regional Natural Areas

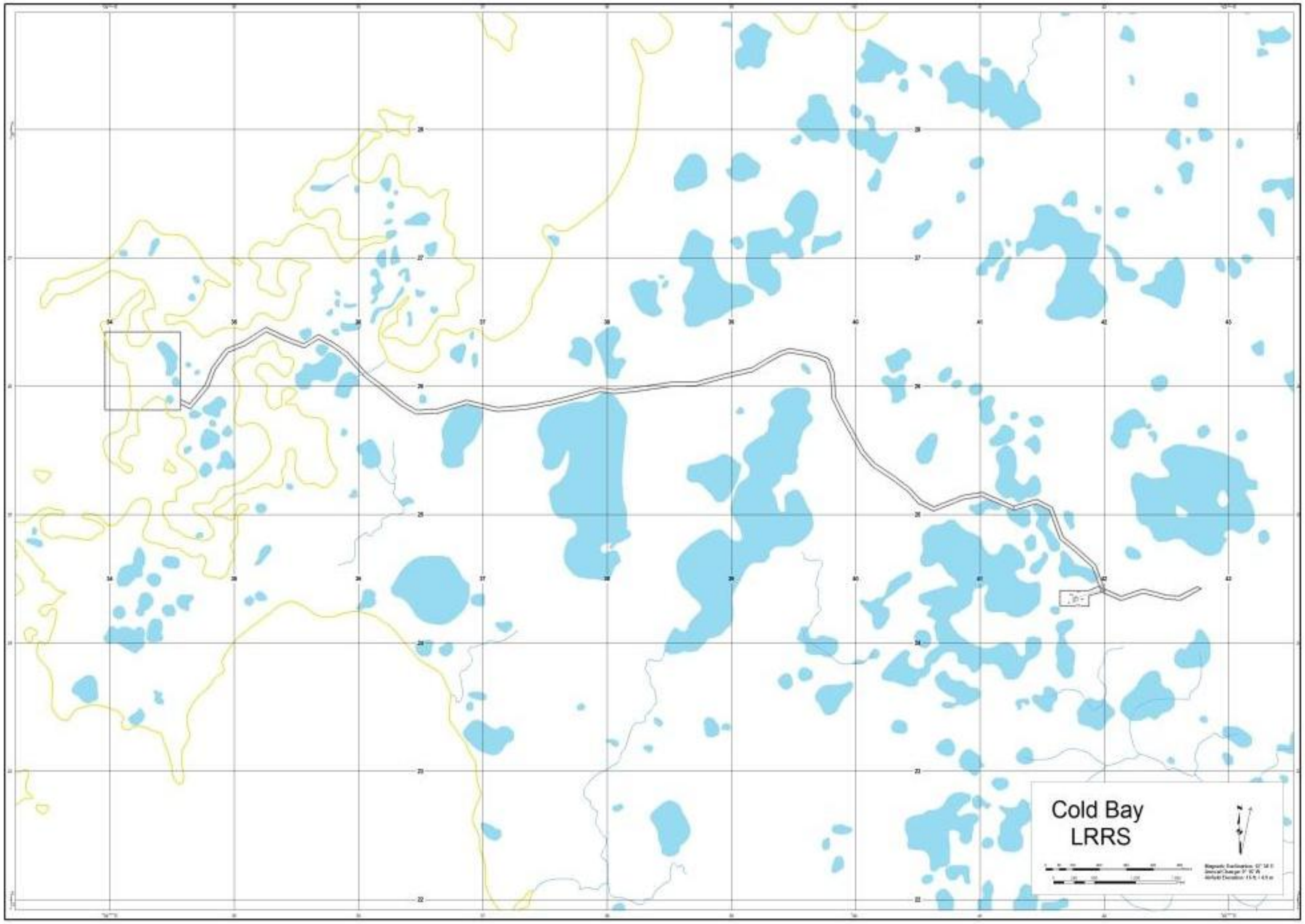
Cold Bay lies within the Pavlof Unit of the Alaska Peninsula NWR, which encompasses 694,510 acres. The Pavlof Unit is administered by the 498,000-acre Izembek NWR, which ranges from steep mountain slopes, to lake-dotted tundra, to a salt water lagoon environment. Russell Creek is the largest stream emptying into Cold Bay. Cold Bay LRRS is flanked by Mount Dutton to the east and Frosty Peak to the southwest. To the north and northwest of the town of Cold Bay lies Izembek Lagoon. The embayment is approximately nine miles across at its widest point and protrudes inland 25 miles from its headlands.

4.0 Physical Environment

4.1 Climate

The climate at Cold Bay LRRS is dominated by a strong marine influence, characterized by frequent but light rains, cool temperatures, and high cloud and fog frequencies. Cold Bay's weather is dominated by frequent cyclonic storms crossing the Northern Pacific and Bering seas. These storms are responsible for common occurrences of high winds, low ceilings, and low visibility in the area. The open bay area to the south-southwest of the LRRS and the high mountainous terrain to the southwest create complex wind patterns. Seasonal periods at Cold Bay are variable due to the moderating effects of nearby, large ocean

Figure 3.1 Cold Bay LRRS



areas. Vegetative growth, heralding the arrival of spring, generally does not begin until late May or early June. August is considered mid-summer, and autumn starts early in October.

The summer season experiences the greatest frequency of fog, with the foggy period extending from mid-July to mid-September. Visibility restriction due to blowing snow is common during winter. Sky cover/visibility is an important climatological feature of the Cold Bay area. Anything in the air which reduces visibility to six miles or less is recorded as an obstruction to vision.

About 90 percent of the sky is covered by clouds on an average day. The shortest day of the year at Cold Bay has seven hours and seven minutes of possible sunshine, while the longest has 17 hours and 27 minutes of possible sunshine. The extreme degree of cloudiness in the area, however, severely restricts the amount of sunshine actually received. The mean annual precipitation is about 42 inches, and although rarely heavy, measurable precipitation occurs approximately 200 days per year.

The average annual snowfall is 55 inches. Wind speeds of 30 mph are common for Cold Bay (www.dced.state.ak.us 2012).

Temperature variation at Cold Bay is minimal. Differences between minimum and maximum temperatures for all individual months average less than 10ºF. The mean annual temperature is 38ºF. Below zero temperatures, occurring December through March, are extremely rare. It is fairly impossible for cold, continental air masses to reach the Cold Bay area on an overland route along the narrow Alaska Peninsula; however, air overlying the frozen Bering Sea may take on continental characteristics. Thus, fairly cold temperatures are experienced in the Cold Bay area.

Table B.1.P Cold Bay, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	33ºF	34ºF	35ºF	39ºF	46ºF	51ºF	55ºF	57ºF	53ºF	46ºF	39ºF	36ºF
Average Low	24ºF	24ºF	25ºF	29ºF	36ºF	41ºF	46ºF	48ºF	43ºF	35ºF	30ºF	27ºF
Mean	29ºF	29ºF	30ºF	34ºF	41ºF	46ºF	51ºF	53ºF	48ºF	41ºF	35ºF	32ºF
Record High	59ºF (1947)	50ºF (1991)	56ºF (1974)	60ºF (1948)	68ºF (2006)	72ºF (2001)	77ºF (1960)	78ºF (1948)	76ºF (1985)	69ºF (1964)	59ºF (1986)	54ºF (1990)
Record Low	-13ºF (2000)	-9ºF (1947)	-13ºF (1971)	4ºF (1976)	18ºF (1973)	27ºF (2007)	33ºF (1982)	32ºF (1999)	26ºF (1992)	6ºF (1999)	1ºF (1963)	-9ºF (1950)
Average Precipitation	3.16 inches	3.06 inches	2.70 inches	2.42 inches	2.60 inches	2.72 inches	2.48 inches	3.68 inches	4.73 inches	4.76 inches	4.98 inches	4.46 inches

Source: www.weather.com (January 16, 2012)

4.2 Landforms

Cold Bay LRRS is surrounded on the landward side by low, rolling tundra with a myriad of freshwater lakes, marsh pools, and interconnecting drainage channels. The area is located within a moraine and outwash-mantled plain. Numerous morainal and thaw lakes dot the wet tundra that surrounds the installation. Elevations range from 5 to 50 feet above msl.

The nearest notable features in the landscape are a large (1,000-foot) rounded hill three miles due west of the community and the 5,784-foot Mt. Frosty, the slopes of which begin their ascent some four miles southwest of town. Being situated on the broad sloping base of Mt. Frosty, Cold Bay is not subject to flooding or dramatic erosion.

The nearest volcano, Mt. Frosty, adjacent to Cold Bay, has been dormant in historical times. The nearest active volcano is the Pavlof complex, about 35 miles away, which consists of six separate peaks that erupted dramatically with lava and ash in 1981. There is no known fault line in the immediate proximity to Cold Bay. Cold Bay is subject to tsunamis that are created by submarine earth movements of earthquakes and volcanic eruptions.

The bay which gives the community its name is 25 miles long, eight miles wide, and approximately four miles wide at its entrance. Cold Bay may be entered by deep-draft vessels via a marked, 60-foot-deep, natural channel that skirts a large reef near Kasolan Point. Currents in the channel can reach velocities of more than four miles per hour during large tides, with tide rips often accompanying adverse winds.

The diurnal tide range in the bay is 6.9 feet, with a mean range of 5.25 feet. Wave heights most frequently recorded in the bay by the U.S. Naval Weather Service Command lie within the 3.0-3.9-foot range. While depths in the bay average 60-180 fathoms, deep water does not generally occur close to the shore. The single existing dock, for example, extends some 1,824 feet to reach depths of 30-36 feet.

4.3 Geology and Soils

The geology of Cold Bay LRRS is dominated by coastal deposits consisting of interlayered marine and alluvial sediments of terrestrial origin. These materials consist of silt and sand. Site geology consists of glacial drift and morainal materials, an unsorted, unstratified mixture of clay, silt, sand, gravel, cobbles, and boulders, deposited in an arcuate pattern about Cold Bay. Numerous small lakes dot the uplands underlain by glacial sediment (Boyer 1987).

Volcanic ash, unconsolidated sand, silt, gravel, and decomposed bedrock form most of the parent material for the soil for the Alaska Peninsula. Soils are generally cindery and well drained on slopes but are often sandy or loamy at low elevations. Peat soil is common in lowlands because of poor drainage and the lack of topographic relief (Boyer 1987).

Although there are zones of discontinuous permafrost on the eastern half of the Alaska Peninsula, permafrost is usually absent in the western portion, where the LRRS is located. The depth of seasonal freezing depends on temperature and the amount of insulation provided by snow cover (Boyer 1987).

4.4 Hydrology

4.4.1 General

Both Cold Bay and Izembek Lagoon are salt water bodies; groundwater obtained from shallow aquifers in the general area may be brackish. For this reason, surface water provides the most reliable drinking water. The facility obtains its water supplies from a 113-foot deep well located on a knoll at 150 feet above msl, adjacent to the site. This well encountered water at 88 feet in predominantly sandy soil (Boyer 1987). The drainage of Cold Bay LRRS land areas is directed to unnamed surface streams and local wetlands, which, in turn, drain to Izembek Lagoon, a principal surface water feature of Izembek NWR.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Terrain of the installation is slightly rolling hills, providing adequate water drainage from the site. In general, the installation is above the 100-year flood plain. Small lakes on the site would rise temporarily due to inflow of local runoff; none of these lakes are a flood hazard.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Cold Bay LRRS. Much information included in INRMP Chapter 5.0 that includes Cold Bay LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Cold Bay LRRS and the surrounding area. ***Appendix 3.0-Newenham***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Cold Bay LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 126 Bering Tundra (Southern) Province
Description: This is a moraine- and outwash-mantled lowland province that rises from sea level to heights of 300-500 feet. Winters are cold, and summers are cool and short. Average precipitation is 13-34 inches. Dominant vegetation is moist and wet tundra communities. Inceptisols are dominant soils of the province; permafrost is sporadic or absent.

5.2 Vegetation

Cold Bay LRRS vegetation is characterized by low rolling coastal heath, with associated shrub willow and alder near stream margins. The area is comprised largely of tidelands and numerous lagoons with a well developed system of tidal channels and flats. About 70 percent of the tidal flats are covered with eelgrass beds (USFWS 1985).

Vegetation at Cold Bay LRRS is generally restricted to low-growing species that can resist cold summer temperatures, strong winds, shallow soils, and a short growing season (USFWS 1985). Moist and wet tundra are the main plant communities found at the LRRS, consisting of relatively monotypic heath (*Empetrum nigrum*) tundra (Zeillemaker 1994). Sizeable alders grow on and adjacent to the 8-acre facility.

Vegetation in the Cold Bay area consists of coastal lowlands with intermixed areas of open low-shrub/ graminoid tundra. Smaller areas of marsh/very wet bog occur in the Bering Sea lowlands to the east and south of Moffet and Izembek lagoons. Closed shrub/graminoid and open low-shrub/ericaceous tundra cover types occur along slopes and drainages that run from the mountains toward the Bering Sea. Open low-shrub/graminoid tundra areas generally have canopies less than 10 percent coniferous, less than 75 percent deciduous species, and a composition of greater than 20 percent graminoids and forbs. Boggy areas are drier than open low-shrub/ericaceous tundra communities that are more common along the lower peninsula and usually have dense-shrub growth form (USFWS 1985).

Open low-shrub/ericaceous tundra areas are considered wetlands if they occur on active floodplains or poorly drained soils but not if they occur on slopes; these communities include black spruce woodlands, dwarf birch with willows or ericaceous shrubs, ericaceous mats with cushion tundra, and dryas mats with cushion tundra (USFWS 1985).

Wet tundra covers portions of lowlands and has developed in areas of little or no topographic relief. Crowberry is associated with prostrate willows and forbs, such as avens, dryas, and saxifrage. Sedges, grasses, and herbs, such as geranium, cow parsnip, and monkshood, are common. Moist tundra occurs in areas of somewhat greater relief and better drainage than wet tundra, predominantly on hummocky, hilly, or rolling terrain. Mats of crowberry and other plants are underlain by a thick, acidic layer of peat. Uppermost portions of the peat layer are usually saturated with water, even during prolonged dry periods (Boyer 1987).

Other vegetation surrounding the installation includes the following: cranberry, miscellaneous mosses and lichens, miscellaneous willows and alder, Alaska violet, northern Labrador tea, bunchberry, coltsfoot, lupine, lousewort, wild mustard, Ross avens, mountain heliotrope, coastal paintbrush, and miscellaneous grasses (fescues, beach reedgrass, etc.). Cow parsnip, hemlock parsley, and beach lovage commonly occur with beach rye; groundsel and seabeach sandwort predominate on sandy beaches (Boyer 1987).

A general vegetation map of Cold Bay LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995e). Schick *et al*. (2004) made significant improvements in vegetation mapping at Cold Bay LRRS (using 2003 QuickBird pan-sharpened natural color imagery) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Cold Bay LRRS in 2001 and 2005. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth. Table 5.2 shows these acreages and changes over this 4-year period. Figure 5.2a shows habitat classes for 2005, and Figure 5.2b shows changes in habitat classes between 2001through 2005.

Table 5.2 Habitat Class Differences between 2001 and 2005, Cold Bay LRRS

Habitat Class	Acres 2001	Acres 2005	Acreage Change
Barren Land	37.9	24.9	-13.0
Dwarf Shrub	21.8	21.8	0.0
Emergent Herbaceous Wetlands	17.6	17.6	0.0
Grassland	78.3	78.3	0.0
Open Water	19.3	32.3	13.0
Totals	**174.9**	**174.9**	**0.0**

Schick *et al*. (2004) described the Cold Bay area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Cold Bay LRRS encompasses 208 acres[1]. Most common wildlife habitats at the LRRS are dwarf scrub, grassland, and open water. The area is primarily well-drained to moderately well-drained and relatively little wet tundra habitat occurs.

The LRRS is strongly dominated by Lowland Dwarf Scrub and Upland Dwarf Scrub, primarily on gentle sloping terrain and hilltops. These are used primarily by ground-nesting passerines and probably breeding shorebirds (*e.g*., Rock Sandpiper, which is abundant in the Cold Bay area in such habitats). Better-drained Upland Rock habitats occur on hilltops. Tall alder scrub habitats (Lowland Tall Closed Scrub, Lowland Tall Open Scrub, Upland Tall Closed Scrub, and Upland Tall Open Scrub) are used by a diversity of passerines, but there is likely fewer nesting species than in mixed areas of willows and alders. Low scrub habitats (Lowland Low Closed Scrub and Lowland Low Open Scrub) are dominated by willows.

[1] Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

5.3 Fish and Wildlife

5.3.1 Fish

Both freshwater and marine fish species occur in the Cold Bay area. Freshwater species include five species of salmon, Dolly Varden/Arctic char, and steelhead trout. At least 34 other species of fish occur in Izembek Lagoon. Most of these species are of little sport or commercial interest, but they are important food sources for aquatic and terrestrial wildlife (USFWS 1985).

Numerous anadromous fish occur in streams in the Cold Bay vicinity. Russell Creek, south of the LRRS, supports chum, pink, and coho salmon as well as Dolly Varden and Arctic char. Frosty Creek supports sockeye salmon as well as the previously mentioned species. The small lakes provide rearing habitat for sockeye salmon. Most anadromous streams have been catalogued in the ADFG stream catalog program (ADFG 1990b).

5.3.2 Mammals

The area supports 14 species of terrestrial mammals, which potentially occur at Cold Bay LRRS. Brown bear and caribou are the most conspicuous terrestrial mammals. In spring bears search the coastline for carrion and early spring vegetation. In summer they move to salmon streams and are noticeable at Frosty and Russell creeks. In fall bears alternate between salmon streams and tundra, where they forage for berries (USFWS 1985). Winter denning is usually in mountainous areas, not within the LRRS area (personal communication, Chase 1993 in Woodward-Clyde 1995a).

The Alaska Peninsula caribou herd consists of three subherds. The subherd which uses the Cold Bay area at one time was the second largest, with 6,000 to 8,000 animals (USFWS 1985). The herd is down to 1,500 to 2,000 caribou. This subherd calves north of Cold Bay near Port Moller and moves into the Cold Bay area by late October. With recent herd growth, it arrives on the winter range earlier than usual and remains longer (personal communication, Chase 1993 in Woodward-Clyde 1995e).

Other land mammals in the area include the red fox, river otter, mink, wolverine, and wolf, which are all occasionally sought by trappers. Arctic ground squirrels are abundant all summer. Short-tailed weasels, Alaskan hares, red-backed and tundra voles, brown lemmings, and porcupines also occur throughout the area (Boyer 1987). Brown lemming are quite rare (Zeillemaker 1994).

5.3.3 Birds

The Cold Bay/Izembek NWR area supports one of the greatest concentrations of migrating waterfowl in the world. The Cold Bay area serves as a crossroad for several waterfowl and shorebird migration routes. Birds from Asia, the mid-Pacific, and the North American Pacific Flyway funnel through this area en route to and from nesting grounds in the Arctic. More than 300,000 geese and 150,000 ducks use Izembek Lagoon each fall. Virtually the entire Pacific Flyway's population of Brant and the world's entire population of Emperor Geese migrate through the area each year. Thousands of ducks stage on Izembek NWR before migrating south. Northern Pintails, Mallards, Harlequin Ducks, Black Scoters, and Steller's Eiders are most common. Up to 140,000 Pintails stage on the NWR and in Izembek Lagoon each fall, and nearly 100,000 Steller's Eiders winter on the lagoon (Kinchloe *et al*. 1988).

Tundra Swans are a common nesting waterfowl on the refuge, which is the only known wild Tundra Swan population in North America that is essentially nonmigratory. Most swans winter in Urilia Bay area on Unimak Island and return to Izembek NWR in mid-March (USFWS 1985).

Shorebirds, including large numbers of Dunlin and Short-billed Dowitchers, also migrate through the Cold Bay area (Kinchloe *et al*. 1988). Shorebirds, waterbirds, passerines, and gulls nest on Izembek NWR. Common nesters include Red-throated Loons, Red-necked Grebes, Tundra Swans, Mallards,

Figure 5.2 Cold Bay LRRS Wildlife Habitat Map, 2005

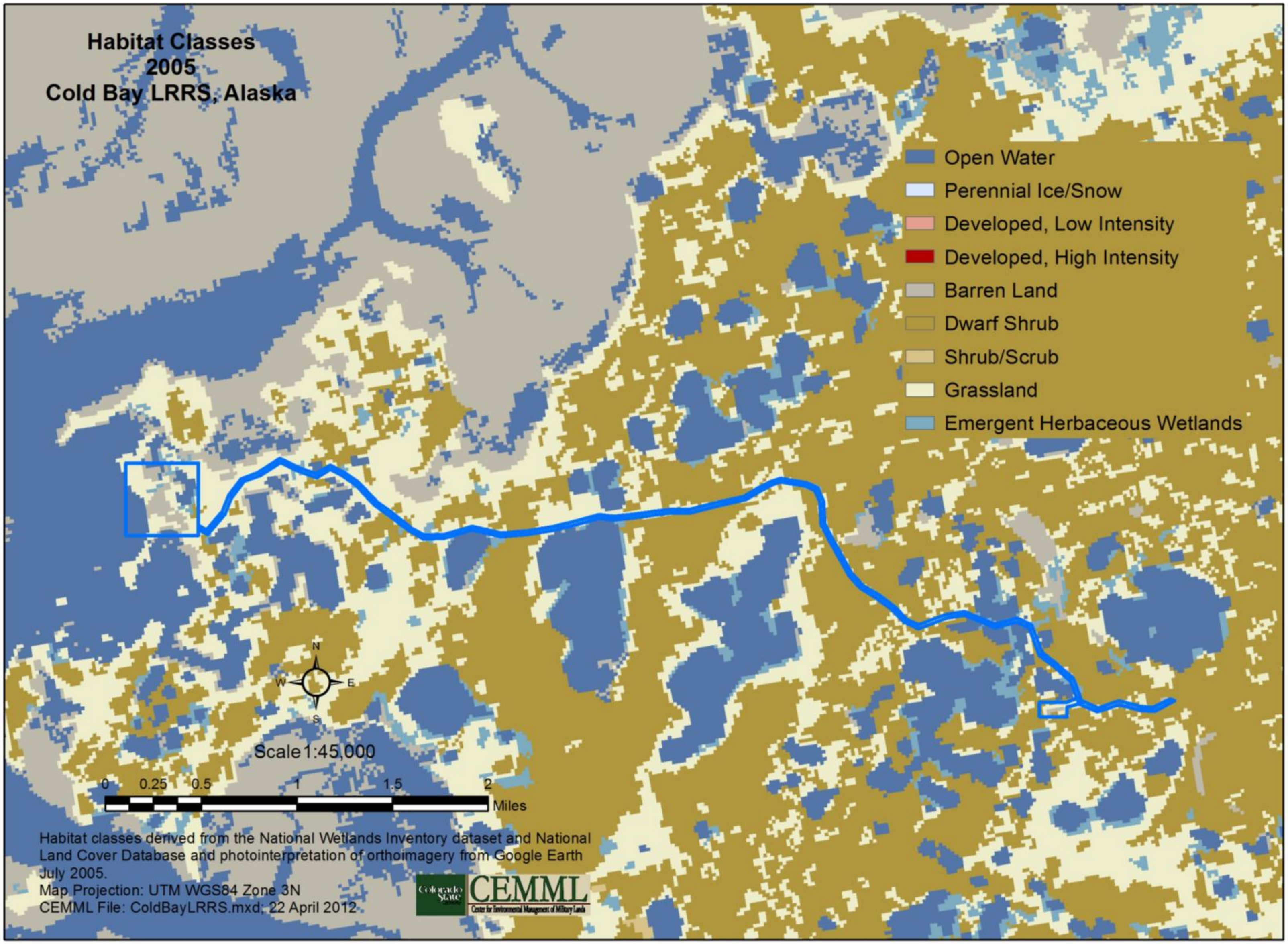


Figure 5.2b Changes in Habitat Classes at Cold Bay LRRS between 2001 and 2005

Greater Scaups, Black Scoters, Willow Ptarmigan, Semi-palmated Plovers, Least Sandpipers, Rock Sandpipers, Mew Gulls, Glaucous-winged Gulls, Arctic Terns, Common Ravens, American Pipits, Yellow Warblers, Savannah Sparrows, and Lapland Longspurs (USFWS 1985, USFWS undated(b)).

Tidal and submerged lands of Izembek Lagoon constitute the Izembek State Game Refuge, a legislatively-designated special area established to protect and preserve natural habitat and game populations (especially waterfowl). The refuge is managed by the ADF&G (Dolezal 1993). Prior to upgrading the existing MAR, the USAF assisted in monitoring waterfowl migrations by tracking bird flocks using radar (personal communication, Dau 1993 in Woodward-Clyde 1995e). There may be future opportunities for cooperation between the USAF and USFWS to monitor wildlife on the site.

Suitable raptor nest sites in the refuge are limited, but several raptors use the refuge, including Rough-legged Hawks, Northern Harriers, Gyrfalcons, Peale's Peregrine Falcons, Short-eared Owls, Snowy Owls, and Bald Eagles. These raptors feed on abundant waterfowl, shorebirds, and fish in the area. The Bald Eagle is a common, year-round resident (USFWS 1985).

5.4 Threatened and Endangered Species

No known threatened or endangered species occur within the boundaries of Cold Bay LRRS. Various threatened or endangered species are present near Cold Bay LRRS, depending on the season. These species include the threatened Steller's Eider and the endangered northern sea otter. Yellow-billed Loons and Kittlitz's Murrelets may be in the area. Formerly listed or former Category 2 species that may also use the area include the Aleutian Cackling Goose, the Bristle-thighed Curlew, and the Harlequin Duck.

5.5 Wetlands

The most common wetland type at Cold Bay LRRS is palustrine, broad-leaved deciduous and evergreen scrub-shrub, which can be mixed with emergent vegetation and/or lichens. These areas are moist dwarf scrub habitats and can be saturated, moderately well-drained, or well-drained, depending primarily on soil type, microtopography, and landscape position. Portions of these areas, when very well-drained, are likely to be jurisdictional uplands. These wetlands and possible uplands occur within the Lowland Dwarf Scrub and Upland Dwarf Scrub wildlife habitat types. Dominant shrub species in these areas include *Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea, Ledum decumbens, Dryas octopetala*, *Arctostaphylos alpina,* and *Salix rotundifolia* (Schick *et al*. 2004).

Wetlands at Cold Bay LRRS are strongly dominated by moist gently sloping areas with far fewer wetter areas of seasonal flooding. On steeper slopes and hilltops, some well-drained rocky areas are likely to be NWI Uplands. Freshwater habitats at the LRRS are classified as palustrine, unconsolidated bottom, permanently flooded (pond) (Schick *et al*. 2004).

Open low-shrub/ericaceous tundra areas are considered wetlands if they occur on active floodplains or poorly drained soils but not if they occur on slopes; these communities include black spruce woodlands, dwarf birch with willows or ericaceous shrubs, ericaceous mats with cushion tundra, and dryas mats with cushion tundra (USFWS 1985).

The general Cold Bay LRRS vegetation map's wetland features (Woodward-Clyde 1995e) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). These sources are used to facilitate decisions regarding facility siting. The 611 ASG's active sites' wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011. However, such data were not available for Cold Bay.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Subsistence and sport hunting and fishing occur in the area. The LRRS lacks wildlife and fish habitat; thus, there are no related issues involved.

Very few people in Cold Bay in 1983 participated in subsistence activities (Impact Assessment, Inc. 1983 in Braund and Associates 2004). However, according to Alaska Department of Community and Economic Development (2003) “subsistence and recreational fishing and hunting are part of the local culture” (Braund and Associates 2004). Cold Bay residents generally hunt caribou and waterfowl in fall and harvest salmon in summer and fall (Impact Assessment, Inc. 1983 in Braund and Associates 2004).

King Cove residents rely heavily on fish and land mammals. Five species, coho, sockeye, and chum salmon; feral cattle; and caribou accounted for about 62 percent of the annual subsistence harvest in terms of edible pounds in 1992. Residents of Cold Bay and King Cove use Izembek NWR for much of their subsistence activity (Braund and Associates 2004).

Residents of False Pass harvest salmon, halibut, geese, caribou, seals, and feral cattle. Residents rely heavily on fish with salmon making the largest contribution (Braund and Associates 2004).

5.6.2 Outdoor Recreation

The most popular recreational activities near the Cold Bay LRRS are hunting, and related support activities. Bear hunting is the most popular non-local hunting activity. Brown bear and caribou hunting are tightly controlled by ADGG. Most caribou hunting is adjacent to the road system. Unlike other areas in Alaska, caribou hunting in the Cold Bay area is most often done from a vehicle and is usually completed in one day (USFWS 1985).

Another form of outdoor recreation in the Cold Bay area is recreational fishing on Izembek NWR. Most fishing is done by local inhabitants, with only about five percent by non-residents. Anglers primarily fish Frosty Creek, which is easily accessible from Cold Bay (USFWS 1985). Over 30,000 activity hours of public use occur annually within the Izembek NWR area. Approximately 25% of the use is waterfowl hunting; 16% is caribou hunting; and 9% is sport fishing. Driving on the existing road system accounts for 22% of activity hours. Ten percent of the public use is foot travel. Cold Bay residents are responsible for the vast majority of the driving and walking.

Anglers primarily use Frosty Creek to catch silver, pink, and chum salmon, as well as Dolly varden. In addition, Grant Point is used for an annual fishing derby (still?) for Arctic char and Dolly varden (personal communication, Chase 1993 in Woodward-Clyde 1995e).

Cold Bay provides excellent wildlife viewing opportunities, particularly during spring and fall migrations of waterfowl. However, because of Cold Bay’s remote location and generally severe weather conditions, wildlife viewing primarily involves local residents.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Land use issues at Cold Bay LRRS are minimal particularly since the area within the perimeter fence is less than two acres and acreage outside of the perimeter fence has been left in its natural condition to contribute to the wildlife habitat of the Alaska Peninsula NWR. Minor gullying of gravel slopes outside of the perimeter fence and some washing of the access road just outside of the gate has been noted in the past. These problems are addressed through routine maintenance activities at the site. The Air Force has a Right-of-Way Permit from the Federal Aviation Administration.

Three are two sites requiring remedial action at Cold Bay: site ST005 (petroleum, oil, and lubricant storage area) and site OT001 (fuel-contaminated groundwater). Groundwater at ST005 continues to exceed Alaska clean-up standards. The current remedy for the site is monitored natural attenuation, which will be ongoing for a number of years. OT001 has met cleanup standards but requires one groundwater monitoring well to be decommissioned. One additional site, LF002, does not require any remedial action but does require five-year reviews to ensure the landfill cap integrity is maintained.

Appendix 3.0 – Yukon. Fort Yukon Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Fort Yukon LRRS

3.1 Location and Area

Fort Yukon LRRS is located on an 84-acre site (Figure 3.1), upstream of the confluence of and between the Porcupine and Yukon rivers, about 140 miles northeast of Fairbanks, Alaska (INRMP Figure 3.1). The site is within the Yukon Flats NWR at an elevation of 435 feet above mean sea level (msl) and is accessible only by air and water. An abandoned WACS site, encompassing 8.99 acres, is just west of the LRRS on a separate tract of land. WACS facilities were demolished in 1999.

3.2 Installation History

Fort Yukon LRRS was established in 1954 as a USAF AC&W site. In 1957 a WACS facility was added to the installation. Operation Bluegrass added a 50-kilowatt forward propagation tropospheric scatter system between Fort Yukon and Barter Island, tying North Coastal facilities into the main WACS system (USAF 1995). In 1980 the WACS was deactivated at Fort Yukon and replaced by a commercial satellite earth terminal.

The staff at Fort Yukon originally consisted of about 100 persons, which was reduced to approximately 30 in 1977. In 1984 a MAR unit was activated, and the site was otherwise deactivated. The area was also used in the 1980s for launching experimental commercial rockets and for studies of the aurora borealis by the University of Alaska Fairbanks. Currently, two persons staff the facility.

3.3 Surrounding Communities

The community of Fort Yukon is about one half-mile west of the LRRS and is connected by road to the installation. The population of Fort Yukon is 583 (2010 estimate) with most Fort Yukon residents being descendents of the Yukon Flats, Chandalar River, Birch Creek, Black River, and Porcupine River Gwich'in Athabascan tribes (www.dced.state.ak.us 2012).

City, state, and federal agencies and the Native corporation are primary employers in Fort Yukon. The School District is the largest employer. The BLM operates an emergency fire fighting base at the airport. Winter tourism has become increasingly popular, Fort Yukon experiences spectacular aurora borealis displays. Trapping and Native handicrafts also provide income. Residents rely on subsistence foods -- salmon, whitefish, moose, bear, caribou, and waterfowl provide most meat sources. In 2009, one resident held a commercial fishing permit (www.dced.state.ak.us 2012).

The elevation in the town of Fort Yukon ranges between 410 and 415 feet above msl. The entire vicinity is situated in a high-risk flood zone. The town is an important transportation, trading, supply, and administrative center for the upper Yukon-Porcupine region.

3.4 Regional Land Use

Archeological evidence suggests that this was part of the route traveled by Siberian hunters from Asia to America over 10,000 years ago. Present Natives of the Yukon Flats are the Gwich'in group of Athabascan Tribes. The first resource to lure Europeans to the Yukon Flats was an abundance of furbearing animals. In 1845 John Bell of the Hudson Bay Company traveled down the Porcupine River to Yukon Flats, where he found a wealth of beavers, otters, muskrats, marten, mink, lynx, weasels, wolverines, foxes, and wolves. Two years later Fort Yukon was established at the confluence of the Porcupine and Yukon rivers. By the 1920s it was the most important fur-collecting point in Alaska.

3.5 Local and Regional Natural Areas

Fort Yukon LRRS lies within Yukon Flats NWR. Yukon Flats NWR is the third largest conservation area in the NWR system at about nine million acres. It includes Yukon Flats, a vast wetland basin bisected by the Yukon River. The basin is underlain by permafrost and includes a complex network of lakes, streams, and rivers. The area is characterized by mixed forests dominated by spruce, birch, and aspen. The refuge supports the highest density of breeding ducks in Alaska and includes one of the greatest waterfowl breeding areas in North America. The same landscape that so favors waterfowl is also beneficial to furbearers, many of which, including beaver, lynx, marten, mink, muskrat, and river otter, thrive on the water-laced flood plain. Moose can be found throughout the refuge and are the region's most important game animal (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

Fort Yukon winters are long and harsh, and summers are short but warm. The Yukon-Tanana Plateau, south of the Yukon Basin, forms a normally effective barrier to the maritime air flow from the North Pacific Ocean. After rivers and marshes freeze, the plateau is a source for cold, continental arctic air. Extended periods of -50°F to -60°F are common. The lowest temperature ever recorded at Fort Yukon was -76°F. Daily minimum temperatures from November through March are usually below 0°F. Summer high temperatures reach 65°F to 72°F, and a high of 97°F has been recorded (www.dced.state.ak.us 2012).

Figure 3.1 Fort Yukon LRRS

Despite high summer temperatures, daily variations can be extreme; freezing temperatures have been recorded in every month of the year. Approximately 90 days each year are frost-free. The last freeze in spring occurs about the end of May; the first fall freeze about the end of August.

There is very little precipitation. Total annual precipitation averages 6.58 inches; about 64 percent of this occurs from June to August. Most rain is in the form of convection showers. Average winter snowfall is about 43 inches. Ground accumulation also averages more than 40 inches.

Prevailing winds come from the northeast during winter and from the west or southwest during summer. Overall mean wind speed is 6.6 knots, which calms 11 percent of the time.

4.2 Landforms

Fort Yukon LRRS is situated within the Yukon Flats physiographic region. Yukon Flats is an area of 13,700 square miles, characterized by meandering channels, oxbow lakes, sloughs, swamps, gently sloping alluvial fans, thaw lakes, sink holes, and sand dunes (Alaska Department of Community and Regional Affairs 1990).

The region consists of a marshy, lake-dotted flatland rising from 300 feet above msl in the west to 600 and 900 feet above msl in the north and east, respectively. The area surrounding Fort Yukon LRRS is characterized by low topographical relief and high stream density (Alaska Department of Community and Regional Affairs 1990). The installation sits on a low terrace overlooking the Yukon River, with an elevation of about 440 feet above msl.

4.3.Geology and Soils

The surficial geology of the Yukon Flats region is dominated by Yukon River alluvial sediments. The region is underlain by more than 300 feet of silt and silty sand deposited when the area was formed. These deposits are overlain by alluvial deposits (clay, silt, sand, and gravel). In some areas sediments are covered by a windblown layer of silty loam, ranging in depth from a few inches to several feet. Fort Yukon LRRS is underlain by permeable alluvium consisting of poor to well-graded sands and gravels, silty sands and gravels, and some interbedded silt.

Permafrost is discontinuous in the Yukon Flats, but in poorly drained areas it may occur to a considerable depth. The maximum depth to the base of permafrost ranges from 18 to 390 feet below grade in the Fort Yukon area. The permafrost table at Fort Yukon LRRS is usually eight or more feet below the surface, and it may be absent close to the river. Riverbank erosion has always been a problem, especially since 1955 when a large amount of gravel was removed from the river for construction of the Air Force site. The increased velocity of the river added to the erosion caused by periodic flooding and permafrost thaw. Along some stretches of the river through Fort Yukon, the bank has been eroded several hundred feet.

The U.S. Army Corps of Engineers constructed a slough-closure dike upstream from the town in 1967. This dike diverted slough flow through the main channel and alleviated the major erosion problem. However, it has caused an undesirable buildup of sediment adjacent the town site, moving the channel outward several hundred feet.

4.4 Hydrology

4.4.1 General

The Yukon Flats region is dotted with lakes, ponds, and swamps and covered by a network of rivers, tributaries, and streams. The Yukon River flows through the flats as an intricately braided stream with many channels. At high water the river overflows from main channels into hundreds of sloughs. The flow rises gradually in the spring to a peak discharge, usually within about two weeks of break-up, which occurs in mid-May. Precipitation is normally low in the spring, and rain does not contribute significantly to the spring peak. Summer rains throughout the basin serve to maintain river flows at near-average rates.

Drainage of the LRRS primarily flows overland to the south to Ylotta Slough, a Yukon River tributary, or northward into adjacent wetlands. Runoff rates are very low due to low precipitation and highly permeable soils.

Thaw lakes and sinks are common. Because of permafrost conditions, there is little groundwater except near streams. Aquifers apparently do not exist, and the yield from wells is low. All water in the area appears to be of the calcium-bicarbonate type categorized as hard water.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. The 100-year flood plain elevation at Fort Yukon is 435.0 feet msl (or 439.0 feet using city datum). Two recorded flood levels have reached that level, in 1889 and 1949. Because the LRRS is situated on a low terrace above the Yukon River, flooding is generally not a problem; however, the Fort Yukon town has experienced floods. Floods resulting from spring runoff are usually aggravated by ice jams. They are characterized by a rapid rise in the water level and last from a few hours to several days. Summer rains have never produced a flood at Fort Yukon. The lowest building elevation on the installation is the sewer treatment plan, with a top of first floor elevation of 437.5 feet msl.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Fort Yukon LRRS. Much information included in INRMP Chapter 5.0 that includes Fort Yukon LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Fort Yukon LRRS and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at Fort Yukon LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 130 Subarctic Division
Province: 139 Upper Yukon Tayga Province
Description: Mostly a flat plain, this province is made up of outwash fans and floodplains. Winters are severely cold, and summers are short and hot. The province is semiarid with an average precipitation of 7 inches; snowfall averages 45 inches per year. In new alluvial areas prone to periodic flooding are alder and willow thickets; in well drained alluvial areas are bottomland spruce-aspen-birch; and in the wettest areas are black spruce, willow, or graminoid marsh cover. In flat and low areas dominant soils are wet Inceptisols. This province may have the most suitable arctic habitat for avian wildlife on the continent.

5.2 Vegetation

Much of the vegetation on Fort Yukon LRRS was initially clear-cut, but the site now supports a variety of vegetation types (Woodward-Clyde 1996b), including taiga, a forest type generally consisting of white spruce and paper birch; shrubland, dominated by willows; and wetlands, occurring in sloughs and low areas. Mixed stands of alder and balsam poplar occur as a minor vegetation type. A wide variety of aquatic vegetation, such as duckweed, pondweed, sedge, and horsetail, occur in numerous lakes, ponds, and other surface water bodies around the LRRS. Dominant tree species include stunted spruce, poplar, and birch. Other common species include polar grass, horsetail, fireweed, yarrow, wild rose, bedstraw, ragweed, marsh fleabane, fescue, dandelion, dogwood, willow, goldenrod, Alaska spring beauty, and stickweed.

A general vegetation map of Fort Yukon LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995f). Schick *et al*. (2004) made significant improvements in vegetation mapping at Fort Yukon LRRS (using 2001 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Fort Yukon LRRS in 2001 and 2011. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth and, if available, 2009-2010 SPOT-5 satellite imagery (http://www.alaskamapped. org/ortho). Table 5.2 shows these acreages and changes over this 10-year period. Figure 5.2a shows habitat classes for 2011, and Figure 5.2b shows changes in habitat classes between 2001through 2011.

Table 5.2 Habitat Class Differences between 2001 and 2011, Fort Yukon LRRS

Habitat Class	**Acres 2001**	**Acres 2011**	**Acreage Change**
Barren Land	0.00	4.50	4.50
Deciduous Forest	23.66	23.12	-0.55
Developed, Low Intensity	26.71	31.36	4.65
Developed, Medium Intensity	7.11	7.11	0.00
Emergent Herbaceous Wetlands	17.26	8.97	-8.29
Evergreen Forest	0.44	0.44	0.00
Mixed Forest	4.17	4.10	-0.07
Shrub/Scrub	1.64	1.64	0.00
Woody Wetlands	3.43	3.19	-0.24
Totals	**84.42**	**84.42**	**0.00**

Schick *et al*. (2004) described the Fort Yukon LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

The Fort Yukon LRRS area encompasses 84 acres along the Yukon River on an old river terrace. The LRRS is well-drained to moderately well-drained and is predominantly flat terrain consisting entirely of riverine and lowland physiography. There are few wet or moist tundra habitats, but these do occur primarily in old river channels and are used primarily by ground-nesting passerines, and possibly some shorebirds (*e.g*., Wilson’s Snipe and Lesser Yellowlegs). Cleared Lowland Moist Graminoid-Herb Tundra habitats west of LRRS facilities are used by brood-rearing Sharp-tailed Grouse and foraging American Kestrels.

Mixed forest types, however, provide the most abundant habitat for a variety of passerines and small raptors, many of which were observed using these habitats during the July 2004 site visit. Tall open shrub types also provide quality habitat for many passerine species observed. Several small mammals were observed at Fort Yukon, including red squirrels and snowshoe hares that use needleleaf and mixed forests,

Figure 5.2 Fort Yukon LRRS Wildlife Habitat Map, 2011

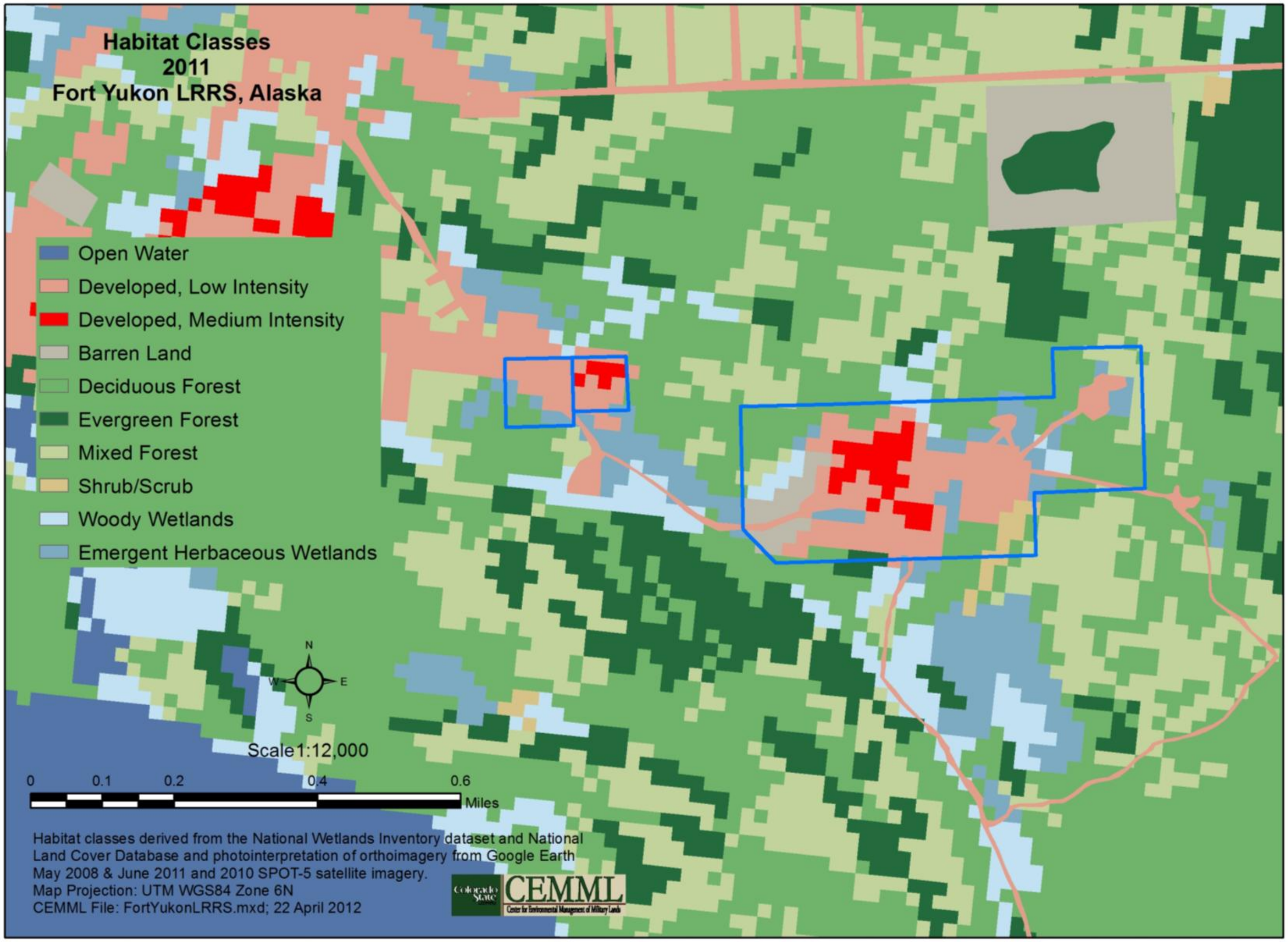


Figure 5.2b Changes in Habitat Classes at Fort Yukon LRRS between 2001 and 2011

and Arctic ground squirrels and the Western meadow jumping mouse that use lowland graminoid-herb habitats.

5.3 Fish and Wildlife

5.3.1 Fish
The Yukon River is extremely productive in terms of quantity and diversity of fish species. Common species include king, coho, and chum salmon; whitefish; northern pike; burbot; Arctic grayling; and sheefish. The Yukon River and its tributaries are important spawning, rearing, and migration habitat for many of these species (ADFG 1990b).

5.3.2 Mammals
Forty mammal species are known to occur in the Yukon Flats NWR. Black and brown/grizzly bears occur throughout the NWR and surrounding hills. Black bears are numerous throughout forested lowlands, while brown/grizzly bears become more abundant in surrounding alpine areas (USFWS 1982b).

Three of Alaska's caribou herds use parts of the NWR. Caribou seen in the White Mountains belong to the White Mountains Herd. According to ADFG Survey-Inventory Activities, the Forty-Mile Caribou Herd generally ranges from the Steese Highway east to western Yukon Territory. Caribou from the Porcupine Herd are occasionally seen in the northeastern section of the NWR. Furbearers, such as the wolf, fox, beaver, otter, muskrat, marten, mink, lynx, weasel, and wolverine, are also found on the NWR (USFWS 1982b).

Moose are found throughout the Yukon Flats NWR. In winter they are most common in areas of willow, birch, and aspen. In summer they are commonly along numerous ponds and marshes. Being the most important game animal, many villagers consider moose synonymous with "meat." They are hunted along the NWR's boatable streams, sloughs, and lakes (USFWS 1982b). Red squirrels, snowshoe hares, Arctic ground squirrels, and western meadow jumping mice were observed during the ABR Inc. 2004 site visit.

5.3.3 Birds
Yukon Flats NWR provides nesting, breeding, and migratory stopover habitat for approximately 150 species of birds, most notably waterfowl (USFWS 1982b). Yukon Flats is one of the largest waterfowl breeding areas in North America. Before the river ice moves out in May, millions of migrating birds from four continents converge on Yukon Flats.

The USFWS has annually conducted a census of breeding populations of waterfowl in the Yukon Flats NWR since 1953 (USFWS 1982b). Predominant species are the Scaup, Pintail, Scoter, and Wigeon. Other species occurring in important numbers are the Mallard, Shoveler, Green-winged Teal, and Canvasback. The fertile lakes of the refuge are of special significance for the Canvasback, since the 50,000 birds which nest in the area represent 10-15 percent of its diminished population. An estimated 8,000 Canada Geese and 5,000 White-fronted Geese use the area for nesting. The rare Trumpeter Swan can occasionally be found. The Arctic, Red-throated, and Common Loon; Grebe; and Sandhill Crane are common to lakes and ponds of this NWR. By September more than two million adult and young waterfowl from Yukon Flats NWR are ready to begin their southward journey. Large lakes serve as staging areas where thousands of birds concentrate before leaving.

In addition to waterfowl, more than 100 other bird species have been identified on the NWR, including the formerly endangered American Peregrine Falcon (USFWS 1982b). Most are migratory, but 13 species (including hawks, owls, grouse, woodpeckers, Gray Jay, and Raven) remain to endure the severe winter.

Twenty-five bird species were observed at Fort Yukon LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included such species as Bald Eagle; American Kestrel; Merlin; Wilson's Snipe; Olive-sided and Alder Flycatchers; Orange-crowned and Yellow Warblers; and White-winged Crossbills. Nesting was confirmed for Sharp-tailed Grouse at the LRRS.

5.4 Threatened and Endangered Species

No threatened, endangered, or sensitive species have been reported within the boundaries of Fort Yukon LRRS. However, the delisted American Peregrine Falcon (USFWS 2004b) is known to nest along major tributaries within Yukon Flats NWR.

5.5 Wetlands

Wetlands at Fort Yukon LRRS are strongly dominated by flat, well-drained ancient river levee deposits with few areas of wet seasonal flooding, and very few areas of persistent standing water. The most common wetland type at Fort Yukon LRRS is palustrine; forested, broad-leaved deciduous and needle-leaved evergreen; saturated. Other common wetlands include saturated broad-leaved deciduous scrub-shrub that is saturated or seasonally flooded. Dominant plant species in these areas include *Populus tremuloides* and *Picea glauca* with understory or dominant shrub stand species, such as *Shepherdia canadensis*, *Salix brachycarpa, S.bebbiana, S. arbusculoides, S. glauca, Arctostaphylos uva-ursi,* and *Festuca saximontana*. Little freshwater habitat at Fort Yukon LRRS is classified as palustrine, unconsolidated bottom, permanently flooded pond or palustrine, persistent emergent vegetation; saturated or seasonally flooded/saturated (Schick *et al*. 2004).

The general Fort Yukon LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Fort Yukon LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (17.85 acres). Figure 5.5 shows wetlands on Fort Yukon LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

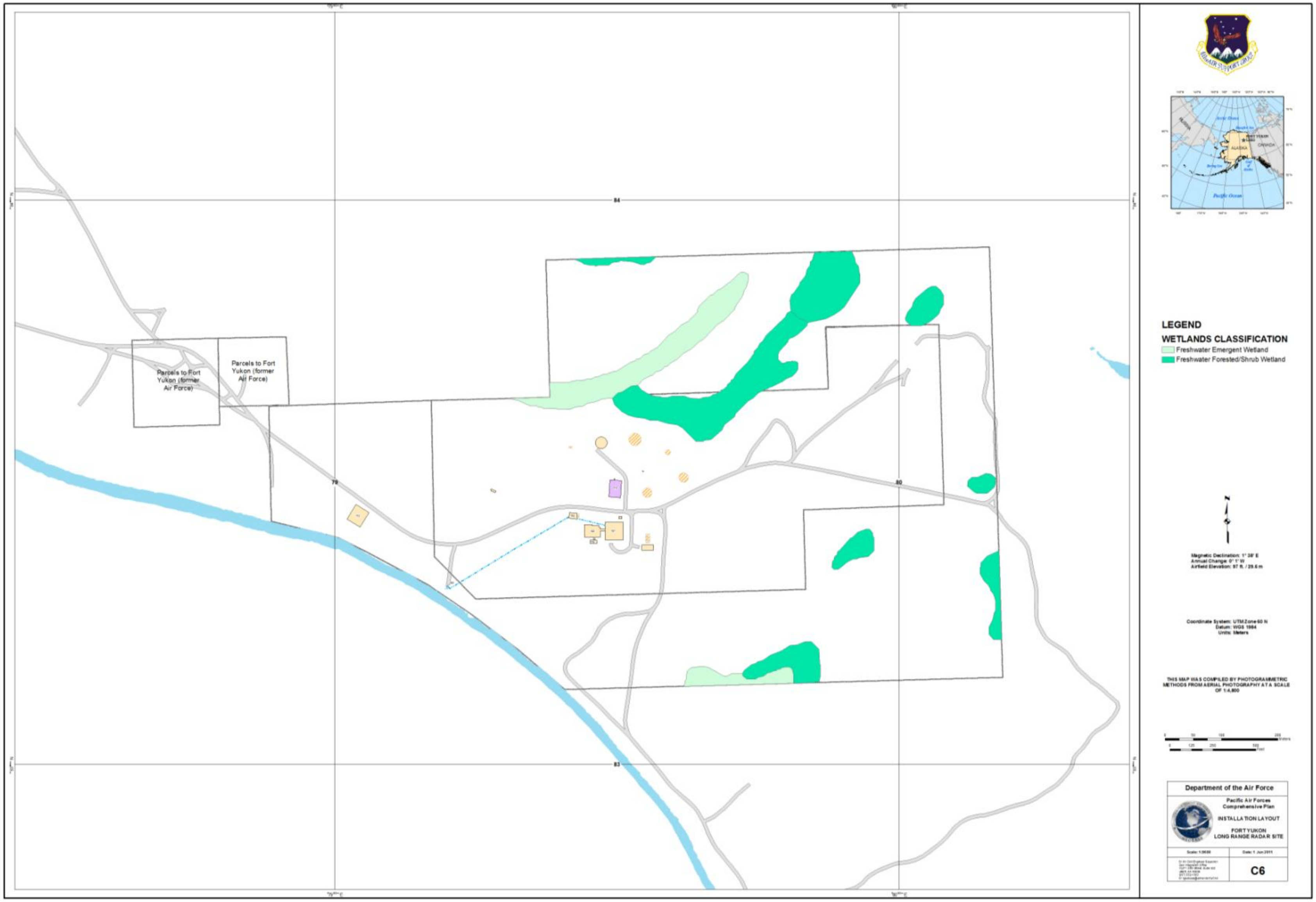
Subsistence gathering is an important component of the local culture. Fort Yukon residents display a high degree of involvement in the harvest, use, and sharing of fish and wildlife resources. Residents rely on such subsistence foods as salmon, whitefish, moose, bear, caribou, and waterfowl. Chum salmon, chinook salmon, and moose accounted for about 78 percent of the annual subsistence harvest in terms of edible pounds in 1987. Chum salmon compose a larger portion of the overall harvest at Fort Yukon than any other single species (Braund and Associates 2004).

Some activities, such as salmon fishing, generally occur within 10-20 miles of Fort Yukon. However, the overall community use area encompasses a 150-mile stretch of the Yukon River and tributary streams between the communities of Beaver and Circle, as well as the Alaska portion of the Porcupine River drainage and its tributaries (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Demands for natural resources near the LRRS include hunting, fishing, and other outdoor recreational activities. The LRRS is about a half-mile east of the village of Fort Yukon, has unfenced boundaries, and is open to local residents. Thus, the LRRS provides the local community with easy access to recreational and/or subsistence opportunities. Land surrounding the LRRS is owned by the USFWS as part of the

Figure 5.5 Fort Yukon LRRS Wetlands, 2011



Yukon Flats NWR, established in 1950. Water sports, such as canoeing, kayaking, and river-rafting are also popular.

Though subsistence and sport hunting occurs in the area, hunting at the LRRS is not an issue. BOS contract personnel stationed at Fort Yukon, temporary duty personnel during free time, and subsistence hunters from the neighboring area hunt the area, but little or no demand exists by DoD personnel to travel to the site for recreational purposes.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Real property facilities include buildings, roads, grounds, antenna structures, and POL tanks. All abandoned fuel tanks, antennas, and buildings (except the old gymnasium) were demolished in 1999. In recent years the LRRS boundary has been resized smaller, two buildings were given to the local community, and a new support agreement with the NASA/UAF Geophysical Institute, who have a building on the LRRS was instituted.

Management issues related to land use identified by Woodward-Clyde (1995d) included revegetation of disturbed sites including demolition sites, preservation of wetlands, effects of ATV use, and vandalism of facilities.

APPENDIX A: Natural Resources of Fort Yukon, Indian Mountain, Murphy Dome, Sparrevohn, and Tatalina Long Range Radar Sites

Table A1: Vascular Plant Species Known to or Potentially Occurring on Fort Yukon, Indian Mountain, Murphy Dome, Sparrevohn, and Tatalina Long Range Radar Sites

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Shrubs								
Sitka alder	*Alnus sinuata*	X	X	X	X	X	TLI, SVW	6, 7
Thinleaf alder	*Alnus tenuifolia*	X	X		X	X	ALL	2, 6, 7
Green alder	*Alnus crispa*	X	X	X	X	X	UTU, MDM, TLI, SVW	7
Saskatoon serviceberry	*Amelanchier alnifolia*	X	X					2
Bog-rosemary	*Andromeda polifolia*	X	X	X	X	X	UTU, TLI, SVW	2, 6, 7
Red-fruit bearberry	*Arctostaphylos rubra*	X	X	X			FYU, TLI	2, 7
Bearberry (kinninnik)	*Arctostaphylos uva-ursi*	X	X	X			FYU	2, 7
Alpine bearberry	*Arctostaphylos alpina*	X	X	X	X	X	FYU, MDM, SVW	2, 4, 6, 7
Alaska sagebrush	*Artemisia alaskana*	X	X	X	X	X	MDM, UTU, SVW	2, 7
Fringed sagebrush	*Artemisia frigida*	X	X			X	FYU	2, 7
Shrub (resin) birch	*Betula glandulosa*	X	X			X	ALL	2, 6, 7
Kenai birch	*Betula kenaica*						UTU	7
Dwarf Arctic birch	*Betula nana*	X	X	X	X	X	UTU, MDM, TLI, SVW	2, 5, 6, 7
Alaska paper birch	*Betula papyrifera var. humilis*	X	X	X	X	X	ALL	2, 5, 6, 7
Hybrid birch	*Betula* hybrids					X	SVW	6
Alaska moss heather	*Cassiope stelleriana*					X	SVW	6, 7
Four-angled cassiope	*Cassiope tetragona*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 2, 3, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Leatherleaf	*Chamaedaphne calyculata*	X	X	X	X	X	UTU, TLI	2, 5, 7
Marsh five-finger	*Comarum palustre*					X	SVW	6
Bunchberry	*Cornus canadensis*	X	X	X	X	X	ALL	1, 2, 3, 7
Red-osier dogwood	*Cornus stolonifera*	X	X	X	X		FYU, UTU	2, 4, 5, 7
Dwarf dogwood	*Cornus suecica*					X	MDM, TLI, SVW	6, 7
Diapensia	*Diapensia lapponica*	X	X	X	X	X	MDM, UTU, TLI, SVW	2, 3, 7
White mountain-avens	*Dryas integrifolia*					X	FYU, SVW	6, 7
Eight-petal mountain-avens	*Dryas octopetala*					X	MDM, UTU, TLI, SVW	6, 7
Silverberry	*Elaeagnus commutata*	X	X		X			2
Crowberry	*Empetrum nigrum*	X	X	X	X	X	ALL	2, 6, 7
Large-leaf avens	*Geum macrophyllum*					X	FYU, TLI, SVW	6, 7
Ross' avens	*Geum rossii*						UTU	7
Common juniper	*Juniperus communis*	X	X	X			UTU	2, 5
American larch	*Larix laricina*		X	X	X	X	TLI	2, 7
Narrowleaf labrador tea	*Ledum decumbens*	X	X	X	X	X	ALL	2, 5, 6, 7
Labrador tea	*Ledum groenlandicum*	X	X	X	X		FYU, MDM, UTU, TLI	2, 7
Twin-flower	*Linnaea borealis*	X	X	X	X	X	ALL	2, 6, 7
Alpine-azalea	*Loiseleuria procumbens*	X	X	X	X	X	ALL	2, 6, 7
Partridge foot	*Luetkea pectinata*					X	SVW	2, 3, 6, 7
Sweet gale	*Myrica gale*	X	X	X	X	X		2

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Tundra rose	*Pentaphylloides floribunda*					X	SVW	6
Aleutian mountain heath	*Phyllodoce aleutica*					X		2
White spruce	*Picea glauca*	X	X	X	X	X	ALL	2, 5, 7
Black spruce	*Picea mariana*	X	X	X	X		ALL	2, 5, 7
Balsam poplar	*Populus balsamifera*	X	X	X	X	X	ALL	2, 5, 6, 7
Quaking aspen	*Populus tremuloides*	X	X	X	X		ALL	2, 5, 6, 7
Shrubby cinquefoil	*Potentilla fruiticosa*	X	X	X	X	X	FYU, UTU, SVW	2, 3, 7
Potentilla	*Potentilla hyparctica*				X	X	TLI, SVW	1, 6
Potentilla	*Potentilla norvegia*					X	FYU, MDM, TLI, SVW	6, 7
Potentilla	*Potentilla uniflora*					X	SVW	6, 7
Potentilla	*Potentilla villosa*						UTU, TLI	7
Lapland rosebay	*Rhododendron lapponicum*	X	X					2, 3
Skunk currant	*Ribes glandulosum*		X		X	X	SVW	2, 6
Northern black currant	*Ribes hudsonianum*	X	X	X	X	X	FYU, TLI	2, 7
Swamp gooseberry	*Ribes lacustre*	X	X					2
Trailing black currant	*Ribes laxiflorum*						SVW	7
Northern red currant	*Ribes triste*	X	X	X	X	X	UTU, TLI, SVW	2, 6, 7
Currant	*Ribes* spp.	X	X	X	X	X		1, 4
Prickly wild rose	*Rosa acicularis*	X	X	X	X	X	ALL	2, 3, 6, 7
Nagoonberry	*Rubus arcticus*	X	X	X	X	X	UTU, TLI, SVW	2, 5, 6, 7
Cloudberry	*Rubus chamaemorus*	X	X	X	X	X	MDM, UTU, TLI,	2, 4, 5, 6, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
							SVW	
American red raspberry	*Rubus idaeus* var. *strigosus*	X	X	X	X	X	MDM, UTU, TLI	2, 5, 7
Trailing raspberry	*Rubus pedatus*					X	SVW	6
Feltleaf willow	*Salix alaxensis*	X	X	X	X	X	ALL	2, 4, 6, 7
Littletree willow	*Salix arbusculoides*	X	X	X	X	X	FYU, MDM, TLI, SVW	2, 6, 7
Dwarf Arctic willow	*Salix arctica*		X		X	X	MDM, UTU, TLI, SVW	2, 4, 6, 7
Barclay willow	*Salix barclayi*				X	X	TLI, SVW	2, 4, 6, 7
Barratt willow	*Salix barrattiana*				X	X		2
Bebb's willow	*Salix bebbiana*	X	X	X	X	X	ALL	2, 6, 7
Silver willow	*Salix candida*	X	X					2
Chamisso's willow	*Salix chamissonis*						UTU	7
Undergreen willow	*Salix commutata*			X		X	UTU	1
Long-beaked willow	*Salix depressa*			X			UTU	1, 5
Alaska bog willow	*Salix fuscescens*	X	X	X	X	X	SVW	2, 6
Grayleaf (northern) willow	*Salix glauca*	X	X	X	X	X	FYU, MDM, UTU, TLI	2, 7
Halberd willow	*Salix hastata*	X	X	X	X	X		2
Sandbar willow	*Salix interior*	X	X				FYU	2, 7
Pacific willow	*Salix lasiandra*	X	X	X	X	X		2
Park willow	*Salix monticola*	X	X					2
Barren-ground willow	*Salix niphoclada = S. brachycarpa*	X	X		X	X	FYU	2, 4, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
	ssp. *niphoclada*							
Oval-leafed willow	*Salix ovalifolia*	X	X					2
Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X	X	X	X	X	MDM, UTU, TLI, SVW	2, 6, 7
Diamondleaf willow	*Salix pulchra = S. planifolia* ssp. *pulchra*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 2, 4, 5, 6, 7
Polar willow	*Salix polaris*				X	X	UTU, SVW	2, 6, 7
Tall blueberry willow	*Salix pseudomyrsinites = S. novae-angliae*	X	X			X	FYU, SVW	2, 6, 7
Netleaf (net-veined) willow	*Salix reticulata*	X	X	X	X	X	MDM, UTU, TLI, SVW	2, 3, 6, 7
Richardson willow	*Salix richardsonii = S. lanata ssp. richardsonii*	X	X	X	X	X	SVW	2, 7
Least dwarf willow	*Salix rotundifolia*		X			X	MDM, UTU, TLI, SVW	2, 6, 7
Scouler willow	*Salix scouleriana*		X		X	X	MDM, TLI	2, 7
Setchell willow	*Salix setchelliana*				X			2
Buffaloberry (soapberry)	*Shepherdia canadensis*	X	X	X	X	X	FYU, SVW	2, 6, 7
	Sibbaldia procumbens					X	SVW	6
Green mountain ash	*Sorbus scopulina*				X	X	TLI, SVW	2, 6, 7
Beauverd spirea	*Spiraea stevenii = S. beauverdiana*	X	X	X	X	X	MDM, UTU, TLI, SVW	2, 5, 6, 7
Trisetum	*Trisetum sibiricum*				X		TLI	1
Trisetum	*Trisetum spicatum*				X		UTU, TLI, SVW	1, 7
Bog cranberry	*Vaccinium oxycoccus = Oxycoccus*	X	X	X	X	X	MDM, UTU, TLI	2, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
	microcarpus							
Alpine (bog) blueberry	*Vaccinium uliginosum*	X	X	X	X	X	ALL	2, 6, 7
Lowbush (mountain) cranberry	*Vaccinium vitis-idaea*	X	X	X	X	X	ALL	2, 5, 6, 7
Highbush cranberry	*Viburnum edule*	X	X	X	X	X	UTU, TLI, SVW	2, 5, 6, 7
Herbaceous Plants								
Yarrow	*Achillea borealis*		X	X			FYU, MDM, TLI	1, 3, 7
Yarrow	*Achillea lanulosa*	X					FYU	1
Siberian yarrow	*Achillea sibrica*	X	X	X	X		ALL	1, 4, 7
Monkshood	*Aconitium delphinifolium*	X	X	X	X	X	ALL	1, 3, 6, 7
Baneberry	*Actaea rubra*		X		X	X		1, 4
Musk root (moschatel)	*Adoxa moschatellina*	X	X	X		X	SVW	1, 4, 6
Bent grass	*Agrostis scabra*	X				X	MDM, UTU, TLI, SVW	1, 7
Wild chives	*Allium schoenoprasum*	X	X	X				1, 3
Meadow foxtail	*Alopecurus aequalis*						MDM	7
Alpine Foxtail	*Alopecurus alpinus*						FYU	7
Foxtail	*Alopecurus geniculatus*				X		TLI	1
Round leaf orchis	*Amerorchis rotundifolia*	X	X	X	X			1, 3
Rock jasmine	*Androsace chamaejasme*					X	SVW	1, 3, 6
Northern jasmine	*Androsace septentrinalis*	X	X		X	X		1, 4
Pasque flower	*Anemone drummondii*	X	X	X				1, 4

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Cut leaf anemone	*Anemone multifida*	X	X					1, 3
Narcissus-flowered anemone	*Anemone narcissiflora*	X	X	X	X	X	ALL	1, 3, 6, 7
Northern anemone	*Anemone parviflora*	X	X	X	X	X		1, 3, 5
Yellow anemone	*Anemone richardsonii*	X	X	X	X	X	TLI, SVW	1, 3, 6, 7
Wild celery	*Angelica lucida*		X		X	X		1, 4
Pink pussytoes	*Antennaria alborosea*	X	X					1, 4
Frie's pussytoes	*Antennaria friesiana*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 4, 6, 7
Cats paws	*Antennaria monocephala*					X	UTU, SVW	1, 4, 6, 7
Tall pussytoes	*Antennaria pulcherrima*		X	X				1, 4
Rosy pussytoes	*Antennaria rosea*						UTU	7
Mayweed	*Anthemis cotula*		X					1, 4
Small-flowered columbine	*Aquilega brevistyla*	X	X					1, 4
Hairy rockcress	*Arabis divaricarpa*		X	X				1, 4
Holboell's rockcress	*Arabis holboelli*		X					1, 4
	Arabis kamchatica					X	SVW	6
Lyre-leaf rockcress	*Arabis lyrata, Arabis hirsuta*		X					1, 4
Polar grass	*Arctagrostis latifolia*					X	MDM, UTU, TLI, SVW	6, 7
Pendent grass	*Arctophila fulva*	X	X	X	X	X	TLI, SVW	1, 4, 6, 7
Tall sandwort	*Arenaria cappilaris*	X	X					1, 4
Alpine arnica	*Arnica alpina*	X	X	X	X	X	TLI, SVW	1, 3, 4

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Tall arnica	*Arnica attenuata*	X	X	X				1, 4
Frigid arnica	*Arnica frigida*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 3, 6, 7
Lessing's arnica	*Arnica lessingii*	X	X	X	X	X	UTU, TLI, SVW	1, 4, 7
Arnica	*Arnica* spp.			X			UTU	1, 5
Arctic wormwood	*Artemisia arctica*				X	X	MDM, UTU, TLI, SVW	1, 6, 7
Arctic wormwood	*Artemisa comata*	X	X	X	X	X		1, 4
Northern wormwood	*Artemisa borealis*	X	X	X	X	X		1, 4
Canada wormwood	*Artemisa canadensis*	X	X					1, 4
Purple wormwood	*Artemisa globularia*				X	X	SVW	1, 3, 6
	Artemisia glomerata					X	SVW	6, 7
Common wormwood	*Artemisa tilesii*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 4, 6, 7
Goatsbeard	*Aruncus sylvester*					X		1, 3
Rush aster	*Aster junciformis*		X				FYU	1, 4, 7
Siberian aster	*Aster sibiricus*	X	X	X	X	X	FYU, SVW	1, 3, 6, 7
Northern aster	*Aster subspicatus*							1, 4
Alpine milkvetch	*Astragalus alpinus*	X	X	X	X	X	MDM	1, 3, 4, 7
American milkvetch	*Astragalus americanus*		X					1, 3, 4
Hairy Alpine (Arctic) milkvetch	*Astragalus umbellatus*		X		X	X	SVW	1, 3, 6
Lady fern	*Athyrium filix-femina*				X	X	TLI, SVW	1, 4, 6, 7
Wintercress	*Barbarea orthoceras*		X			X	SVW	1, 4, 6

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Beckmania	*Beckmannia erucaeformis*	X	X	X	X	X	ALL	1, 4, 7
Alpine meadow bistort	*Polygonum viviparum*	X	X	X	X	X	SVW	1, 4, 6
Broomrape	*Boschniakia rossica*	X	X	X	X	X	SVW	1, 3, 6, 7
Moonwort	*Botrychium boreale*	X	X	X		X		1, 4
Moonwort	*Botrychium lunaria*	X	X	X	X	X		1, 4
Alaska boykinia	*Boykinia richardsonii*	X	X	X	X			1, 3
Fringed brome	*Bromus ciliatus*						FYU	7
Canola	*Brassica* spp.	X						1, 4
Thoroughwax	*Bupleurum triradiatum*					X	TLI, SVW	6, 7
Bluejoint grass	*Calamagrostis canadensis*	X	X	X	X	X	ALL	1, 4, 6, 7
Slim-stem reed grass	*Calamagrostis inexpansa*						FYU	7
Lapland reed grass	*Calamagrostis lapponica*					X	MDM, SVW	6, 7
Reed bent grass	*Calamagrostis* spp.	X	X	X	X	X	ALL	1, 4
Wild calla lily	*Calla palustris*	X	X	X	X	X		1, 3
Marsh marigold	*Caltha palustris*	X	X	X	X	X		1, 3
Fairy slipper	*Calypso bulbosa*			X				1, 3
Bellflower	*Campanula aurita*	X	X					1, 4
Mountain harbell (bluebell)	*Campanula lasiocarpa*	X	X	X	X	X	ALL	1, 3, 6, 7
Bluebells of Scotland	*Campanula rotundifolia*		X					1, 3
One-flowered harebell	*Campanula uniflora*					X	SVW	6
Alpine bittercress	*Cardamine bellidifolia*					X	SVW	6

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Cuckoo flower	*Cardamine pratensis*	X	X	X	X	X	SVW	1, 4, 6
Bittercress	*Cardamine purpurea*	X	X	X	X	X	ALL	1, 3
Bittercress	*Cardamine umbellata*					X	SVW	6
Water sedge	*Carex aquatilis*	X	X	X	X	X	FYU, UTU, SVW	1, 4, 6, 7
Sedge	*Carex atheroides*	X	X	X				1, 4
Sedge	*Carex atrofusca*						FYU	7
Sedge	*Carex bigelowii*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 4, 6, 7
Sedge	*Carex brunnescens*					X	SVW	6
Sedge	*Carex canescens*					X	SVW	6
Sedge	*Carex capillaris*					X	SVW	6
Sedge	*Carex lachenalii*					X	SVW	6
Sedge	*Carex loliacea*					X	SVW	6
Sedge	*Carex macrochaeta*						SVW	7
Sedge	*Carex media*					X	SVW	6
Sedge	*Carex membranacea*						UTU	7
Sedge	*Carex microchaeta*						TLI	7
Sedge	*Carex podocarpa*					X	SVW	6
Sedge	*Carex scirpoidea*					X	SVW	6
Sedge	*Carex spectabilis*						SVW	7
Sedge	*Carex utriculata*						FYU, TLI	7
Sedge	*Carex* spp.	X	X	X	X	X	ALL	1, 5, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Elegant paintbrush	*Castilleja elganus*	X	X		X	X	UTU, TLI, SVW	1, 3, 6, 7
Paintbrush	*Castilleja raupii*				X		TLI	1
Paintbrush	*Castilleja* spp.	X	X	X	X	X	FYU, SVW	1, 3, 7
Beringian (Bering Sea, mouse-ear) chickweed	*Cerastium beeringianum*	X	X	X	X	X	UTU, TLI, SVW	1, 4, 6, 7
Tall fireweed	*Chamerion angustifolium = Epilobium angustifolium*	X	X	X	X	X	ALL	1, 3, 4, 5, 6, 7
River beauty (dwarf fireweed)	*Chamerion latifolium = Epilobium latifolium*	X	X	X	X	X	UTU, TLI, SVW	1, 3, 6, 7
Pigweed	*Chenopodium album*						FYU, UTU	7
Strawberry blight	*Chenopodium capitatum*	X	X	X	X	X	FYU, TLI, SVW	1, 3, 7
Chrysanthemum	*Chrysanthemum intregrifolium*	X	X					1, 3
Northern water carpet	*Chrysosplenium tetrandrum*					X	SVW	6
Wright’s golden-saxifrage	*Chrysosplenium wrightii*						TLI, SVW	7
Mackenzie water hemlock	*Cicuta virosa*	X	X	X	X	X	FYU	1, 3, 7
Alaska spring beauty	*Claytonia sarmentosa*		X	X	X	X	TLI, SVW	1, 3, 6
Jakutsk snow-parsley	*Cnidium cnidiifolium*						FYU	7
Coral root	*Corallorrhiza trifida*	X	X	X	X	X		1, 3
Golden corydalis	*Corydalis aurea*		X		X	X	TLI, SVW	1, 3
Few-flowered corydalis	*Corydalis pauciflora*					X	SVW	6
Cushion hawk’s beard	*Crepis nana*	X	X		X			1, 3, 4
Parsley fern	*Cryptogramma sitchensis*					X	SVW	6
Pink (orchid) lady slipper	*Cypripedium guttatum*		X		X	X	SVW	1, 3, 6

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Northern lady's slipper	*Cypripedium passerinum*	X	X	X	X		FYU	1, 3, 7
Fragile fern	*Cystopteris fragilis*					X	SVW	6
Arctic larkspur	*Delphinium glaucum*	X	X	X	X	X	UTU	1, 3, 5
Diapensia	*Diapensia lapponica*					X	SVW	6
Frigid shooting star	*Dodecatheon frigidum*	X	X	X	X	X		1, 3
Douglasia	*Dougladia gormanii*		X					1, 3
Northern rockcress	*Draba borealis*					X	SVW	6
Smoothing Whitlow-grass	*Draba hirta*	X	X	X				1, 3
	Draba lonchocarpa					X	SVW	6
	Draba nivalis					X	SVW	6
	Draba stenopetala					X	SVW	6
	Draba spp.						SVW	7
Long-leaved sundew	*Drosera angelica*		X		X	X		1, 3
American dragonhead	*Dracocephalum parviflora*						FYU	7
Yellow dryas	*Dryas drummondii*	X	X		X			1, 3
Arctic (mountain) avens	*Dryas integrifolia*	X	X	X	X	X	UTU, SVW	1, 3, 5
Eight-petaled dryas	*Dryas octopetala*		X		X	X		1, 3
Spreading wood fern	*Dryopteris expansa = D. dilitata*					X	TLI, SVW	6, 7
Fragrant wood fern	*Dryopteris fragrans*						MDM, TLI	7
Slender Wheatgrass	*Elymus trachycaulus* ssp. *trachycaulus*						FYU, SVW	7
Slender Wheatgrass	*Elymus trachycaulus* ssp.						FYU	7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
	subsecundus							
Hornemann's willowherb	*Epilobium hornemannii*					X	TLI, SVW	6, 7
Marsh willowherb	*Epilobium palustre*						FYU, TLI	7
Field horsetail	*Equisetum arvense*					X	ALL	6, 7
Swamp horsetail	*Equisetum fluviatile*					X	FYU, TLI, SVW	6, 7
Meadow horsetail	*Equisetum pratense*						UTU, TLI	7
Dwarf scouring-rush	*Equisetum scirpoides*						FYU	7
Woodland horsetail	*Equisetum sylvaticum*					X	UTU, TLI, SVW	6, 7
Variegated scouring-rush	*Equisetum variegatum*						TLI	7
Horsetail	*Equisetum* spp.	X	X	X	X	X	ALL	1, 5
Erigeron	*Erigeron acris*					X	MDM, UTU, TLI, SVW	1, 7
Alaskan fleabane	*Erigeron caespitosus*	X	X					1, 3
Cutleaf fleabane	*Erigeron compositus*	X	X					1, 3
Fringed fleabane	*Erigeron glabellus*	X	X	X			FYU	1, 3, 7
Fleabane	*Erigeron humilis*	X	X					1, 3
Arctic fleabane	*Erigeron hyperboreus*	X	X	X				1, 3
Tall cottongrass	*Eriophorum angustifolium*					X	ALL	6, 7
Russett-bristle cottongrass	*Eriophorum russeolum*						MDM, UTU, SVW	7
White (Arctic) cottongrass	*Eriophorum scheuchzeri*	X	X	X	X	X	ALL	1, 3, 5, 6, 7
Tussock cottongrass	*Eriophorum vaginatum*					X	MDM, UTU, SVW	6, 7
Worm-seed wallflower	*Erysimum cheiranthoides*						FYU	7

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Arctic forget-me-not	*Eritichum aretioides*	X	X	X	X			1, 3
Rough fescue	*Festuca altaica*					X	MDM, SVW	6, 7
Short-leaf fescue	*Festuca brachyphylla*					X	MDM, SVW	6, 7
Red fescue	*Festuca rubra*					X	FYU, SVW	6, 7
Rocky Mountain fescue	*Festuca saximontana*						FYU	7
Fescue grass	*Festuca* spp.	X	X	X	X	X	UTU	1, 4, 5
Chocolate lily	*Fritillaria camschatcensis*					X	SVW	6
Northern bedstraw	*Galium boreale*	X	X	X	X	X	FYU, UTU, TLI, SVW	1, 3, 6, 7
Sweet-scented bedstraw	*Galium triflorum*					X	SVW	6, 7
Whitish gentian	*Gentiana algida*		X		X	X		1, 3
Glaucous gentian	*Gentiana glauca*	X	X	X	X	X	SVW	1, 3, 6, 7
Four-part dwarf gentian	*Gentianella propinqua = Gentiana propinqua*						FYU	7
False toadflax	*Geocaulon lividum*						FYU, UTU, TLI, SVW	7
Bicknell geranium	*Geranium bicknellii*		X					1. 4
Wild geranium	*Geranium erianthum*				X	X	SVW	1, 3, 6, 7
Glacier avens	*Geum glaciale*	X		X				1, 3
Ross avens	*Geum rossii*		X		X	X	SVW	1,3, 6
Fowl manna grass	*Glyceria striata*						FYU	7
Oak fern	*Gymnocarpium dryopteris*					X	TLI, SVW	6, 7
Alpine sweet-vetch	*Hedysarum alpinum*						FYU	7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Boreal sweet-vetch	*Hedysarum mackenzii*						FYU	7
Cow parsnip	*Heracleum lanatum*	X	X	X	X	X	ALL	1, 3, 5, 6, 7
Alpine holy grass	*Hierochloe alpina*					X	MDM, UTU, TLI, SVW	6, 7
Common mare's tail	*Hippuris vulgaris*						FYU	7
Squirreltail (foxtail) grass	*Hordeum jubatum*	X				X	ALL	1, 6, 7
Fir clubmoss	*Huperzia haleakalae*					X	SVW	6
Touch-me-not	*Impatiens noli-tangere*				X	X		1, 3
Wild iris	*Iris setosa*		X		X	X		1, 3, 4
Arctic rush	*Juncus arcticus*	X	X				FYU	1, 4, 7
Chestnut rush	*Juncus castaneus*					X	UTU, SVW	6, 7
Drummond's rush	*Juncus drummondii*						SVW	7
	Kobresia myosuroides					X	SVW	6
Glaucous weaselsnout	*Lagotis glauca*						UTU	7
Blue bur	*Lappula myosotis*		X				FYU	7
Vetchling	*Lathyrus palustris*				X			1, 4
Common duckweed	*Lemna minor*						FYU	7
	Lepidium densiflorum					X	SVW	6
Bladder pod	*Lesquerella arctica*	X	X					1, 4
Lyme (beach) grass	*Leymus mollis*					X	SVW	6
Wild lovage	*Ligusticum mutellinoides*						TLI	7
Butter and eggs	*Linaria vulgaris*		X					1, 4

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Alp lily	*Lloydia serotina*	X	X	X	X	X	SVW	1, 3, 6
	Lomatogonium rotatum						FYU	7
Alaska spirea	*Luetkea pectinata*					X	SVW	1, 3, 7
Arctic lupine	*Lupinus arcticus*	X	X	X	X		MDM	1, 4, 7
Nootka lupine	*Lupinus nootkatensis*				X			1, 3
Arctic wood-rush	*Luzula arctica*						UTU	7
Curved wood-rush	*Luzula arcuata*					X	UTU, TLI, SVW	6, 7
Northern wood-rush	*Luzula confusa*					X	UTU, TLI, SVW	6, 7
	Luzula kjellmaniana					X	SVW	6
Common wood-rush	*Luzula multiflora*					X	MDM, UTU, TLI, SVW	6, 7
Small-flower wood-rush	*Luzula parviflora*					X	MDM, UTU, SVW	6, 7
	Luzula rufescens					X	SVW	6
	Luzula spicata					X	SVW	6
	Luzula tundricola						UTU, SVW	7
Wahlenberg's rood-rush	*Luzula wahlenbergii*						UTU, SVW	7
Alpine clubmoss	*Lycopodium alpinum*	X	X	X	X	X	MDM, SVW	1, 4, 6, 7
Stiff clubmoss	*Lycopodium annotinum*					X	MDM, UTU, TLI, SVW	6, 7
Common clubmoss	*Lycopodium clavatum*						MDM, SVW	7
Creeping clubmoss	*Lycopodium complanatum*						MDM, TLI	7
Fir clubmoss	*Lycopodium selago*						MDM, UTU, TLI, SVW	7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Pineapple weed	*Matricaria matricarioides*						UTU, TLI, SVW	7
White sweetclover	*Melilotus albus*						FYU	7
Bogbean (buckbean)	*Menyanthes trifoliata*	X	X	X	X	X	UTU	1, 4, 7
	Mertensia eastwoodae					X	SVW	6
Chiming bells	*Mertensia paniculata*	X	X	X	X	X	FYU, TLI, SVW	1, 3, 7
Wild snapdragon	*Mimulus guttatus*		X		X	X		1, 3
Arctic sandwort	*Minuartia arctica*		X	X	X	X	UTU, TLI, SVW	1, 4, 5, 6, 7
	Minuartia macrocarpa					X	MDM, UTU, TLI, SVW	6, 7
Grove sandwort	*Moehringia lateriflora*					X	SVW	6
Shy maiden	*Moneses uniflora*	X	X	X	X	X	UTU, TLI	1, 3, 7
Alpine forget-me-not	*Myosotis alpestris*		X	X	X	X	SVW	1, 3, 6
Yellow pond lily	*Nuphar polysepalum*	X	X	X	X	X		1, 4
Dwarf water lily	*Nymphaea tetragona*		X		X	X		1, 3
Sidebells	*Orthilia secunda = Pyrola secunda*						FYU, UTU, TLI, SVW	7
Mountain sorrel	*Oxyria digyna*					X	SVW	6, 7
Oxytrope	*Oxytropis bryophila*					X	SVW	6
Northern yellow oxytrope	*Oxytropis campetris*						UTU, TLI	7
Maydell's oxytrope	*Oxytropis maydelliana*	X	X	X	X	X	SVW	1, 3, 6
Blackish oxytrope	*Oxytropis nigrescens*	X	X	X	X	X	UTU, TLI, SVW	1, 3, 7
Scamman's oxytrope	*Oxytropis scammaniana*					X	SVW	6

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Boreal oxytrope	*Oxytropis viscida*	X					FYU	1, 7
	Packera cymbalaria = Senecio resedifolius						UTU, TLI	7
Alaska poppy	*Papaver alaskanum*				X	X	TLI	1, 3
Arctic poppy	*Papaver lapponicum*	X		X	X		UTU, TLI	1, 3, 5
Macoun's poppy	*Papaver macounii*				X		UTU, TLI	1, 7
Grass of Parnassus	*Parnassia kotzebuei*					X	FYU, SVW	6, 7
Grass of Parnassus	*Parnassia palustris*	X	X	X	X	X	FYU, UTU, SVW	1, 3, 4, 6, 7
Parry's wallflower	*Parrya nudicaulis*					X	SVW	6
Capitate lousewort	*Pedicularis capitata*		X		X	X	MDM, SVW	1, 3, 6, 7
Wooley lousewort	*Pedicularis kanei*					X	MDM, UTU, TLI, SVW	6, 7
	Pedicularis labradorica					X	MDM, SVW	6, 7
	Pedicularis langsdorffii					X	UTU, TLI, SVW	6, 7
	Pedicularis parviflora						MDM	7
Oeder's lousewort	*Pedicularis oederi*	X	X	X	X	X	UTU, SVW	1, 3, 5, 6
Fernweed	*Pedicularis sudetica*	X	X	X	X	X	ALL	1, 3, 5, 7
Bumblebee flower	*Pedicularis verticillata*	X	X	X	X	X	UTU	1, 3, 5
Yukon beardtongue	*Pentstemon gormanii*	X		X			UTU	1, 3, 5
Arctic coltsfoot	*Petasites frigidus*					X	MDM, UTU, TLI, SVW	6, 7
Coltsfoot	*Petasites hyperboreus*						MDM, UTU	7
Arrowleaf coltsfoot	*Petasites sagittatus*	X	X				FYU	1, 4, 7

Common Name	**Scientific Name**	**Fort Yukon**	**Murphy Dome**	**Indian Mountain**	**Tatalina**	**Sparrevohn**	**Observed**	**Reference**
Siberian phlox	*Phlox sibrica*	X		X	X	X		1, 3
Plantain	*Plantago major*					X	FYU, UTU, TLI, SVW	6, 7
Butterwort	*Pinguicila vulgaris*		X			X		1, 3, 4
Northern green orchid	*Platanthera hyperborea*						FYU	7
Small northern bog orchid	*Platanthera obtusata*	X	X	X	X	X		1, 3
Alpine blue grass	*Poa alpina*		X		X	X	UTU, TLI	1, 4, 7
Arctic blue grass	*Poa arctica*					X	TLI, SVW	6, 7
Blue grass	*Poa brachyanthera*				X	X	TLI, SVW	1
Canadian blue grass	*Poa compressa*						FYU	7
White blue grass	*Poa glauca*						MDM, SVW	7
Blue grass	*Poa lanata*						MDM	7
Blue grass	*Poa malacantha*					X	SVW	6
Blue grass	*Poa pratensis*	X	X	X	X	X	ALL	1, 5, 6
Blue grass	*Poa pseudoabbreviata*					X	SVW	6
Blue grass	*Poa* spp.	X	X	X	X	X	ALL	1, 4, 5, 7
	Podistera macounii					X	SVW	6
Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 3, 6, 7
Jacob's ladder	*Polemonium pulcherrimum*	X	X	X				1, 3, 4
	Polygonum alaskanum						MDM, UTU, TLI	7
Pink bistort	*Polygonum bistorta*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 3, 6, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
	Polygonum lapathifolium						FYU	7
Alpine meadow bistort	*Polygonum vivparum*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 4, 6, 7
Silverweed	*Potentilla anserina*	X					FYU	1
Two-flowered cinquefoil	*Potentilla biflora*	X	X					1, 3
Silverweed	*Potentilla egedii*	X	X		X			1, 3
Marsh fivefinger	*Potentilla palustris*	X	X	X	X	X	FYU, UTU, TLI	1, 3, 5, 7
One-flowered cinquefoil	*Potentilla uniflora*		X		X	X	SVW	1, 3
Wedge-leafed (pixie eyes) primrose	*Primula cuneifolia*					X	SVW	1, 3, 6
Chukchi primrose	*Primula tschuktschorum*						UTU, TLI	7
Pasqueflower	*Pulsatilla patens*	X	X	X			FYU	1, 3, 7
Pink pyrola	*Pyrola asarifolia*	X	X	X	X	X	FYU, SVW	1, 3, 7
Large-flowered wintergreen	*Pyrola grandiflora*	X	X	X	X	X	SVW	1, 3, 6, 7
Pyrola.	*Pyrola* spp.						MDM	7
Buttercup	*Ranunculus cymbalaria*	X					FYU	1, 3
Mountain buttercup	*Ranunculus eschscholtzii*					X	UTU, TLI, SVW	6, 7
Lesser yellow water buttercup	*Ranunculus gmelinii*						UTU	7
Far northern buttercup	*Ranunculus hyperboreus*					X	SVW	6
Lapland buttercup	*Ranunculus lapponicus*						FYU	7
Snow buttercup	*Ranunculus nivalis*					X	SVW	6
Pygmy buttercup	*Ranunculus pygmaeus*					X	SVW	6

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Buttercup	*Ranunculus* spp.	X	X	X	X	X		1, 4
Roseroot	*Rhodiola integrifolia = Sedum rosea*	X	X	X	X	X	TLI, SVW	1, 3, 6
Hoary yellowcress	*Rorippa barbareaefolia*					X	SVW	6
Bog yellowcress	*Rorippa hispida*				X		FYU, UTU, TLI	1, 7
Yellowcress	*Rorippa* spp.						MDM	7
	Rumex acetosa					X	SVW	6
Arctic dock	*Rumex arcticus*	X	X	X	X	X	MDM, UTU, SVW	1, 4, 6, 7
Canadian burnet	*Sanguisorba canadensis = S. stipulata*					X	SVW	1, 7
European great burnet	*Sanguisorba officinalis*	X	X	X	X	X	FYU, SVW	1, 6, 7
Narrow-leaf saussurea	*Sausserea angustifolia*		X				MDM	1, 3, 7
Yellow-spotted saxifrage	*Saxifraga bronchialis*		X	X		X	UTU, TLI, SVW	1, 3, 6, 7
Bublet (nodding) saxifrage	*Saxifraga cernua*		X			X		1, 3
Whiplash saxifrage	*Saxifraga flagellaris*	X	X		X	X		1, 3
Rusty saxifrage	*Saxifraga hieracifolia*		X		X	X	UTU, TLI, SVW	1, 3, 7
Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	X	X	X		1, 3, 4
Red stemmed saxifrage	*Saxifraga lyalii*	X				X		1, 3
Brook saxifrage	*Saxifraga nelsoniana = S. punctata*	X				X	MDM, UTU, TLI, SVW	1, 3, 6, 7
Snow saxifrage	*Saxifraga nivalis*						UTU	7
Purple mountain saxifrage	*Saxifraga oppositifolia*		X		X	X	TLI	1, 3
	Saxifraga reflexa					X	UTU, TLI, SVW	6, 7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Alpine brook saxifrage	*Saxifraga rivularis*					X	UTU, SVW	6, 7
	Saxifraga serpyllifolia					X	SVW	6
Spiked saxifrage	*Saxifraga spicata*	X	X	X	X	X		1, 3
Prickly saxifrage	*Saxifraga tricuspidata*						MDM	7
Hooded skullcap	*Scutellaria galericulata*						FYU	7
Marsh fleawort (mastodon flower)	*Senecio congestus*	X	X	X	X	X	FYU	1, 3, 7
Black-tipped groundsel	*Senecio lugens*	X	X	X	X	X		1, 3
	Senecio ogotorukensis					X	SVW	6
	Senecio yukonensis					X	SVW	6
Moss campion	*Silene acaulis*	X	X	X	X	X	UTU, SVW	1, 3, 6, 7
Bladder campion	*Silene uralensis = Melandrium apetalum*	X	X	X	X	X	UTU, TLI, SVW	1, 4, 6, 7
Rocky Mountain goldenrod	*Solidago multiradiata*	X	X	X	X	X	SVW	1, 3, 6
Mt. albert goldenrod	*Solidago simplex*						FYU	7
Bur-reed	*Sparganium angustifolium*	X	X	X	X	X		1, 4
Ladies' tresses	*Spiranthes romanzoffiana*		X	X	X	X		1, 3
	Stellaria borealis					X	SVW	6
	Stellaria calycantha					X	SVW	6
	Stellaria longipes					X	SVW	6
Twisted stalk	*Streptopus amplexifolius*					X	TLI, SVW	6, 7
Dandelion	*Taraxacum* spp.	X	X	X	X	X	ALL	1, 3, 7
	Taraxacum kamtschaticum					X	SVW	6

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Alpine meadow rue	*Thalictrum alpinum*					X	SVW	6
Meadow rue	*Thalictrum sparsiflorum*					X	UTU, TLI, SVW	1, 6, 7
	Thelyperis phegopteris					X	SVW	6, 7
False asphodel	*Tofieldia coccinea*					X	MDM, TLI, SVW	6, 7
	Trisetum spicatum					X	SVW	6
Star flower	*Trientalis europaea*		X		X	X	FYU, UTU, TLI, SVW	1, 3, 6, 7
Star clover	*Trifolium repens*						TLI	7
Arrow grass	*Triglochin maritimum*	X	X				FYU	1, 4, 7
Bladderwort	*Utricularia intermedia*	X	X	X				1, 4
Capitate valerian	*Valeriana capitata*	X	X	X	X	X	MDM, UTU, TLI, SVW	1, 3, 6, 7
White false hellebore	*Veratrum album*						UTU	7
False hellebore	*Veratrum escholtzii*					X		1, 3
American false hellebore	*Veratrum viride*					X	SVW	6, 7
American brook lime	*Veronica americana*		X			X		1, 4
Purple-white tufted vetch	*Vicia cracca*						TLI	7
Yellow (two-flowered) violet	*Viola biflora*		X		X	X	TLI, SVW	1, 3, 6, 7
Marsh violet	*Viola epipsila*					X	SVW	6
Alaska violet	*Viola langsdorffii*					X	SVW	1, 3, 6
Violet	*Viola* spp.						UTU, TLI, SVW	7
Arctic flower	*Whilhelmsia physodes*						UTU	7

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn	Observed	Reference
Rusty woodsia	*Woodsia ilvensis*					X	TLI, SVW	6, 7
Death camass	*Zygadenus elegans*	X	X	X	X		FYU	1, 3, 7

Codes for Observations:
FYU - Fort Yukon
MDM - Murphy Dome
UTU - Indian Mountain
TLI - Tatalina
SVW - Sparrevohn

Reference:
1 - Hulten 1968
2 - Viereck and Little 1972
3 - White 1974
4 - Pratt 1991
5 - Jacobs Engineering Group, Inc. 1995
6 - Parker 2000
7 - ABR Inc. (Boisvert and Frost) during 2004 site visits

Note:
Species listed alphabetically by scientific name. Observed species collected and identified during June 1993 site visit (Woodward-Clyde 1995f), by Jacobs Engineering Group (1995), by Parker (2000), or by ABR Inc. (Boisvert and Frost during 2004 site visits).

Table A2: Fish Species Potentially Occurring on or near Fort Yukon, Indian Mountain, Murphy Dome, Sparrevohn, and Tatalina Long Range Radar Sites

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indian Mountain	Tatalina	Sparrevohn
Sockeye (red) salmon	*Oncorhynchus nerka*				X	X
Chinook (king) salmon	*Oncorhynchus tshaytscha*	X		X	X	X
Coho (silver) salmon	*Oncorhynchus kisutcyh*	X		X	X	X
Chum salmon	*Oncorhynchus keta*	X		X	X	X
Pink salmon	*Oncorhynchus gorbuscha*				X	
Arctic char	*Salvelinus alpinus*				X	X
Dolly Varden	*Salvelinus malma*				X	X
Sheefish	*Stenodus leucichthys*		X	X	X	X
Whitefish	*Coregonus* spp.	X	X	X	X	X
Arctic grayling	*Thymallus arcticus*	X	X	X	X	X
Northern pike	*Esox lucius*	X	X	X	X	X
Longnosed sucker	*Catostomus catostomus*		X	X	X	X
Alaska blackfish	*Dallia pectoralis*				X	X
Slimy sculpin	*Cottus cognatus*			X		
Arctic lamprey	*Lampreta* spp.			X		
Burbot	*Lota lota*	X	X	X	X	X

Sources:
Gutleber, R. J. undated (b, c, and d)
Boyer, L. undated (a and b)
Morrow 1980
ADFG 1990b
Woodward-Clyde 1995f
Note: Species listed by phylogenetic order.

Table A3: Mammal Species Potentially Occurring on or near Fort Yukon, Indian Mountain, Murphy Dome, Sparrevohn, and Tatalina Long Range Radar Sites

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indain Mountain	Tatalina	Sparrevohn
Dusky shrew	*Sorex vagrans*			X	X	X
Masked shrew	*Sorex cinereus*	X	X	X	X	X
Brown/grizzly bear	*Ursus arctos*	X	X	X	X	X
Black bear	*Ursus americanus*	X	X	X	X	X
Red fox	*Vulpes vulpes*	X	X	X	X	X
Wolf	*Canis lupus*	X	X	X	X	X
Coyote	*Canis latrans*		X			X
Marten	*Martes americana*	X	X	X	X	X
Short-tailed weasel (ermine)	*Mustela erminea*	X	X	X	X	X
Least weasel	*Mustela rixosa*	X	X	X	X	X
Mink	*Mustela vison*	X	X	X	X	X
River otter	*Lutra canadensis*	X		X	X	X
Wolverine	*Gulo gulo*	X	X	X	X	X
North American lynx	*Felis lynx*	X	X	X	X	X
Snowshoe hare	*Lepus americanus*	X	X	X	X	X
Arctic hare	*Lepus poadromus*				X	
Arctic ground squirrel	*Spermophilus paryi*	X	X	X	X	X
Red squirrel	*Tamiasciurus hudsonicus*	X	X	X	X	X
Bog lemming	*Synaptomys borealis*	X	X	X	X	X
Varying lemming	*Dicristonyx torquatus*			X		
Northern red-backed vole	*Clethrionomys rutilus*	X	X	X	X	X
Tundra vole	*Microtus oeconomus*	X	X	X	X	X
Meadow vole	*Microtus pennsylvanicus*	X	X	X	X	X
Jumping mouse	*Zapus hudsonius*			X	X	X
Beaver	*Castor canadensis*	X		X	X	X
Porcupine	*Erethizon dorsatum*					X
Muskrat	*Ondatra zibethicus*	X		X	X	X

Common Name	Scientific Name	Fort Yukon	Murphy Dome	Indain Mountain	Tatalina	Sparrevohn
Moose	*Alces alces*	X	X	X	X	X
Caribou	*Rangifer tarandus*		X			X

Sources:
Gutleber, R. J. undated (b, c, and d)
Boyer, L. undated (a and b)
Woodward-Clyde 1991b
Woodward-Clyde 1995f
1998 conversations with installation personnel
Jacobs Engineering Group, Inc. 1995
Note: Species listed by phylogenetic order.

Table A4: Bird Species Potentially Occurring on or near Fort Yukon, Indian Mountain, Murphy Dome, Sparrevohn, and Tatalina Long Range Radar Sites

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
Red-throated Loon	*Gavia stellata*	U	U	U	-	*	
Pacific Loon	*Gavia pacifica*	C	C	C	-	*	
Common Loon	*Gavia immer*	C	C	C	-	*	
Horned Grebe	*Podiceps auritus*	C	C	C	-	*	
Red-necked Grebe	*Podiceps grisegena*	C	C	C	-	*	
Tundra Swan	*Cygnus columbianus*	C	U	C	-	*	
Trumpeter Swan	*Cygnus buccinator*	U	U	U	-	*	
Greater White-fronted Goose	*Anser albiforns*	C	U	C	-		
Snow Goose	*Chen caerulescens*	C	A	C	-		
Brant	*Branta bernicla*	A	-	-	-		
Canada Goose	*Branta canadensis*	C	C	C	-	*	
Green-winged Teal	*Anas crecca*	C	C	C	-	* ~ (TLI)	UTU, TLI
Mallard	*Anas platyrhynchos*	C	C	C	R	*	SVW, TLI**
Northern Pintail	*Anas acuta*	C	C	C	A	*	FYU
Blue-winged Teal	*Anas discors*	U	R	U	-	*	
Cinnamon Teal	*Anas cyanoptera*	A	A	-	-		
Northern Shoveler	*Anas clypeata*	C	C	C	A	*	FYU
Gadwall	*Anas strepera*	R	R	R	-		
Eurasian Wigeon	*Anas penelope*	R	A	-	-		
American Wigeon	*Anas americana*	C	C	C	A	*	
Canvasback	*Aythya valisineria*	U	U	U	-	*	
Redhead	*Aythya americana*	U	R	U	-	*	
Ring-necked Duck	*Aythya collaris*	U	U	U	-	*	
Greater Scaup	*Aythya marila*	C	C	C	C	*	
Lesser Scaup	*Aythya affinis*	C	C	C	A	*	
Harlequin Duck	*Histrionicus histrionicus*	U	U	U	-	*	
Long-tailed Duck	*Clangula hyemalis*	C	U	C	-	*	
Black Scoter	*Melanitta nigra*	R	R	R	-	*	

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
Surf Scoter	*Melanitta perspicillata*	C	C	C	-	*	
White-winged Scoter	*Melanitta fusca*	C	C	C	-	*	
Common Goldeneye	*Bucephala clangula*	C	C	C	A	*	
Barrow's Goldeneye	*Bucephala islandica*	C	C	C	-	*	
Bufflehead	*Bucephala albeola*	C	C	C	A	*	
Common Merganser	*Mergus merganser*	R	R	R	R	*	
Red-breasted Merganser	*Mergus serrator*	R	R	R	R	*	
Osprey	*Pandion haliaetus*	R	R	R	-	*	
Bald Eagle	*Haliaeetus leucocephalus*	U	U	U	R	*	FYU
Northern Harrier	*Circus cyaneus*	U	U	U	A	*	
Sharp-shinned Hawk	*Accipiter striatus*	C	C	C	A	*	
Northern Goshawk	*Accipiter gentilis*	U	U	U	U	*	TLI
Red-tailed Hawk	*Buteo jamaicensis*	C	C	C	-	*	TLI
Rough-legged Hawk	*Buteo lagopus*	C	U	C	A	*	
Golden Eagle	*Aquila chrysaetos*	C	C	C	A	*	UTU, SVW
American Kestrel	*Falco sparverius*	C	C	C	-	*	FYU
Merlin	*Falco columbarius*	U	U	U	A	*	FYU
Peregrine Falcon	*Falco peregrinus*	R	R	R	-	*	SVW
Gyrfalcon	*Falco rusticolus*	U	U	U	R	*	
Spruce Grouse	*Falcipennis canadensis*	C	C	C	C	* ~ (TLI)	TLI**
Willow Ptarmigan	*Lagopus lagopus*	C	C	C	C	*	MDM, TLI
Rock Ptarmigan	*Lagopus mutus*	C	C	C	C	*	UTU, TLI, SVW
White-tailed Ptarmigan	*Lagopus leucurus*	U	U	U	U	*	
Ruffed Grouse	*Bonasa umbellus*	C	C	C	C	*	TLI
Sharp-tailed Grouse	*Tympanuchus phasianellus*	U	U	U	U	* ~ (FYU)	FYU
Sandhill Crane	*Grus canadensis*	C	U	C	-	*	FYU, TLI
Black-bellied Plover	*Pluvialis squatarola*	R	R	R	-		
American Golden Plover	*Pluvialis dominica*	C	C	C	-	*	
	Charadrius						

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
Semipalmated Plover	*semipalmatus*	C	C	C	-	*	UTU, FYU, UTU
Killdeer	*Charadrius vociferus*	R	R	R	-	*	
Greater Yellowlegs	*Tringa mela*	R	R	R	-	*	FYU
Lesser Yellowlegs	*Tringa flavipes*	C	C	C	-	*	FYU, UTU
Solitary Sandpiper	*Tringa solitaria*	U	U	U	-	* ~ (UTU)	UTU
Wandering Tattler	*Heteroscelus incanus*	U	U	U	-	*	
Spotted Sandpiper	*Actitis macularia*	C	C	C	-	*	SVW, TLI, UTU
Upland Sandpiper	*Bartramia longicauda*	U	U	U	-	*	
Whimbrel	*Numenius phaeopus*	C	C	U	-	*	UTU
Hudsonian Godwit	*Limosa haemastica*	R	A	-	-		
Ruddy Turnstone	*Arenaria interpres*	R	A	-	-		
Black Turnstone	*Arenaria melanocephala*	-	A	A	-		
Surfbird	*Aphriza virgata*	U	U	U	-	* ~ (UTU)	UTU
Semipalmated Sandpiper	*Calidris pusilla*	C	A	U	-	*	
Western Sandpiper	*Calidris mauri*	R	A	R	-	*	
Least Sandpiper	*Calidris minutilla*	C	U	U	-	*	
Baird's Sandpiper	*Calidris bairdii*	U	U	U	-	*	
Pectoral Sandpiper	*Calidris melanotos*	C	U	U	-		
Stilt Sandpiper	*Calidris himantopus*	R	-	A	-		
Buff-breasted Sandpiper	*Tryngites subruficollis*	R	-	A	-		
Long-billed Dowitcher	*Limmodromus scolopaceus*	C	U	U	-	*	
Common Snipe	*Gallinago gallinago*	C	C	C	-	*	FYU, TLI**
Wilson’s Snipe	*Gallinago delicata*						FYU
Red-necked Phalarope	*Phalaropus lobatus*	C	C	C	-	*	
Long-tailed Jaeger	*Stercorarius longicaudus*	C	C	C	-	*	UTU
Bonaparte’s Gull	*Larus philadelphia*	U	U	U	-	*	
Mew Gull	*Larus canus*	C	C	C	-	*	UTU, TLI**
Herring Gull	*Larus argentatus*	U	U	U	-	*	FYU

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
Glaucous-winged Gull	*Larus glaucescens*	-	R	R	-		
Glaucous Gull	*Larus hyperboreus*	R	R	R	-		
Arctic Tern	*Sterna paradisaea*	U	U	U	-	*	
Great Horned Owl	*Bubo virginianus*	C	C	C	C	*	
Snowy Owl	*Nyctea scandiacascandian*	R	-	A	R		
Northern Hawk Owl	*Surnia ulula*	C	C	C	C	*	UTU
Great Grey Owl	*Strix nebulosa*	R	R	R	R	*	TLI**
Short-eared Owl	*Asio flammeus*	C	C	C	-	*	
Boreal Owl	*Aegolius funereus*	C	C	C	C	*	
Belted Kingfisher	*Ceryle alcyon*	C	C	C	-	*	UTU
Downy Woodpecker	*Picoides pubescens*	U	U	U	U	*	
Hairy Woodpecker	*Picoides villosus*	U	U	U	U	*	
Three-toed Woodpecker	*Picoides tridactylus*	U	U	U	U	*	
Black-backed Woodpecker	*Picoides arcticus*	R	R	R	R	*	
Northern Flicker	*Colaptes auratus*	C	C	C	A	*	FYU
Olive-sided Flycatcher	*Contopus borealis cooperi*	U	U	U	-	*	TLI**, FYU
Western Wood-pewee	*Contopus sorididus*	U	U	U	-	*	
Alder Flycatcher	*Empidonax alnorum*	C	C	C	-	* ~ (MDM)	FYU, MDM, UTU, TLI**
Hammond's Flycatcher	*Empidonax hammondii*	C	C	C	-	*	UTU, TLI
Say's Phoebe	*Sayornis saya*	U	U	U	-	*	UTU, FYU
Horned Lark	*Eremophila alpestris*	C	C	C	-	*	SVW
Tree Swallow	*Tachycineta bicolor*	C	C	C	-	*	TLI
Violet-green Swallow	*Tachycineta thalassina*	C	C	C	-	*	MDM, SVW, TLI**
Bank Swallow	*Riparia riparia*	C	C	C	-	*	FYU, TLI**, MDM
Cliff Swallow	*Petrochelidon pyrrhonota*	C	C	C	-	*	ALL, TLI**, MDM
Barn Swallow	*Hirundo rustica*	A	A	A	-		
Gray Jay	*Perisoreus canadensis*	C	C	C	C	* ~ (UTU)	UTU, SVW,

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
							TLI**
Black-billed Magpie	*Pica pica*	C	C	C	C	*	
Common Raven	*Corvus corax*	C	C	C	C	*	FYU, UTU, TLI**, MDM, SVW
Black-capped Chickadee	*Poecile atricapillus*	C	C	C	C	*	FYU, TLI**, UTU, MDM, SVW
Boreal Chickadee	*Poecile hudsonicus*	C	C	C	C	* ~ (TLI)	SVW, TLI**, FYU, UTU
Brown Creeper	*Certhia americana*	R	R	R	R	*	
American Dipper	*Cinclus mexicanus*	U	U	U	U	*	TLI
Arctic Warbler	*Phylloscopus borealis*	C	C	C	-	*	TLI**
Ruby-crowned Kinglet	*Regulus calendula*						UTU, TLI**
Northern Wheatear	*Oenanthe oenanthe*	U	U	U	-	*	UTU
Mountain Bluebird	*Sialia currucoides*	R	R	A	-	*	
Townsend’s Solitaire	*Myadestes townsendii*	R	R	R	A	*	
Gray-cheeked Thrush	*Catharus minimus*	C	C	C	-	*	SVW, TLI**
Swainson’s Thrush	*Catharus ustalatus*	C	C	C	-	*	FYU, UTU, SVW, TLI**
Hermit Thrush	*Catharas guttatus*	U	U	U	-	*	UTU, SVW, TLI
American Robin	*Turdus migratorius*	C	C	C	A	*	ALL, TLI**, FYU
Varied Thrush	*Ixoreus naevius*	C	C	C	-	*	TLI**
American Pipit	*Anthus rubescens*	C	C	C	-	*	SVW, UTU, MDM, TLI
Bohemian Waxwing	*Bombycilla garrulus*	C	C	C	R	*	FYU
Northern Shrike	*Lanius exubitor*	U	U	U	R	*	
Orange-crowned Warbler	*Vermivora celata*	C	C	C	-	*	FYU, UTU, TLI**
Yellow Warbler	*Dendroica petechia*	C	C	C	-	*	FYU, UTU, SVW, TLI**
Yellow-rumped Warbler	*Dendroica coronata*	C	C	C	-	*	TLI**
Townsend’s Warbler	*Dendroica townsendi*						TLI**
Blackpoll Warbler	*Dendroica striata*	U	U	U	-	*	SVW TLI**
Northern Waterthrush	*Seiurus noveboraxensis*	C	C	C	-	*	TLI**, FYU

Common Name	Scientific Name	Seasonal Occurrence				Breeding	Observed
		SP	SU	FA	WI		
Wilson's Warbler	*Wilsonia pusilla*	C	C	C	-	*	SVW, TLI**
American Tree Sparrow	*Spizella arborea*	C	C	C	A	*	FYU, UTU, SVW
Chipping Sparrow	*Spizella passerina*	U	U	U	-	*	
Savannah Sparrow	*Passerculus sandwichensis*	C	C	C	A	*	UTU, SVW, TLI, FYU, MDM
Fox Sparrow	*Passerella iliaca*	C	C	C	A	*	FYU, SVW, TLI**, UTU, MDM
Lincoln's Sparrow	*Melospiza lincolnii*	C	C	C	-	*	TLI**
Golden-crowned Sparrow	*Zonotrichia atricapilla*	U	U	U	A	*	SVW
White-crowned Sparrow	*Zonotrichia leucophrys*	C	C	C	A	* ~ (MDM)	ALL, TLI**
Dark-eyed Junco	*Junco hyemalis*	C	C	C	R	*	FYU, UTU, TLI**, MDM, SVW
Lapland Longspur	*Calcarius lapponicus*	C	C	C	-	*	TLI, SVW
Snow Bunting	*Plectrophenax nivalis*	C	U	U	R	*	SVW, TLI
Red-winged Blackbird	*Agelaius phoeniceus*	U	U	U	A	*	
Rusty Blackbird	*Euphagus carolinus*	U	U	U	R	*	
Gray-crowned Rosy Finch	*Leucosticle tephrocotis*	U	U	U	A	*	
Pine Grosbeak	*Pinicola enucleator*	U	U	U	U	*	
White-winged Crossbill	*Loxia leucoptera*	U	U	U	U	*	TLI**, FYU, UTU
Common Redpoll	*Corduelis flammea*	C	C	C	C	*	SVW, TLI**, FYU, UTU
Hoary Redpoll	*Carduelis hornemanni*	C	R	U	C	*	SVW
Pine Siskin	*Carduelis pinnus*	R	R	R	A	*	

Codes:
FYU - Fort Yukon
MDM - Murphy Dome
UTU - Indian Mountain
TLI - Tatalina
SVW - Sparrevohn
SU - Summer
SP - Spring
FA - Fall
WI - Winter
C - Common
U - Uncommon
R - Rare
A - Accidental

Sources:
Armstrong 1991
Gibson, D.D. 1993
Woodward-Clyde 1995f
Jacobs Engineering Group, Inc. 1995
Skinner 2000

Notes:
Species listed by phylogenic order.
Species observed by Woodward-Clyde and USAF in 1993 (Woodward-Clyde, 1995f)
(FYU 14-15 Jun 93, MDM 14 Jun 93, UTU 13-14 Jun 93, TLI 22-23 Jun 93, SVW 23-24 Jun 93), Jacobs Engineering Group (1995), and Boisvert and Frost (ABR Inc. 2004 site visits) at FYU 22-23 July, MDM 24-25 July, UTU 19-21 July, TLI 16-19 July, SVW 1-3 Sept. Tatalina Breeding Bird Survey (BBS) 1995 - 1998 conducted along the road from Sterling Landing, through the Tatalina LRRS to Ophir were run between June 10 and June 30

* - Within Breeding Range
** - Tatalina BBS
- = Not expected during season
~ Nesting confirmed

Appendix 3.0 – Indian. Indian Mountain Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Indian Mountain LRRS Upper Camp

3.1 Location and Area

Indian Mountain LRRS is located 410 miles north of Anchorage and 195 miles northwest of Fairbanks (INRMP Figure 3.1). Public Land Orders 1748, 3942, 5164, and 6706 reserve 9,247 acres for military use. Public Land Order 6706 is jointly administered by USAF and BLM under two memoranda of understanding.

The 611 ASG has 4,226 acres for the operations of the LRRS (Figure 3.1). This adjoins and overlaps about 130 acres of approximately 5,000 acres the Air Force Technical Application Center's seismic monitoring site. While this INRMP is principally for 611 ASG property, descriptive information, issues, and management measures can be applied to the remaining property. The installation is accessible primarily by air. There is an overgrown trail to the village of Hughes that was used when the installation was fully staffed from the 1950s to early 1980s. The trail is nearly impassable but could be cleared if there was any reason to do so.

3.2 Installation History

An early 20th Century mining settlement called Utopia was the original settlement. In 1951 an AC&W facility was constructed at Indian Mountain to cover radar gaps in the interior of Alaska. A high frequency radio system supplied initial communications. The installation became operational as an inland surveillance site in 1953. This system proved unreliable due to atmospheric disturbances, and a WACS was built and activated in 1958. The WACS system became obsolete and was replaced in 1979 by a commercial satellite earth terminal. In 1984 a MAR was installed and remains active. An average of four BOS contract personnel maintain the site.

3.3 Surrounding Communities

Hughes is the nearest community to the LRRS (15 miles west). Hughes has a population of 77 (2010 estimate) (www.dced.state.ak.us 2012). Hughes is located on a 500-foot bluff on the eastern bank of the Koyukuk River. A federally recognized tribe is located in Hughes, the Hughes Village (a.k.a. Hut'odleekkaakk'et Tribe). Hughes is a Koyukon Athabascan village and traditional ways of life persist, such as potlatches and dog races, which attract visitors from surrounding river villages. Subsistence is the focus of the local economy. Salmon, freshwater fish, moose, black bear, rabbits, waterfowl, and berries are utilized. Caribou are also sought when available. Part-time jobs exist with the city, school, tribal clinic, and store. BLM emergency fire fighting, construction work, skin sewing, beadwork, sled building, and trapping also provide seasonal income. In 2010, one resident owned a commercial fishing permit (www.dced.state.ak.us 2012). The town is not connected to the LRRS by any roads.

3.4 Regional Land Use

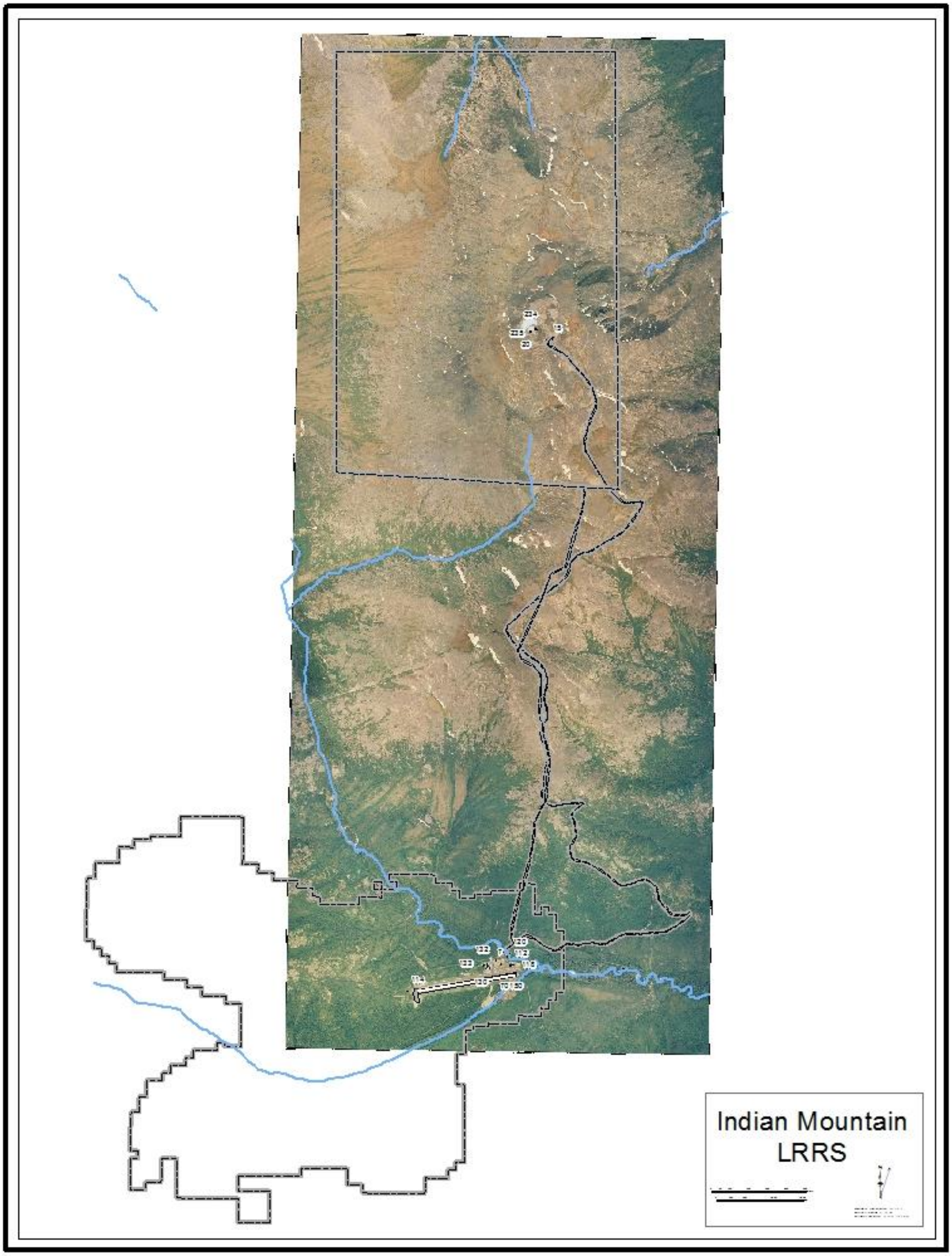
The Indian Mountain area is home to the Koyukuk River Athapaskans. Their original territory covered parts of the lower Yukon drainage as well as drainages of the Innoko and Koyukuk rivers. Villages were usually located on or near major rivers, complemented by many seasonal, family and group fish camps along the rivers and interior hunting and trapping camps. The distinctively Athapaskan occupancy of this region was somewhat modified by the presence of Yupik Eskimo settlements above Holy Cross near the Yukon-Koyukuk confluence and by the presence of Inupiat Eskimos along the upper reaches of the Koyukuk River (Gutleber undated(b)).

Contact between Europeans and the people of the middle Yukon area was late with respect to more accessible coastal areas of Alaska. The period of western discovery of Alaska began with the Russian expedition of 1728. In 1837 the first Russian trading post in interior Alaska was established at Skogmiut. By 1838 the Russians had penetrated the middle Yukon, establishing a trading post at Nulato, which was destroyed 13 years later in one of the few Alaskan Native uprisings on record. The Russian influence in these areas was transitory and remained little-known until the gold rush and geological exploration of the 1890s. Russian influence is reflected primarily in the reconcentration of numbers of aboriginal people around centers which provided opportunities for trade and missionary services (Gutleber undated(b)).

The purchase of Alaska by the United States in 1867 had minimal effect on the region. American fur traders replaced Russians, and the Moravian Church assumed the role of the Russian Church. From 1870 through the 1890s, the Alaskan economic potential was more fully exploited. Americans enriched themselves with sea otters, salmon, and whales. In 1879 the first Alaskan gold-mining operations were established at the head of Silver Bay near Sitka. However, difficult terrain, sparse population, and paucity of fur resources that had limited Russian interests in the Yukon and Kuskokwim regions also discouraged American interests (Gutleber undated(b)).

During 1883 to 1885 the United States Army initiated exploration of interior Alaska. Published accounts of these and other expeditions increased public interest in the area, and occasional reports of the presence of gold began to attract prospectors to the region. Prospectors followed various streams, panning the sand of their innumerable sandbars. As prospectors found their way into the Yukon basin, trading posts very quickly began to stock mining equipment and supplies. As a result, prospectors could stay longer in the Interior. Trading posts became stores for miners and eventually grew into communities. The first major

Figure 3.1 Indian Mountain LRRS



break in the pattern of Yukon prospecting came in fall 1886 with a strike at a placer field on a tributary of Forty-Mile River (Gutleber undated(b)).

The Yukon gold boom declined around the time of World War II. Local costs mounted, and resupply and maintenance were hampered by wartime shortages. The Japanese invasion of the Aleutian Islands initiated a large-scale government involvement in the region during the early part of World War II. The upgrading and construction of existing and new airfields and communication sites were the principal goals of this early military construction. After World War II the military presence in the region continued. The Korean War and succeeding Cold War necessitated the development of an air defense early warning system (Gutleber undated(b)).

3.5 Local and Regional Natural Areas

Indian Mountain LRRS has no special natural areas (*e.g.*, refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate

Indian Mountain lies in a continental climatic zone. Summers are short and rainy, and winters are cold. Temperatures are extreme, although not as extreme as in many other interior Alaska areas. The average high temperature during July is 70°F; the average low during January is well below 0°F. Extended periods of -40 °F are common. The highest temperature ever recorded was 90 °F; the lowest was -68 °F. Average annual precipitation is 13 inches, with 30 inches of snowfall. The Koyukuk River is ice-free from June through October (www.dced.state.ak.us 2012). Winds are light to moderate and are predominantly from the east-northeast. Winds are calm about one-third of the time (Woodward-Clyde 1991a).

4.2 Landforms

Indian Mountain is located in the Koyukuk portion of the Yukon Region of Alaska, an area of about 3,000 square miles. This subregion is drained by the Koyukuk River and its tributaries from the divide in the Kokrines-Hodzana highlands and Philip Smith Mountains west to the Nulato Hills. The Koyukuk River flows mostly southwest for 320 miles from its headwaters in the Endicott Mountains to its confluence with the Yukon River near the village of Koyukuk.

The Indian River Uplands are within a physiographic province which is situated south of the Endicott Mountains and is characterized by alternating lowlands, high hills, and mountains. The Indian Mountains and Purcell Mountains border the Koyukuk lowlands to the north. The surrounding area has significant vertical relief, ranging from 700 feet above msl in lowlands to about 3,400 feet above msl on ridge tops. Indian Mountain, at 4,234 feet above msl, is the highest peak in the area (Woodward-Clyde 1991a).

4.3 Geology and Soils

The Koyukuk subregion is within the Yukon-Koyukuk basin geologic province, which was formed during Cenozoic subsidence. The Yukon-Koyukuk basin is a volcanogenic province mostly formed by sediments of volcanic origin. Although referred to as a basin, episodes of uplifting have produced hills and ridges of sedimentary rocks throughout the basin. The Indian River Uplands and Purcell Mountains were formed in this manner. The Kobuk Fault, a major Tertiary fault, runs east-west through the Yukon-Koyukuk basin along the Alatna Hills, 509 miles north of Indian Mountain LRRS. This fault is probably still active (Woodward-Clyde 1991a).

Bedrock material in the Indian River Uplands is predominantly mid-Cretaceous and Tertiary volcanics, with some Cretaceous shale and sandstone. Outcrops of bedrock are generally restricted to highlands and crestlines, where weathered rubble has moved downslope. At Indian Mountain LRRS, bedrock material is andesitic (felsic volcanics) with outcrops along steep slopes and eroded mountain surfaces (Woodward-Clyde 1991a).

Quaternary deposits dominate the surface geology in the Yukon-Koyukuk basin. During the Pleistocene Period several glaciers from the Brooks Range left glacial deposits. These deposits and eroding uplands make up the deep surface material of area lowlands. Most sediments have been reworked by rivers and distributed as outwash and lower terrace alluvium. The most widespread sediment is glacial loess, a fine rock flour easily dispersed by wind (Woodward-Clyde 1991a).

The surficial geology at Lower Camp is dominated by coarse and fine-grained alluvium eroded from mountain slopes. Recent deposits from Indian River and its tributaries consist of stratified accumulations of silt, sand, and gravel. The maximum thickness is unknown, but it is greater than the water gallery depth of 25 feet (Woodward-Clyde 1991a).

The surface geology of Upper Camp consists of thin deposits of residual sand, gravel, and cobbles overlying bedrock. Northern and northeastern slopes of Indian Mountain have been glaciated. Thin accumulations of outwash sand and gravel have been deposited on steep slopes and eroded mountain surfaces (Woodward-Clyde 1991a).

Permafrost reportedly ranges from thick to thin and is discontinuous in the vicinity of the installation. Permafrost occurrence in this region depends on elevation, soil type, soil depth, slope orientation, and other factors (Woodward-Clyde 1991a). Permafrost has been encountered by IRP investigations at Upper Camp and Lower Camp.

4.4 Hydrology

4.4.1 General

Surface water bodies in the vicinity of Indian Mountain LRRS include Indian River and Utopia, Sleepy Bear, Colorado, Flat, and Cirque creeks. The general area is drained by the Koyukuk River, which flows into the Yukon River.

Highlands in the Koyukuk subregion have numerous stream and river valleys. Various small lowland areas occur throughout the subregion in broad stream valleys. The community of Hughes is located a few miles north of the Koyukuk Lowlands on a broad flat plain centered around the Koyukuk River. Lowlands are characterized by meandering rivers and streams in addition to numerous lakes and marshes (Woodward-Clyde 1991a).

At Lower Camp surface water drainage flows into the Indian River and Utopia Creek. Indian River flows toward Lower Camp from the north, turning to the east below the camp. The overall gradient of the river in this vicinity is about 50 feet per mile (Woodward-Clyde 1991a).

Surface water drainage from Upper Camp is directed toward tributaries of Notoniono Creek and Indian River. Surface flow from northern and eastern slopes of Indian Mountain drains into Notoniono Creek and the Mentanontli River, located in a flat lowland area 20 miles northeast of Upper Camp. Surface flow from western and southern slopes of Indian Mountain is directed towards Indian River, which joins the Koyukuk River about 20 miles southwest of the installation. Most Upper Camp surface runoff flows into Notoniono Creek via Sleepy Bear Creek (Woodward-Clyde 1991a).

Groundwater throughout the region generally occurs in river and stream-bed alluvium, except where affected by permafrost. At Lower Camp, alluvium deposited by Indian River and its tributaries covers the valley floor. In the spring/summer season, the groundwater level in the alluvium is shallow and likely determined by the river stage. During winter the shallow alluvium is frozen and less permeable, and frost layers can redirect groundwater movement. Upper Camp surficial material consists of thin, highly permeable residuum through which groundwater percolates downslope following bedrock contours or the permafrost table (Woodward-Clyde 1991a).

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Insufficient information was available to determine the 100-year flood plan for Indian River and Utopia Creek, as neither stream was gauged. Both streams will overbank during severe storms and flood low benches adjacent to the streams. Flood flow from a 1994 storm reached the low chord of the bridge crossing Indian River. The 100-year flood would exceed the 1994 flood level by several feet. The Indian River bridge would likely be destroyed by a 100-year flood as would power and communications cables to Top Camp and to Alascom, which are attached to the bridge. The water supply to the installation would be severely threatened by a 100-year flood. Except for the Indian River bridge and water supply intake downstream of the bridge, there is no flood threat to installation structures.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Indian Mountain LRRS. Much information included in INRMP Chapter 5.0 that includes Indian Mountain LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Indian Mountain LRRS and the surrounding area. ***Appendix 3.0-Yukon***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Indian Mountain LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 130 Subarctic Division
Province: 131 Yukon Intermontane Plateaus Tayga Province
Description: The province is made up of a series of broad valleys, dissected uplands, and lowland basins covered with alluvial deposits. In this semiarid province winters are long and severe with temperatures dropping as low as -75°F ,and summers are short and hot with temperatures rising as high as 100°F. Dense white spruce-cottonwood-poplar forests are found on major river bottoms; evergreen and coniferous forests are on outer valley edges; and in upland areas are dense white spruce-birch-aspen-poplar forests. Near streams are pure stands of white spruce. The dominant soil is Inceptisols, which are found in the river bottoms, lower slopes, and uplands; bog soils are Histosols.

5.2 Vegetation

Gutleber (undated(b)) identified seven vegetation/cover types at Indian Mountain LRRS. These consist of relatively pure stands of white and black spruce, upland spruce/hardwood, wetlands, disturbed grassland, mine tailings/gravel, and alpine tundra. The vegetation type in the immediate vicinity of the LRRS is upland spruce/hardwood forest, a moderately dense forest of white spruce, birch, aspen, and balsam poplar. Black spruce usually replaces white spruce on north-facing slopes and poorly drained flat areas. White spruce trees, 40-80 feet high and up to 15 inches in diameter, occur in mixed stands on south-facing slopes and well-drained soils and may form pure stands near streams. Tussocks of bentgrass and sphagnum moss are also found in this area.

White birch and aspen stands, usually an early stage of succession following a fire, tend to be even-aged and more uniform in size than spruce stands. Largest birches are about eight inches in diameter and 50 feet tall; aspen trees are up to 10 inches in diameter and 50 feet tall. Aspen and birch predominate on well- to excessively-drained southern slopes (Gutleber undated(ab)).

Undergrowth in spruce/hardwood forest normally consists of mosses and grasses on drier sites and brush on moist slopes. Typical undergrowth species are willow, alder, ferns, rose, high-bush cranberry, lingonberry, raspberry, currant, Labrador tea, and horsetail (Gutleber undated(b)).

Grasslands at the LRRS are primarily artificial, a result of past mowing and brush cutting activities. White spruce becomes sparse among high brush, which includes dwarf and resin birch, and willows as the treeline is approached. Upper Camp (4,200-foot elevation) is above treeline, and the sole vegetation consists of lichens (Gutleber undated(b)).

A general vegetation map of Indian Mountain LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995f). Schick *et al*. (2004) made significant improvements in vegetation mapping at Indian Mountain LRRS (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Indian Mountain LRRS in 2001 and 2005. This project used 2001 National Land Cover Database data (http://www.mrlc. gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth. Table 5.2 shows these acreages and changes over this 4-year period. Figure 5.2a shows habitat classes for 2005, and Figure 5.2b shows changes in habitat classes between 2001through 2005.

Table 5.2 Habitat Class Differences between 2001 and 2005, Indian Mountain LRRS and Other Adjoining Withdrawn Lands

Habitat Class	Acres 2001	Acres 2005	Acreage Change
Barren Land	47.8	237.6	189.8
Deciduous Forest	793.1	823.3	30.2
Dwarf Shrub	4,314.9	4,239.6	-75.3
Evergreen Forest	935.7	935.7	0.0
Mixed Forest	876.0	876.0	0.0
Sedge/Herbaceous	3.3	3.3	0.0
Shrub/Scrub	2,745.2	2,600.6	-144.6
Totals	**9,716.0**	**9,716.0**	**0.0**

Schick *et al*. (2004) described the Indian Mountain LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Air Force withdrawn lands (including Indian Mountain LRRS [4,226 acres]) encompass 9,247 acres[1]. The LRRS is separated into two distinct areas; the Lower Camp and runway, which occur in the Indian River Valley that contains riverine, lowland, and upland scrub and forest habitats, and the larger Upper Camp area, which is mostly mountainous alpine terrain with rock, dwarf scrub, and herbaceous tundra. Indian Mountain LRRS is well-drained to moderately well-drained, and there are no wet and few moist tundra

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

habitats. Common wildlife habitats at the LRRS include Upland Rock, Upland Dwarf Scrub, and Upland Open Mixed Forest.
Alpine habitats at Indian Mountain, which tend to occur on steep high elevation slopes, include Upland Dwarf Scrub, Upland Moist Graminoid-Herb Tundra, Upland Moist Sedge-Shrub Tundra, and Upland Rock. These habitats are used by ground-nesting passerine species (*e.g.*, American Pipits and Savannah Sparrows), as well as ptarmigan and shorebirds, such as Surfbirds. They also are used by mammals, such as the red fox, Arctic ground squirrel, and caribou. The most common wildlife habitats at Lower Camp include Lowland Open Needleleaf Forest, Upland Open Mixed Forest, Upland Open Broadleaf Forest, and Upland Tall Open Scrub. These types provide foraging and nesting habitat for a variety of passerine and corvid species.

Other riverine, lowland, and upland habitats occur in the Indian Mountain LRRS area, but none cover a significant percentage of area. However, these still provide suitable habitat for many shrub and tree-nesting passerines, and shorebird species, like Lesser Yellowlegs and Spotted Sandpipers. Red squirrels also use mixed and needleleaf forest types at Lower Camp, and moose use riverine and lowland scrub and forest habitats. The large area and diversity of habitat types that the Indian Mountain LRRS encompasses provide for a diversity of bird and mammal species.

5.3 Fish and Wildlife

5.3.1 Fish

Grayling may occur in winter in larger rivers, such as the Tanana, and usually spawn in mid-June in smaller tributaries. Large numbers of anadromous lamprey on spawning migrations may be conspicuous in some years (ADFG 1978). Typically, only grayling occur in Indian and Utopia creeks at the installation (Gutleber undated(b))

5.3.2 Mammals

Rolling hills and mountains that surround Indian Mountain LRRS are generally less productive than other habitats in the region. The site is primarily covered with upland spruce/hardwood forest and supports few animals. Red squirrel and pine marten, which meet all their habitat requirements in this area, are exceptions (Gutleber undated(b)).

Broad river valleys of the general area support moose. These broad valleys, covered with mixed spruce/hardwood and muskeg/bog vegetation, and river islands, covered with young willows, provide excellent year-round moose habitat. This intermixture of types is also favorable for other woodland mammals (Gutleber undated(b)).

Caribou seen in this area are probably from the Western Arctic Caribou Herd. Typically, less than 100 caribou move through the site in winter. However, during winter 1992/1993 approximately 2,000 caribou moved through the area, many staying on exposed ridge tops and slopes at Upper Camp for an extended period. Caribou use a wide variety of habitats, but the best winter range is in sparse upland spruce timber where they can paw through the snow cover for lichens beneath. Some windblown alpine slopes also provide good forage. Both moose and caribou are important elements in the local subsistence economy, and both contribute to recreation (Gutleber undated(b)).

The brown/grizzly bear of the Yukon Region, which do not attain the size of their counterparts on the coast, tend to favor open slopes and mountainous areas along the lower Yukon-Innoko-Koyukuk drainages and elsewhere throughout the area. In fall they feed on salmon along tributaries of the Koyukuk River as the fish migrate upstream to their spawning area. Black bears range throughout forested valleys, showing a preference for open, mixed forests. Other large carnivores found in the area include the wolf,

Figure 5.2a Indian Mountain LRRS and Other Adjoining Withdrawn Lands Wildlife Habitat Map, 2005

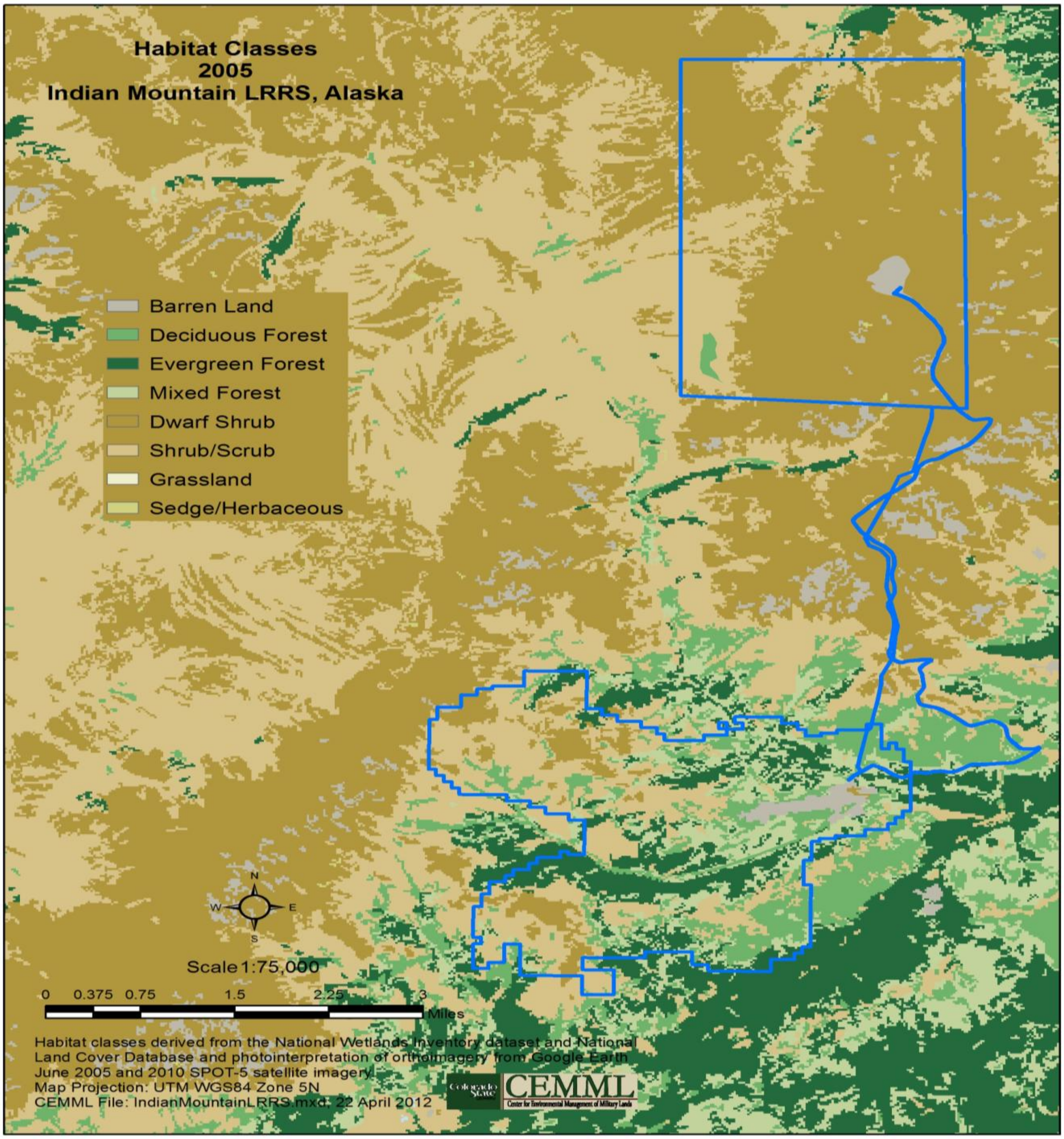


Figure 5.2b Changes in Habitat Classes at Indian Mountain LRRS and Other Adjoining Withdrawn Lands between 2001 and 2005

wolverine, red fox, and North American lynx. Beavers, muskrats, and river otters use various waterways and wetlands of the Koyukuk River and its tributaries. Smaller mammals that inhabit the region include the shrew, marten, weasel, mink, squirrel, lemming, vole, mouse, porcupine, and snowshoe hare (Gutleber undated(b)).

5.3.3 Birds

The central Yukon River region contains several lakes dotted with alluvial basins which support excellent summer habitat for aquatic birds. Areas such as the Koyukuk-Nowintna NWR, located south of the LRRS, support the Glaucous, Glaucous-winged, Mew, Bonaparte's, and Herring Gulls, Arctic Tern; and the Parasitic and Long-tailed Jaeger. Several species of shorebirds, particularly the Common Snipe, inhabit the area. Several species of plovers and sandpipers are common nesters or visitors, while the Whimbrel, Godwit, Lesser Yellowlegs, Dunlin, Sanderling, and Red Phalarope are less common. The northwestern limit of the Trumpeter Swan extends to the Koyukuk and Nowintna areas. Some more common waterfowl that nest or stop over in the area during their migratory flights include the American Wigeon, Mallard, Green-winged Teal, Northern Pintail, and Canada, White-fronted, and Snow Goose.

Other waterbirds commonly nesting in the Koyukuk-Nowintna area include the Common, Arctic, and Red-throated Loon and Horned and Red-necked Grebe. Sandhill Cranes nest by the thousands throughout the area (Gutleber undated(b)).

Interior valleys in the Koyukuk-Nowintna area are important habitats for passerine birds and raptors. Raptors that commonly nest in the area are Red-tailed, Rough-legged, and Northern Harrier Hawk; Osprey; American Kestrel; and Short-eared and Northern Hawk Owl. The Northern Goshawk and Great Horned Owl are common year-round residents in valleys, and the Gyrfalcon is a resident of surrounding hills. Occasional nests of the Golden Eagle and Great Gray Owl have also been recorded. The Sharp-shinned, Red-tailed, and Swainson's Hawk; Snowy Owl; and Bald Eagle have also been observed. A small population of the formerly endangered American Peregrine Falcon (*Falco peregrinus anatum*) occurs throughout the Yukon River region, including the Indian Mountain area (Gutleber undated(b)).

Passerine birds are abundant throughout the LRRS area and the surrounding countryside. Some common species observed in the area include Dark-eyed Junco, Hermit Thrush, Yellow and Yellow-rumped Warbler, White-crowned and Savannah Sparrow, Cliff Swallow, and American Robin. Common nesters include Swainson's and Gray-cheeked Thrushes, Wilson's and Yellow Warblers, Common Redpoll, White-crowned and Fox Sparrows, Dark-eyed Junco, and White-winged Crossbill. American Dippers, Orange-crowned Warblers, and Three-toed Woodpeckers occasionally nest in the region. The American Pipit, Northern Shrike, Snow Bunting, Lapland Longspur, Hoary Redpoll, and Belted Kingfisher have also been recorded. A few hardy passerine birds, such as Common Raven, Gray Jay, Black-capped and Boreal Chickadee and, more rarely, Northern Flicker and Hairy and Downy Woodpecker, remain in these latitudes all winter (Gutleber undated(b)).

Twenty-one bird species were observed at Indian Mountain LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations confirmed nesting Solitary Sandpiper, Surfbird, and Common Raven occurred. Other species observed included Rock Ptarmigan; Lesser Yellowlegs; Spotted Sandpiper; Say's Phoebe; Swainson's Thrush; Orange-crowned Warbler; and Savannah, Fox, and White-crowned Sparrows.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur within the boundaries of Indian Mountain LRRS. However, the delisted American Peregrine Falcon (USFWS 2004b) potentially occurs in the vicinity of Indian Mountain (Alaska Natural Heritage Program 1993, Buckle 1993). The American Peregrine Falcon was removed from the Endangered Species List in 1999. The USFWS recommends agencies avoid impacts to the Peregrine Falcon to assure a healthy long-term population (Sousa 1999).

5.5 Wetlands

Wetlands at Indian Mountain LRRS are strongly dominated by well-drained, steep-sloping areas that are classified as jurisdictional Uplands, although moist sloping areas of wetter saturated or seasonal flooding and of persistent standing water do occur. Dominant dwarf scrub species in these areas include *Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea, Ledum decumbens, Dryas octopetala, Arctostaphylos alpina,* and *Salix rotundifolia*. Dominant forest species include *Betula papyrifera* and *Picea glauca*, and associated species include *Alnus crispa, Calamagrostis canadensis, Galium triflorum, Linnaea borealis, Mertensia paniculata, Trientalis europaea, Artemisia tilesii*, and *Rosa acicularis.* (Schick *et al*. 2004).

The general Indian Mountain LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Table 5.2 shows wetland acreages at Indian Mountain LRRS. The general Fort Yukon LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Indian Mountain LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (1,951.58 acres within Air Force lands). Figure 5.5 shows wetlands on Indian Mountain LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Residents of Hughes harvest salmon, freshwater fish, moose, caribou, black bear, rabbits, waterfowl, and berries. Seasonal resources that define the annual subsistence cycle are salmon, land mammals, and waterfowl. Two species, chum salmon and moose, accounted for about 84 percent of the annual harvest in terms of edible pounds in 1982. Fishing activities at Hughes focus on the Koyukuk River and its tributaries. Hughes residents concentrate hunting activities along the Koyukuk River from the mouth of the Kanuti River to the mouth of Hogatza River for hunting terrestrial mammals and birds (Braund and Associates 2004).

5.6.2 Outdoor Recreation

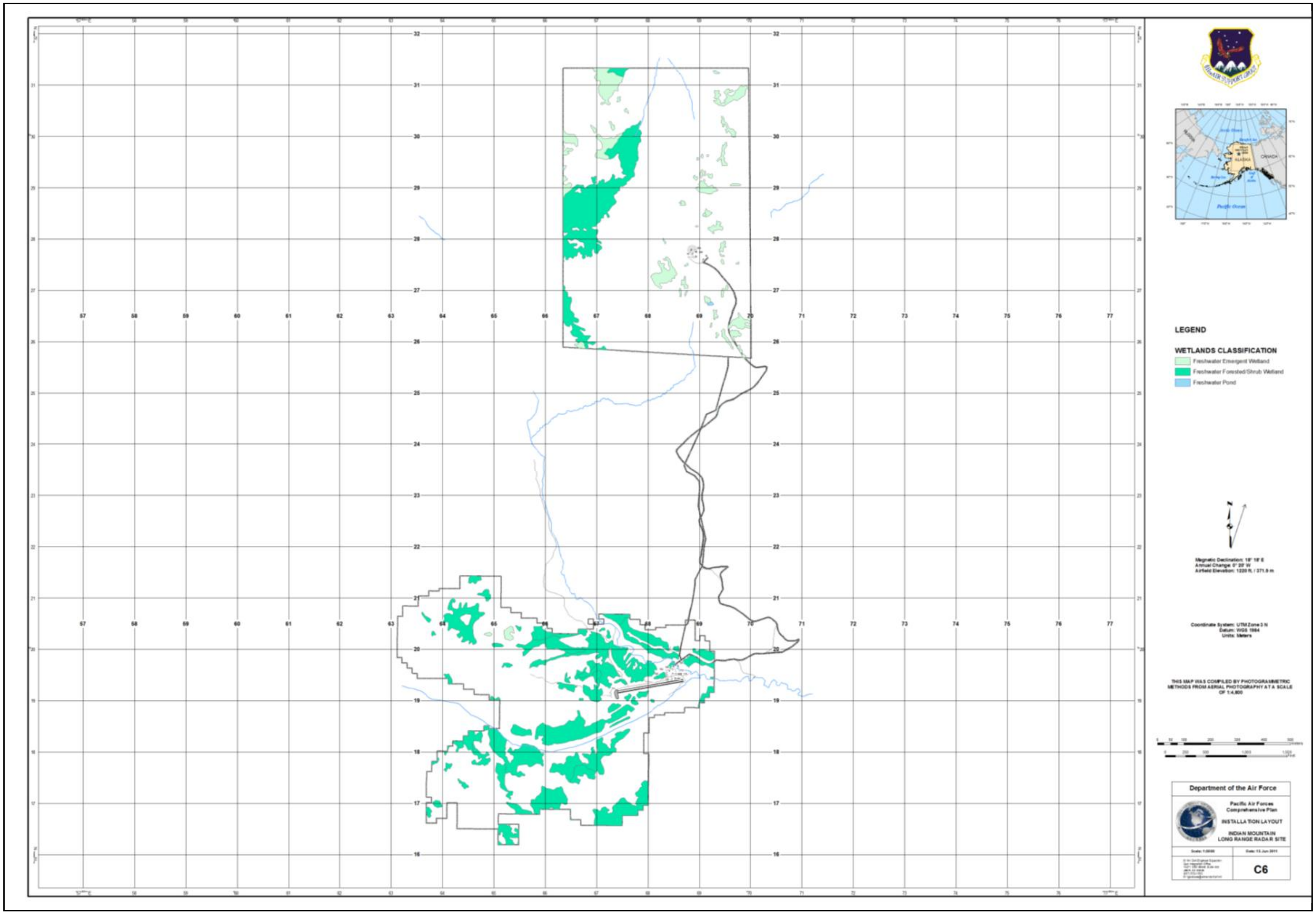
Outdoor recreation in the Indian Mountain area consists of activities such as hunting, fishing, trapping, and gold panning. BOS contract personnel stationed at Indian Mountain, temporary duty personnel during free time, and subsistence hunters from Hughes hunt the area, but little or no demand exists by DoD personnel to travel to the site for recreational purposes. Subsistence and recreational fishing and hunting are part of the local culture by members of the village of Hughes.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Indian Mountain LRRS is divided into two camps connected by a steep winding road that is about eight miles long and terminates at the summit of Indian Mountain at 4,234 feet above msl. Lower Camp, located at the confluence of Indian River and Utopia Creek, has an airfield, bulk fuel storage, and other facilities which support operations for both camps. The residential dome and industrial dome were completed at Lower Camp in 1984. The only structures at Upper Camp are the MAR unit and a small shack housing a backup generator. A non-directional beacon was installed at Indian Mountain in 2006.

Figure 5.5 Indian Mountain LRRS and and Other Adjoining Withdrawn Lands Wetlands, 2011



In recent years a landfill lift has occurred; a new storage building was built; and a new gravel quarry (less than one acre) was established about six miles towards Upper Camp. Five temporary buildings are maintained as survival shelters along the road between Lower and Upper Camp. These are relatively small (6 x 6-8 x 10 feet) wooden shelters and are stocked with survival gear to accommodate personnel during vehicle breakdowns in portions of the road that are outside radio coverage. The LRRS is within a BLM Area of Critical Environmental Concern.

Land surrounding the LRRS is managed by the BLM. However, there are numerous placer-mining claims along Indian River and Utopia Creek. The BLM Kobuk District's Central Resource Plan and Record of Decision designated 162,822 acres within the Indian River watershed as an Area of Critical Environmental Concern, including Indian Mountain LRRS. The primary purpose of this designation is to identify sensitive and valuable aquatic resources that require special consideration, particularly chum and chinook salmon production habitats (Jacobs Engineering Group, Inc. 1995).

BLM (2000) would like to see a provision that the BLM can continue to use the LRRS for staging field activities; the Air Force will continue to accommodate BLM on a space-available basis.

Land at Indian Mountain LRRS is leased to the Federal Aviation Administration for general aviation communication and to AT&T for and general communications.

Appendix 3.0 – Kotzebue. Kotzebue Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Kotzebue LRRS, Prior to Demolition of Most Facilities

3.1 Location and Area

Kotzebue LRRS is 610 miles northwest of Anchorage and 450 miles west-northwest of Fairbanks (INRMP Figure 3.1). The LRRS is located on 676 acres of land on Kotzebue Sound (Figure 3.1). The LRRS is 26 miles north of the Arctic Circle (Tetra Tech, Inc. 1995).

3.2 Installation History

Kotzebue LRRS was originally built as a temporary AC&W site to fill a radar coverage gap while the Cape Lisburne and Tin City sites were being built. Kotzebue LRRS was equipped with lightweight search radar when first activated in 1950 (Boyer undated(a)). In 1954 the site was converted to a permanent station. Kotzebue operated as a ground-controlled intercept site from 1958-1973 when satellite communications systems began being used at the site. Communications for Kotzebue LRRS were provided by WACS from 1957 until 1979 when it was replaced by a commercial satellite earth terminal.

In 1977 personnel at Kotzebue LRRS were reduced from 85 to 16, and in 1984 to only two technicians to maintain the MAR system, which was installed in 1985. One contractor, a full-time radar maintenance technician, is now employed at the LRRS and lives in the community. The only remaining structures at Kotzebue LRRS are the radome building and a storage building.

3.3 Surrounding Communities

The community of Kotzebue is four miles north of the LRRS. Kotzebue has a population of 3,2010 (2010 estimate) comprised primarily of Inupiat Eskimos (www.dced.state.ak.us 2012). Subsistence activities are an integral part of the lifestyle. Each summer the North Tent City fish camp is set up to dry and smoke the season's catch. Kotzebue is the service and transportation center for all villages in the northwest region. It has a healthy cash economy, a growing private sector, and a stable public sector. Most income is directly or indirectly related to government employment, such as the School District, Maniilaq Association, and the city and borough. The Cominco Alaska Red Dog Mine is a significant regional employer. Commercial fishing permits are held by 115 residents in 2010. Most residents rely on subsistence to supplement income (www.dced.state.ak.us 2012). The Kotzebue Electric Association has a wind farm adjacent to the LRRS. This project has not affected operations at Kotzebue LRRS.

3.4 Regional Land Use

The area's native name is Kikiktak, and it had long been the site of a summer fish camp. It was also the site of the largest annual Eskimo trade fair in Alaska, drawing natives from Siberia as well as Alaska. Kotzebue is within the historic territory of the Malemiut who subsisted on caribou, salmon, and seals. Large winter villages were located along the rivers, and winter houses were semi-subterranean log structures covered with moss.

Kotzebue is named after Baron Otto van Kotzebue who began exploring the Bering Straits in 1815. Natives felt the presence of white Europeans soon after Baron Otto van Kotzebue's time when the area was explored and later exploited. The search for Sir John Franklin in 1847 and American whaling, which began in 1845, brought an increasing number of outsiders. In 1880 approximately 200 persons lived in the Kotzebue area. In 1897 a reindeer station was established, and people were drawn to Kotzebue as it became a distribution center for goods and services. Historically, it has grown as a transportation hub for river travel along the Noatak, Kobuk, and Selawik rivers, as well as a hub for air travel to northern Alaska (Selkregg 1975).

3.5 Local and Regional Natural Areas

Kotzebue LRRS has no special natural areas (*e.g*., refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate

Kotzebue is located in the Transitional Climactic Zone, which is characterized by long, cold winters and cool summers. The coastal area experiences a predominantly maritime climate. The climate is strongly influenced by the seasonable coverage of sea ice in Kotzebue Sound (Tetra Tech, Inc. 1995). Average summer high temperatures range from about 51º to 60ºF. Average winter low temperatures typically range between -3º and 3ºF. A record high temperature of 85ºF was recorded in 1958 and 1991, and a record low temperature of -58ºF was recorded in 1930. Average annual precipitation is approximately 10 inches, with most occurring between July and October (www.weather.com).

Surface waters generally freeze-up between early and mid-October, and break-up occurs in mid to late-May. Prevailing winds average 10 knots annually and are easterly in winter and westerly in summer (Tetra Tech, Inc. 1995).

Figure 3.1 Kotzebue LRRS

Table 4.1 Kotzebue, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	4ºF	6ºF	9ºF	21ºF	38ºF	51ºF	60ºF	56ºF	47ºF	29ºF	14ºF	9ºF
Average Low	-10ºF	-8ºF	-7ºF	5ºF	26ºF	40ºF	50ºF	47ºF	38ºF	20ºF	4ºF	-4ºF
Mean	-3ºF	-1ºF	1ºF	13ºF	32ºF	46ºF	55ºF	52ºF	43ºF	25ºF	9ºF	3ºF
Record High	39ºF (1961)	40ºF (1989)	39ºF (1973)	48ºF (1988)	71ºF (2002)	85ºF (1991)	85ºF (1958)	80ºF (1968)	69ºF (1978)	57ºF (1904)	40ºF (2003)	37ºF (1982)
Record Low	-55ºF (1934)	-52ºF (1968)	-56ºF (1930)	-44ºF (1943)	-12ºF (1964)	20ºF (1903)	30ºF (1976)	26ºF (1902)	13ºF (1992)	-19ºF (1975)	-37ºF (1935)	-49ºF (1935)
Average Precipitation	0.55 inches	0.42 inches	0.38 inches	0.41 inches	0.33 inches	0.57 inches	1.43 inches	2.00 inches	1.70 inches	0.95 inches	0.71 inches	0.60 inches

Source: www.weather.com (January 16, 2012)

5.1 Landforms

Kotzebue LRRS is located on the Baldwin Peninsula within the Kobuk-Selawik Lowland section of coastal western Alaska. This physiographic section is characterized by broad river flood plains and lowlands forming deltas along seaward margins. The ground surface is moist tundra with permafrost underlying most of the area.

Kotzebue is located on a recurved spit, which is about three miles long and ranges in width from 1,100 to 3,600 feet. A shallow, narrow-mouthed, brackish lagoon separates the spit from the highland edge of the Baldwin Peninsula. The lagoon freezes solid each winter. The LRRS is situated on temnants of an eroded moraine on Baldwin Peninsula (Boyer undated(a)). Topographic relief at the LRRS is about 155 feet from Kotzebue Sound to the top of the hill at the composite facility.

4.3 Geology and Soils

For the last two or three million years, frost climates have prevailed in Alaska, and geomorphic processes have been either glacial or periglacial. During Quaternary time, Alaska's landscapes have been reworked by advancing and retreating extensive, but by no means all-encompassing, continental glaciers.

Alaska's generally cold climatic regime results in a broad distribution of permanently frozen ground (permafrost). Permafrost occurs in both unconsolidated sediments and bedrock, and it is distributed throughout much of the state, with the notable exception of the Pacific coastal area. Permafrost has a significant impact on the flow of groundwater.

The geology of the area is dominated by glacial moraine and drift deposits, overlain locally by thin, sandy beach deposits. These deposits include mixed clay, silt, sand, and gravel of uncertain thickness (Boyer undated(a)).

Soil characteristics of the spit at Kotzebue vary greatly within short distances. Generally, the seaward side is underlain by a gravel bench while the inland side facing the slough is underlain by gravel covered with silts and very fine sand.

Permafrost is continuous under Kotzebue and present at shallow depths. Polygonal ground is visible wherever the surface has not been disturbed by grading, indicating that vertical ice lenses are common in frozen silts. Permafrost is moderately thick and has been reported to a depth of 238 feet below grade. The permafrost is underlain by fine-grained sediments containing brackish water, and salinity has been reported to increase with depth (Boyer undated(a)). The presence of permafrost beneath beach sands is uncertain.

4.4 Hydrology

4.4.1 General

Runoff originating from Kotzebue LRRS is directed either west to Kotzebue Sound or east to adjacent wetlands. Runoff draining east eventually reaches the LRRS lake (former LRRS water supply). Flooding is not known to have been a problem, although the U.S. Army Corps of Engineers indicates the site has been designated by the Federal Insurance Administration as located within a coastal flood hazard zone. The combination of high tides and high shoreward winds periodically floods local beaches and adjacent low-lying areas.

The hydrogeology of Kotzebue LRRS is dominated by glacial moraine and drift deposits. Permafrost is generally encountered within several feet of the ground surface, and brackish water is contained in the fine-grained sediments underlying the permafrost. The salinity of groundwater reportedly increases with depth below the land surface. Groundwater of unknown quality occurs seasonally or intermittently above permafrost in the active zone at Kotzebue LRRS, moves at very slow rates below the tundra, and has no identified beneficial use to the LRRS.

Two general subsurface flow regimes at Kotzebue LRRS include (1) the tundra hill and surrounding areas and (2) the Kotzebue Sound beach area. The tundra hill and surrounding areas generally have near-surface silts extending to permafrost. Shallow, seasonal groundwater in this area may flow east toward the former water supply lake or west toward Kotzebue Sound, depending on site location with respect to the hill at the composite facility. Recharge to the active zone is limited by the low average annual precipitation. Flow is relatively slow because of the low permeability of silt soils and seasonal soil freezing. Suprapermafrost groundwater is derived from snowmelt and rainfall and is likely fresh.

The Kotzebue Sound beach area contains coarse sands and gravel. Shallow groundwater along the beach likely flows towards the Sound at relatively high rates because of high soil permeability. Groundwater along the beach is probably saline and influenced by tidal activity.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. The 100-year flood elevation of Kotzebue Sound at Kotzebue is 10.4 feet msl. There are no installation facilities within the flood plain. The level of the unnamed lake is not recorded, so no estimation could be made of its 100-year flood plain. However, its maximum rise should be less than three feet.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Kotzebue LRRS. Much information included in INRMP Chapter 5.0 that includes Kotzebue LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Kotzebue LRRS and the surrounding area. ***Appendix 3.0-Lisburne***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Kotzebue LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division

Province: 125 Bering Tundra (Northern) Province
Description: As a western extension of the arctic coastal plain, the Bering Tundra is a broad lowland area rising gradually to the east. Winters are cold, and summers are generally cool. Annual precipitation is 17 inches. Along coastal areas the vegetation is mainly sedge and cottongrass; on higher sites are woody plants. In transition areas between beach and forest are birch-willow-alder thickets. Inceptisols over silt, sand, and marine sediments are found along the coast; in the lower Yukon and Kuskokwim Valley bottoms are pockets of Entisols. In most of the area, the permafrost is continuous.

5.2 Vegetation

Moist tundra vegetation surrounds Kotzebue LRRS. Cottongrass tussocks and dwarf shrubs usually completely cover the ground. The soil is commonly saturated, and mosses and lichens grow in channels between tussocks. Frost conditions may create small frost polygons supporting grass and forbs. Common plants occurring on Kotzebue LRRS include cottongrass, dwarf birch, willows, Labrador tea, mountain avens, bistort, and saxifrages (Boyer undated(a)). The moist tundra in the Kotzebue area is very sensitive, and recovery of natural vegetation of disturbed plant communities may take years.

A general vegetation map of the Kotzebue LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995d). Schick *et al*. (2004) made significant improvements in vegetation mapping at Kotzebue LRRS (using 1998 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Kotzebue LRRS in 2001 and 2007. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth. Table 5.2 shows these acreages and changes over this 6-year period. Figure 5.2a shows habitat classes for 2007, and Figure 5.2b shows changes in habitat classes between 2001through 2007.

Table 5.2 Habitat Class Differences between 2001 and 2007, Kotzebue LRRS

Habitat Class	Acres 2001	Acres 2007	Acreage Change
Barren Land	3.7	3.3	-0.4
Developed, Low Intensity	59.4	60.3	0.9
Developed, Medium Intensity	9.9	9.9	0.0
Dwarf Shrub	90.8	90.8	0.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0
Open Water	12.0	13.3	1.3
Sedge/Herbaceous	57.5	57.5	0.0
Shrub/Scrub	294.8	294.8	0.0
Woody Wetlands	134.4	132.6	-1.8
Totals	**662.4**	**662.4**	**0.0**

Schick *et al*. (2004) described the Kotzebue LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source. Kotzebue LRRS encompasses 676 acres[1] acres of very gently rolling tundra terrain. Wildlife habitats at the LRRS are primarily upland low and tall scrub, lowland low and tall scrub, and lowland tundra types.

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

Figure 5.2a Kotzebue LRRS Wildlife Habitat Map, 2007

Figure 5.2b Changes in Habitat Classes at Kotzebue LRRS between 2001 and 2007

One large, deep lacustrine lake, located in the central portion of the LRRS, accounts for most lacustrine waters in the area. This lake has partially drained in the relatively recent past. The lake has small tundra islands and may provide preferred habitat for nesting and brood-rearing waterbirds. The bulk of the LRRS, however, is composed of Upland Low Open Scrub and Upland Low Shrub-Tussock Scrub. These habitats are used primarily by nesting passerines, some shorebirds, and perhaps ptarmigan.

Tall scrub habitats, lowland scrub, and tundra types are primary wildlife habitats at the LRRS. These habitats may also be frequented by passerines, shorebirds, and ptarmigan. Of note is the presence of Lowland Low Shrub-Sedge Bog at the site. This habitat is a mixture of raised shrub islands and wet sedge tundra and during the 2002 visit was being used by what appeared to be brood-rearing Whimbrels. The only riverine habitats at the site, which line the banks of small streams, are low scrub types.

5.3 Fish and Wildlife

5.3.1 Fish

A variety of fish inhabit inland and coastal waters of the Kotzebue area. All five species of salmon are found in Kotzebue Sound, but only chum salmon occur in substantial numbers. Species important to subsistence fishing in the area include whitefish and Arctic char. Other species found in the area include tomcod, Arctic cod, rainbow smelt, flounder, nine-spined stickleback, and herring (Boyer undated(a)).

5.3.2 Mammals

Terrestrial mammals inhabiting moist tundra habitats include several species of voles, tundra shrews, lemmings, tundra hares, Arctic ground squirrels, and red foxes. Larger species, such as caribou, brown/grizzly bears, wolves, and moose, typically do not range into the Baldwin Peninsula (Boyer undated(a), Tetra Tech, Inc. 1995).

The endangered bowhead whale, gray whale, killer whale, minke whale, and beluga whale, as well as harbor porpoise, may occur in the Kotzebue area. Several seal species, including spotted, harbor, ringed, and bearded seals, occur in the area and are harvested by the local native community (Wynne 1993).

Because the peninsula lies within the relatively protected water of Kotzebue Sound, marine mammals that follow the pack ice (*e.g.*, walrus, bearded seal, polar bear) typically occur within the Sound only for a short period in spring when leads open in the sea ice (Tetra Tech, Inc. 1995).

Although most marine mammals are under the jurisdiction of the NMFS, walruses and polar bear are under the jurisdiction of the USFWS. The Kotzebue area is within the range of the polar bear, a protected species under the provision of the MMPA (Bridges 2001).

5.3.3 Birds

Seabirds observed in the area during a 1993 site visit (Woodward-Clyde 1995d) included the Long-tailed Jaeger, Arctic Tern, and Glaucous Gull. Other birds observed at Kotzebue LRRS included the Greater Scaup, Northern Pintail, Ruddy Turnstone, Bank Swallow, Western Sandpiper, Common Snipe, Common Raven, Yellow Wagtail, Yellow Warbler, Savannah and White-crowned Sparrow, and Hoary Redpoll.

Common breeding or resident birds in the area include the Pacific Loon, Greater White-fronted and Canada Goose, Green-winged Teal, Northern Pintail, Northern Shoveler, American Wigeon, Greater Scaup, Longtail Duck, Black Scoter, Common Murre, Lesser Golden Plover, Whimbrel, Least Sandpiper, Common Snipe, Red-Necked Phalarope, Long-tailed Jaeger, Mew and Glaucous Gull, Arctic Tern, Bank Swallow, Yellow Wagtail, Yellow Warbler, White-crowned Sparrow, and Common and Hoary Redpoll (USFWS 1992).

Breeding species observed in 1998 at the Kotzebue Monitoring Avian Productivity and Survivorship (MAPS) station, administered by the NPS, include Yellow Wagtail, Yellow Warbler, Northern Waterthrush, Wilson's Warbler, American Tree Sparrow, Savannah Sparrow, Fox Sparrow, White-crowned Sparrow, and Common and Hoary Redpolls (personal communication, C. Eberly, DoD Partners in Flight with G. Augustine). The MAPS station is located within 10 kilometers of and contains habitat similar to the LRRS.

Twenty-three bird species were observed at Kotzebue LRRS during the ABR, Inc. 2002 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included such species as Red-throated Loon, Green-winged Teal, Greater Scaup, Sandhill Crane, Whimbrel, Long-billed Dowitcher, Bank Swallow, Yellow Warbler, and four species of Sparrows.

The USFWS survey of breeding birds (Andres *et al*. 1999) on the Army National Guard training area at Kotzebue is a valuable addition to the database for the Kotzebue LRRS area. This three-day study identified 69 species, including 64 confirmed, probable or possible breeders.

5.4 Threatened and Endangered Species

The threatened polar bear occurs at Kotzebue LRRS, and the endangered bowhead whale occurs in off-shore waters. Threatened ringed and bearded seals are known in the area. The potential exists for other federally-protected species to occur in the Kotzebue area, including threatened Spectacled and Steller's Eiders, and endangered humpback whales (Alaska Natural Heritage Program 1993, USFWS 1997b, Rappoport 1993, Sousa 1993). There is low potential for either the Spectacled or Steller's Eider to nest at Kotzebue LRRS. The Pacific walrus, Kittlitz's Murrelet, and Yellow-billed Loon (candidates) are potentially at Kotzebue LRRS.

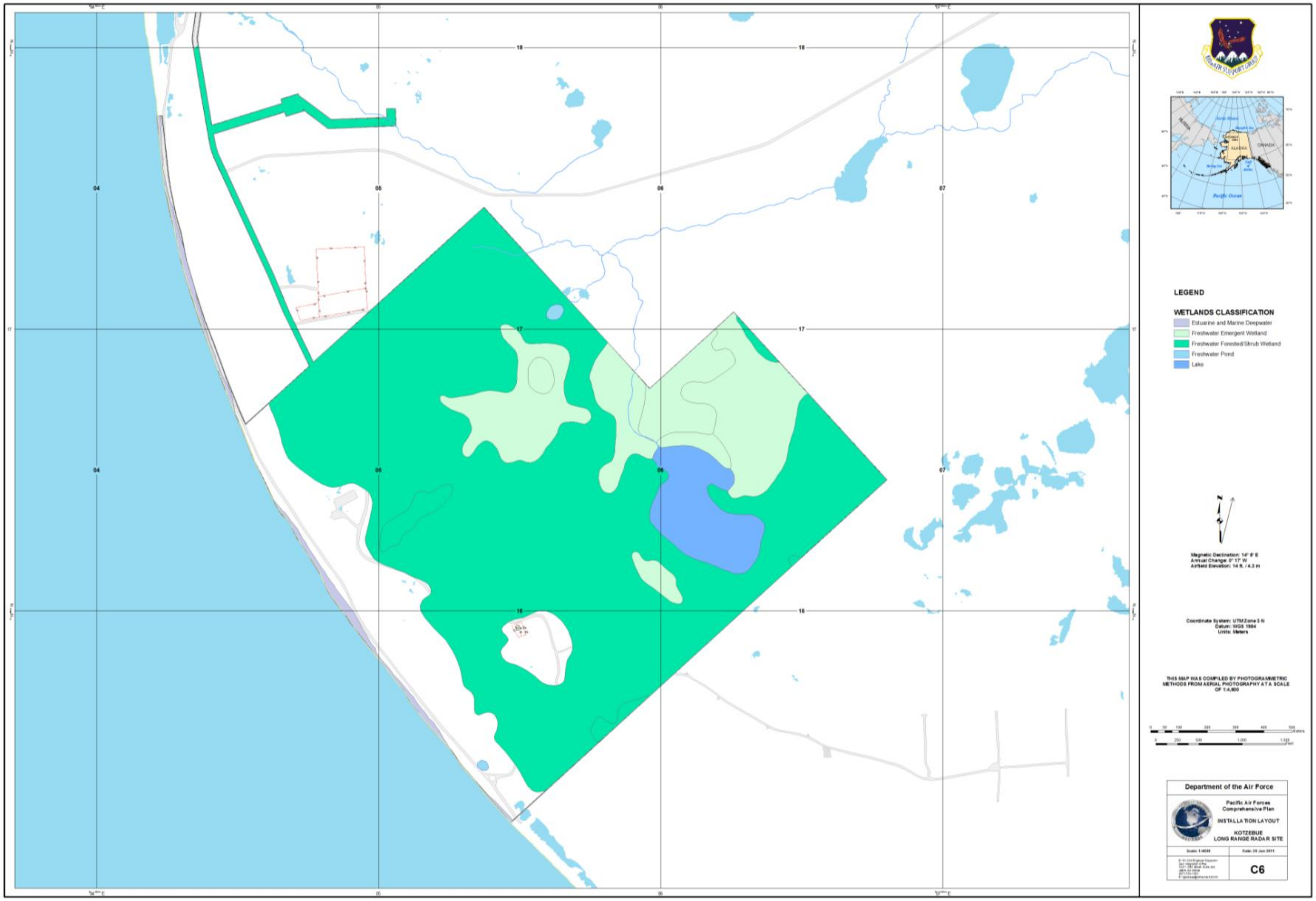
Several formerly listed or former Category 2 species (Harlequin Duck, Arctic Peregrine Falcon, North American lynx, and gray whale) are either confirmed or possible near Kotzebue LRRS. The formerly threatened Arctic Peregrine Falcon has been noted along major drainages in the area; therefore it may occasionally range into the LRRS (Sousa 1993). One plant species, Barneby's milkvetch (*Oxytropis arctica* var. *barnebyana)*, is a former Category 2 species and is known to occur only in the Kotzebue area (USFWS 1993B, Sousa 1993). This species has been confirmed on the LRRS.

An issue identified for Kotzebue LRRS in 1993 was the presence of Barneby's milkvetch (*Oxytropis arctica* var. *barnebyana*), a then Category 2 candidate species. This species was known to occur only in the Kotzebue area, and periodic surveys of the LRRS were recommended to document the presence or absence of the species. This species has since been confirmed on the LRRS. Thus, the issue has shifted from confirmation to protection. In 1996 inventories of potential habitat at No Name and North Fork tributaries of the Squirrel River located an estimated 14,282 plants at the No Name and 1,400 at the North Fork (Moran 1997). In light of the discovery, the rank of Barneby's milkvetch was reduced from critically imperiled as a rare plant to imperiled in state (Moran 1997).

5.5 Wetlands

The most common wetland type at the Kotzebue LRRS is palustrine, deciduous broad-leaved scrub-shrub. These areas are typically moist scrub and tundra habitats and are either saturated or somewhat well-drained depending on microtopography and landscape position. The few freshwater habitats at Kotzebue LRRS are classified as palustrine, unconsolidated bottom, permanently flooded (pond). These wetlands are composed primarily of the Upland Low Open Scrub wildlife habitat type and may also include Upland Low Shrub-Tussock Scrub, Upland Tall Open Scrub, and Lowland Low Shrub-Sedge Bog. Dominant shrub species in these areas include *Betula nana*, *Salix pulchra*, and *Alnus crispa*. Some upland tall scrub habitats at the site may, in fact, not be classified as wetlands depending on soil drainage (Schick *et al*. 2004).

Figure 5.5 Kotzebue LRRS Wetlands, 2011



The general Kotzebue LRRS vegetation map's wetland features (Woodward-Clyde 1995d) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Kotzebue LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (556.86 acres). Figure 5.5 shows wetlands on Kotzebue LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Ninety-seven percent of Kotzebue's population engages in subsistence activities. Traditional subsistence activates in the Kotzebue area have revolved principally around caribou and marine mammals, especially bearded seals, and a variety of fish species. Waterfowl, moose, furbearers, berries and "greens" have also been important although secondary. Five species, caribou, salmon, bearded seal, sheefish, and moose, account for about 80 percent of Kotzebue's annual subsistence harvest in terms of edible pounds in 1991 (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation at Kotzebue LRRS consists primarily of such activities as beachcombing and ATV riding along trails and beaches. Extensive ATV tracks on tundra vegetation are evident in the Kotzebue area; however, most ATV use on the LRRS is restricted to designated roads. BOS contract personnel stationed at Kotzebue, temporary duty personnel during free time, and subsistence gatherers from the neighboring area may hunt or fish in the general area. No interest exists by DoD personnel to travel to the site for recreation purposes.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

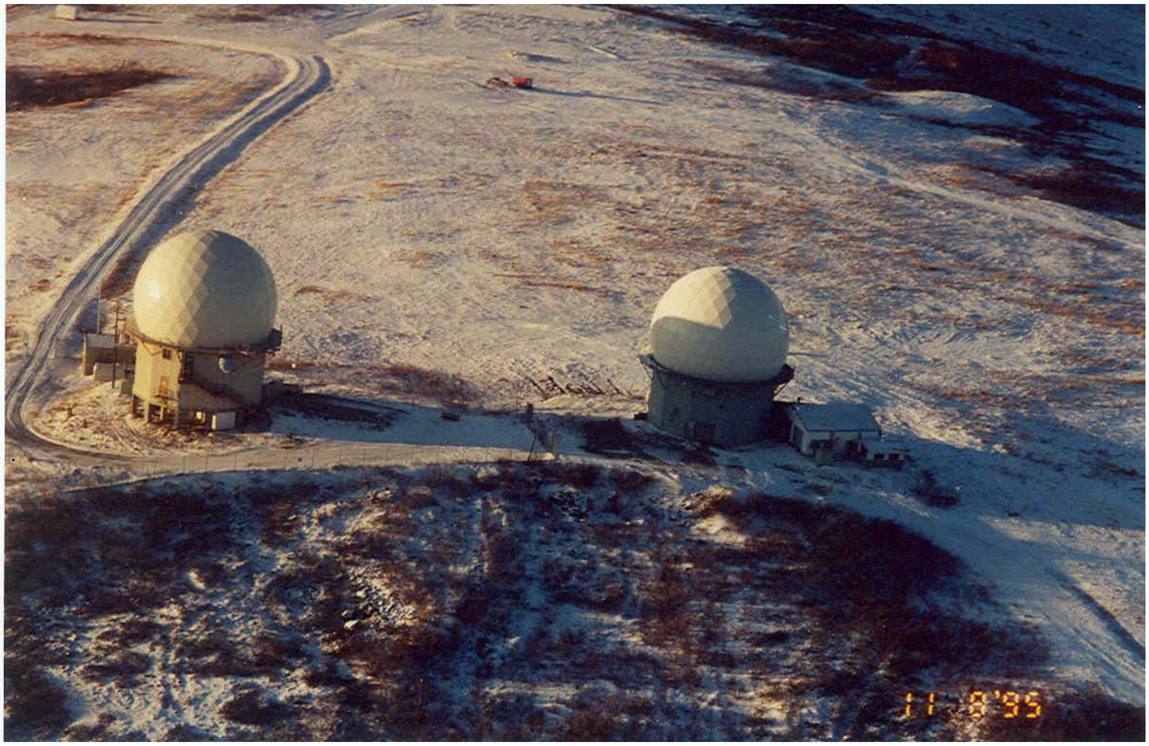
6.1 Land Use

Kotzebue LRRS is used solely as a MAR site and maintains no active housing facilities or military presence. Facilities include the radome building and a storage building. The active site, including the MAR and storage building, is completely fenced and secured. The Air Force leases space to the Kotzebue Electric Association, University of Alaska at Fairbanks, AT&T, and the Kikiktagruk Inupiat Corporation. The local Native Corporation has a right-of-way for a road access to an adjacent windmill. The local electric company also has an easement for an aboveground power line. The Kotzebue Electric Association's easement for a wind farm has expired.

Appendix 3.0 – Murphy. Murphy Dome Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Murphy Dome LRRS



3.1 Location and Area

Murphy Dome LRRS is located in the interior of Alaska, approximately 20 miles west-northwest of Fairbanks (INRMP Figure 3.1). The 846-acre installation, situated on top of Murphy Dome at an elevation of 2,920 feet above msl, is accessible by road from Fairbanks (Figure 3.1).

3.2 Installation History

Murphy Dome LRRS was the North Alaska Control Center as well as one of the original AC&W sites constructed to establish a permanent air defense system in Alaska. Site construction was completed in 1951, and the facility became operational in spring 1952 (Boyer undated(b)). In 1960 a WACS facility was constructed at Murphy Dome. The WACS was deactivated in 1979 and replaced with a commercial satellite earth terminal. A MAR unit was installed in 1986 and remains active. The radar tower does have living quarters to support 24-hour operations at the site for two technicians.

3.3 Surrounding Communities

Murphy Dome LRRS is located 20 miles from Fairbanks, the second largest city in Alaska. The population of Fairbanks is 31,535 (2010 estimate) and the Fairbanks North Star Borough population is 97,581 (2010 estimate) (www.dced.state.ak.us 2012). It is the only major terminus for rail, air, and highways in interior Alaska. Fairbanks offers a diverse economy, including city, borough, state, and federal government services, transportation, communication, manufacturing, financial, and regional medical services. Tourism and mining also comprise a significant part of the economy. The Fairbanks North Star Borough is largely non-industrial and remains primarily dependent on local, state, and federal government employment. Military personnel stationed at several installations in the Borough also contribute heavily to the economy. The University of Alaska Fairbanks is another important employer.

3.4 Regional Land Use
The Murphy Dome area was inhabited historically by the Chena band of the Tanana Athapaskans. The Chena band subsisted on caribou taken in fall. Caribou meat lasted throughout the winter, so hunting camps remained in uplands until spring when the Tanana moved down to fish camps near the main river. Game hunted included moose, muskrat, and beaver. In June whitefish and salmon were harvested in cylindrical fish traps and dip nets at weirs built across streams. After fishing season was over, the Chena's diet was supplemented by ducks, berries, and roots. In early autumn men hunted mountain sheep while women snared marmots and ground squirrels. After this, the cycle began again with the autumn caribou hunt (Boyer undated(b)).

Euro-American contact with the Tanana began in the 1880s when the natives began visiting the trading post of Nuklukayet at the mouth of the Tanana River. The natives also journeyed north to trade at posts along the Yukon, although this pattern was disrupted when gold was found in Canada and the Alaska Interior. The fur trade also brought radical changes, especially in native subsistence patterns and demography, with the establishment of semipermanent villages next to trading posts. Christian missions also had the effect of creating semipermanent villages rather than historical seasonal villages. An Episcopal mission was established at Chena in 1908. The Indian Bureau began setting up schools in the 1930s. The first thoroughfare through Tanana territory was the Fairbanks-Valdez Road, which included a series of roadhouses, but this was not as disruptive as the Alaska Railroad, which linked the south-central coast to the interior (Boyer undated(b)).

3.5 Local and Regional Natural Areas
Murphy Dome LRRS has no special natural areas (*e.g.*, refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate
Murphy Dome is within the continental climate zone. The climate of Murphy Dome is characteristic of the Fairbanks area (Table 4.1). Summer temperatures generally range from 35° to 72°F, and winter temperatures are usually -22° to 26°F. The mean annual temperature is below freezing. The area receives measurable precipitation more than 100 days per year. Only about 60 days per year are frost-free, and snow covers the ground from mid-October through mid-April (Boyer undated(b)). Winds are generally from the north and average 5.4 knots (Woodward-Clyde 1989, 1993a). Temperature extremes recorded in Fairbanks have been -66° and 94°F. The average annual precipitation is about 13 inches (www.weather .com).

4.2 Landforms
Murphy Dome LRRS is located in the Yukon-Tanana Uplands, an area of ridges and valleys lying in an arcuate belt between the Brooks Range to the north and Alaska Range to the south. The Tanana River Valley separates the Alaska Range from Yukon-Tanana Upland mountain groups. The mountains have summits reaching to 6,000 feet above msl (Boyer undated(b)). Principal physiographic features of the area are rounded, gently sloping ridges and domes.

Figure 3.1 Murphy Dome LRRS

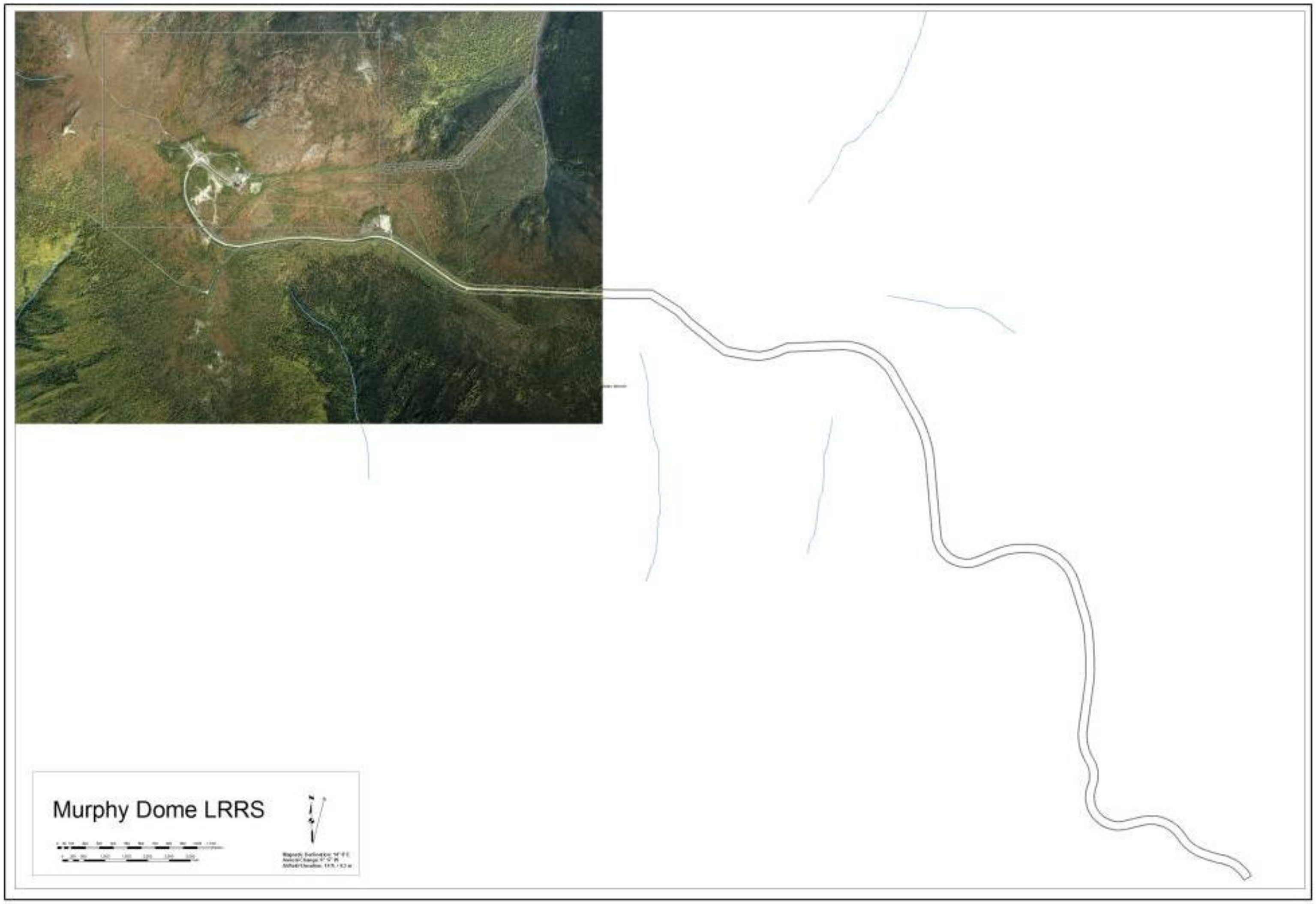


Table 4.1 Fairbanks, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	3ºF	11ºF	25ºF	44ºF	61ºF	71ºF	72ºF	66ºF	54ºF	32ºF	12ºF	7ºF
Average Low	-11ºF	-7ºF	2ºF	21ºF	36ºF	48ºF	51ºF	45ºF	34ºF	16ºF	-2ºF	-8ºF
Mean	-4ºF	2ºF	14ºF	33ºF	49ºF	60ºF	62ºF	56ºF	44ºF	24ºF	5ºF	-1ºF
Record High	47ºF (1981)	49ºF (1980)	57ºF (1998)	71ºF (2005)	88ºF (1960)	94ºF (1991)	92ºF (1993)	93ºF (1994)	82ºF (1957)	71ºF (2003)	49ºF (1976)	44ºF (1985)
Record Low	-60ºF (1969)	-52ºF (1999)	-41ºF (1971)	-24ºF (1986)	3ºF (1964)	27ºF (2006)	32ºF (1957)	24ºF (1987)	5ºF (1992)	-27ºF (1975)	-45ºF (1990)	-66ºF (1961)
Average Precipitation	0.58 inches	0.50 Inches	0.27 inches	0.31 inches	0.64 inches	1.76 inches	2.34 inches	2.08 inches	1.31 inches	0.91 inches	0.77 inches	0.68 inches

Source: www.weather.com (January 16, 2012)

4.3 Geology and Soils

The geology of the Murphy Dome area is characterized by thin residual clay, silt, sand, gravel, and cobble deposits overlying metamorphic bedrock. The bedrock is made up of schists of the Yukon-Tanana Complex with minor amounts of granite intrusives and basalt volcanics. Alluvial sand and gravel deposits have accumulated in lowland areas and local stream valleys. The thickness of the alluvium is highly variable. Much of the bedrock is overlain by late Quaternary deposits of loess or silt that was transported by wind from outwash areas below glaciers in the Alaska Range to the south. Underlying bedrock crops out along steep slopes and eroded mountain surfaces (Woodward-Clyde 1993a).

Based on various subgrade geotechnical investigations by the U.S. Army Corps of Engineers, the Murphy Dome site is composed of silty sand and schist gravel with some boulders. Percolation tests indicate that the soil is highly permeable. Bedrock is shallow, consisting of hard quartzite schist resistant to tungsten-carbide drill bits, and lies at depths ranging from two to 10 feet. Test pits and borings have found no evidence of any perched aquifers or permafrost above the bedrock on the top of Murphy Dome (Woodward-Clyde 1993a).

4.4 Hydrology

4.4.1 General

Surface water runoff from Murphy Dome LRRS flows north and east to unnamed tributaries of Murphy and Shovel creeks and flows to the south to Dawson, Keystone, and Cache creeks. Goldstream Creek is the final major receiving stream south of the installation (Woodward-Clyde 1989, 1993a).

Much of the snow that falls on Murphy Dome summit probably blows off, and hard rainfall tends to travel off-site as surface runoff. The upper limit of precipitation that actually percolates into the soil has been estimated at about 50 percent. Because of the geology of the dome summit, water that does percolate into the soil probably seeps out to surface water within short distances (Woodward-Clyde 1989, 1993a).

The hydrogeology of Murphy Dome is dominated by thin residual deposits overlying metamorphic bedrock on uplands and by relatively thick alluvial deposits in stream valleys below the dome. Permafrost is discontinuous in the area. Seasonal groundwater occurs in the residuum as a result of the melt and thaw cycle; perennial ground water occurs in stream alluvium. Seasonal groundwater discharge is likely directed downslope to local surface streams. Principal groundwater flow directions probably mirror the area's surface topography; flowing to the north, east, and south (Woodward-Clyde 1989, 1993a).

Where permafrost exists, groundwater beneath the site would only reach aquifers through unfrozen zones that perforate the permafrost. Groundwater percolating downslope may encounter permafrost and migrate laterally as supra-permafrost water on the slope of the permafrost table until the groundwater surfaces or reaches another unfrozen zone. Groundwater resurfaces where the water table intersects the land surface. The occurrence of bedrock at shallow depths on the dome affects groundwater hydrology in much the same way as permafrost (Woodward-Clyde 1989, 1993a).

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. All installation lands are well above any flood plain.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Murphy Dome LRRS. Much information included in INRMP Chapter 5.0 that includes Murphy Dome LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Murphy Dome LRRS and the surrounding area. ***Appendix 3.0-Yukon***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Murphy Dome LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M139 Upper Yukon Tayga-Meadow Province
Description: Low rounded mountains of 2,000-4,000 feet are found within this province, but no glaciers exist here. The landscape is mostly rolling topography, including plateaus and highlands along with gentle slopes and valleys. Severely cold winters and short; hot summers showcase the extreme continental boreal climate that is characteristic of the province. Average precipitation is 10-15 inches with the heaviest precipitation occurring in late summer. On lower slopes are forests of white spruce, paper birch, and quaking aspen; at higher elevations are black spruce forests. Above black spruce forests, the dominant vegetation is alpine meadow. Dominant soils of the province are Inceptisols; permafrost is discontinuous.

5.2 Vegetation

The predominant vegetation community around Murphy Dome LRRS is alpine tundra. Much of the alpine tundra type consists of barren rocks; however, low mat plants, both herbaceous and shrubby, are interspersed between bare rocks and rubble. In northern areas and the Alaska Range, low mats of white mountain avens are dominant and may cover entire ridges and slopes; mat-forming herbs, such as campion moss, black oxytrope, Arctic sandwort, and several grasses and sedges, are also common.

Lower elevation areas surrounding the LRRS are characterized by the upland spruce/hardwood forest vegetation community. This is a fairly dense forest of white spruce, black spruce, paper birch, aspen, balsam poplar, tamarack, green alder, and several species of willow (West and DeWolfe 1974). Black spruce usually occurs on north-facing slopes and poorly drained flat areas. Aspen and birch are predominant on well-drained southern slopes (Boyer undated(b)).

Undergrowth normally consists of mosses and grasses on drier sites and brush on moist slopes. Typical undergrowth species are willow, alder, ferns, rose, high-bush cranberry, lingonberry, raspberry, currant, Labrador tea, and horsetail. These species are seral, occurring in disturbed areas, as found in and around the installation (Boyer undated(b)). Common species found at the LRRS include Arctic lupine, crowberry, dwarf birch, vaccinium, and several species of lichen and prostrate willow. Demolition and burial of abandoned structures from 1988 to 1989 resulted in a large area of disturbance. This area was reseeded and has achieved fairly good ground cover. Common species in the disturbed vegetation type include yarrow, reedgrass, bluegrass, and several sedge species.

A general vegetation map of Murphy Dome LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995f). Schick *et al*. (2004) made significant improvements in vegetation mapping at Murphy Dome LRRS (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Murphy Dome LRRS in 2001 and 2010. This project used 2001 National Land Cover Database data (http://www.mrlc. gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth and, if available, 2009-2010 SPOT-5 satellite imagery (http://www.alaskamapped. org/ortho). Table 5.2 shows these acreages and changes over this 9-year period. Figure 5.2a shows habitat classes for 2010, and Figure 5.2b shows changes in habitat classes between 2001through 2010.

Table 5.2 Habitat Class Differences between 2001 and 2010, Murphy Dome LRRS

Habitat Class	Acres 2001	Acres 2010	Acreage Change
Barren Land	1.3	1.3	0.0
Deciduous Forest	57.3	57.3	0.0
Developed, Low Intensity	45.1	49.0	3.9
Developed, Open Space	9.3	10.5	1.1
Dwarf Shrub	20.7	19.9	-0.8
Evergreen Forest	119.0	119.0	0.0
Grassland	0.7	0.0	-0.7
Mixed Forest	47.7	47.7	0.0
Shrub/Scrub	553.8	550.2	-3.5
Woody Wetlands	5.6	5.6	0.0
Totals	**860.6**	**860.6**	**0.0**

Schick *et al*. (2004) described the Murphy Dome LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Murphy Dome LRRS encompasses 846 acres[1] of upland, sub-alpine, and alpine terrain near Fairbanks. The most common wildlife habitats at the LRRS are low and tall scrub, and open mixed forest. Murphy Dome is well-drained with no waterbodies, moist or wet tundra types. The LRRS is dominated by Upland Low Open Scrub and Upland Tall Open Scrub. These types occur primarily on gentle sloping terrain near tree line and are likely used primarily by passerines such as Fox Sparrows, Savannah Sparrows, White-crowned Sparrows, and Alder Flycatchers. Forested habitats such as Upland Open Mixed Forest, Upland Broadleaf Forest, and Upland Open Needleleaf Forest comprise much of the remaining LRRS area. These types provide additional habitat for passerines like Black-capped Chickadees and Dark-eyed Juncos. Better-drained Upland Dwarf Scrub and Upland Rock habitats occurring on hilltops are likely used by American Pipits. Structures, such as the radar dome, are used by Cliff Swallows and Bank Swallows for nesting. Field observations indicated that porcupines are present at the LRRS and likely use shrub and

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

Figure 5.2a Murphy Dome LRRS Wildlife Habitat Map, 2010

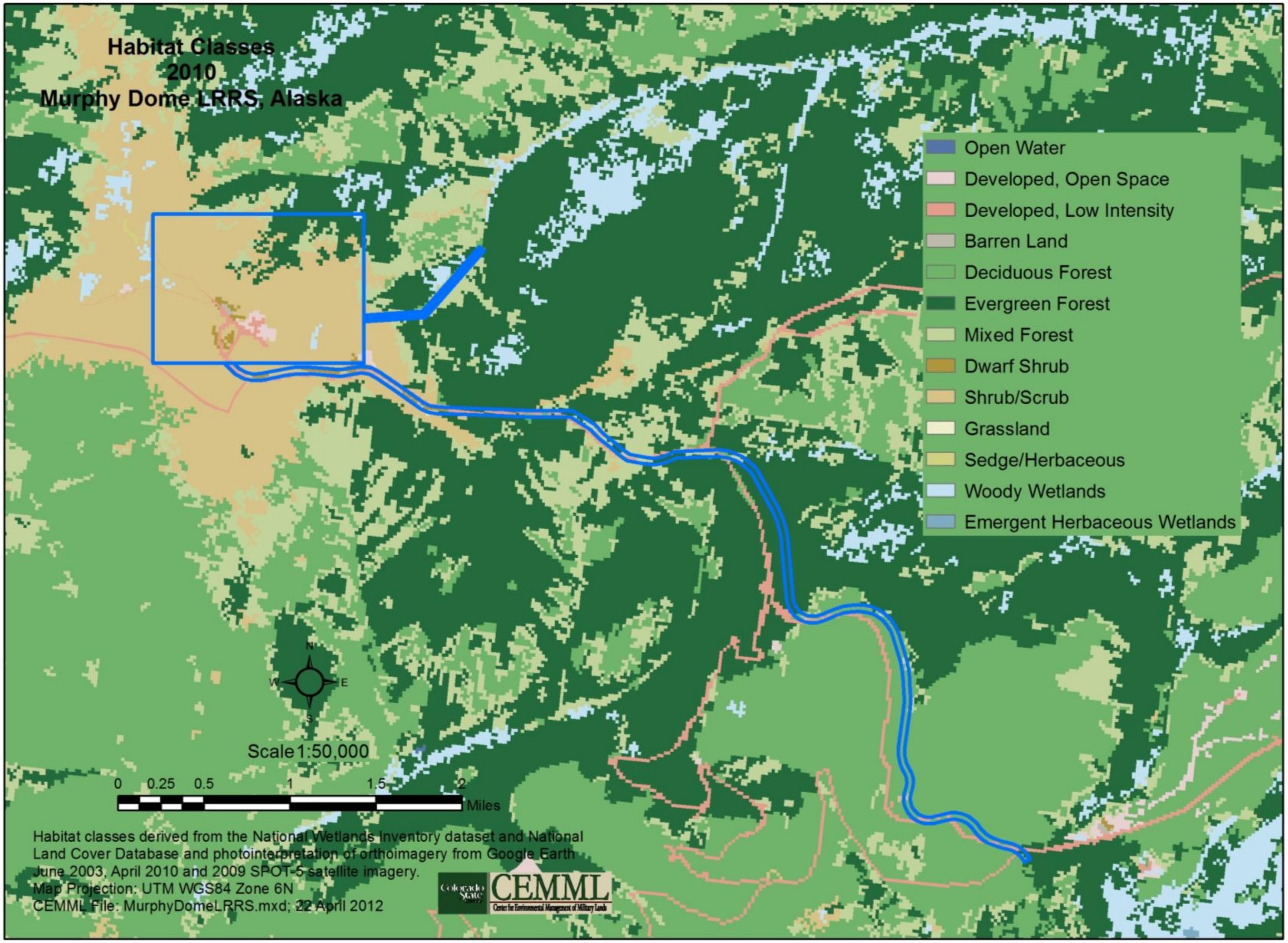
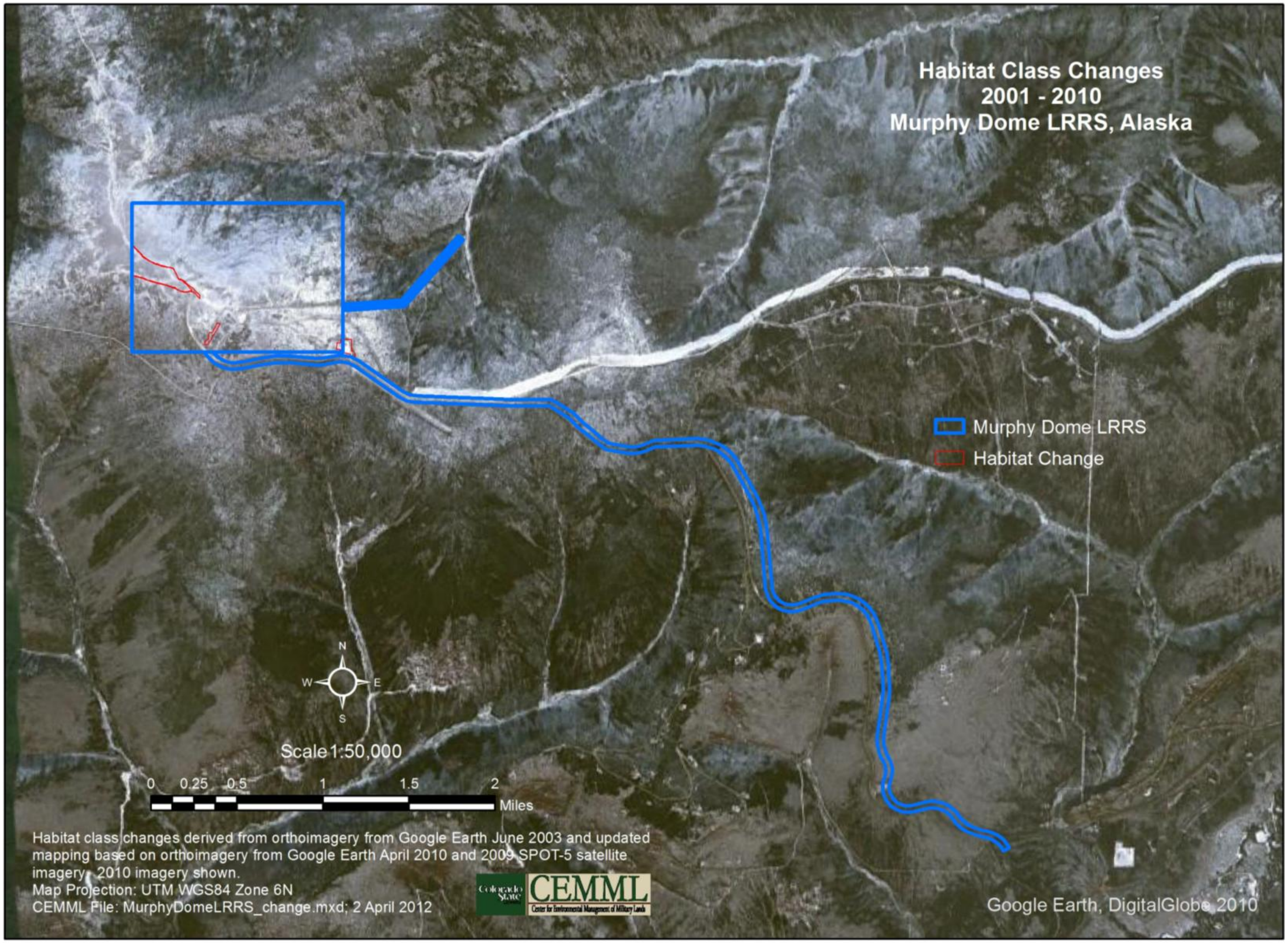


Figure 5.2b Changes in Habitat Classes at Murphy Dome LRRS between 2001 and 2010



tree habitat types in the area; there was sign of high moose use of most of the upland shrub habitats during spring through fall.

5.3 Fish and Wildlife

5.3.1 Fish

Though no bodies of water occur on Murphy Dome LRRS, surface water bodies in the area of Murphy Dome include Murphy, Shovel, Dawson, Keystone, Cache, and Goldstream creeks and their tributaries. Fish species likely to be found in these creeks are Arctic grayling, whitefish, northern pike, and longnose sucker (Boyer undated(b)).

5.3.2 Mammals

Common small mammal species include the snowshoe hare, red squirrel, pine marten, least and short-tailed weasel, mink, vole, Arctic ground squirrel, fox, coyote, and North American lynx. Occasional moose and caribou may be observed in the Murphy Dome area. The most important seasonal moose habitats are lowland areas from the spring thaw to late summer and in heath bog and tall shrub communities in late summer. Seral stages of vegetation attract moose. A certain amount of this sort of vegetation exists at the LRRS, which was caused by past construction and operations at the facility.

Some mammals in the Fairbanks area are the snowshoe hare, common in willow thickets; red squirrel, common in white spruce/hardwood habitat; pine marten, common in dense spruce; least weasel, in black spruce and tussock low-shrub bog; short-tailed weasel, in boreal forests; mink, along lakeshores, riverbanks, and swamps; and lynx, in climax boreal forest with dense undercover of thickets and windfalls (Boyer undated(b)). The ABR Inc. 2004 site visit indicated that porcupines are present at the LRRS and likely use shrub and tree habitat types in the area; and there was sign of high moose use of most of the upland shrub habitats during spring through fall.

Wolf and black bear populations are moderate in this area. Black bears are widely distributed in boreal forest and forest/tundra fringe habitats. Occurrence of brown/grizzly bear is variable in the region. Small mammal abundance is highest in tussock low-shrub bog habitat. Thereafter, habitats arranged in decreasing order of importance for small mammals include black spruce, tall shrub, white spruce/ hardwood, seral birch, and old farm fields.

5.3.3 Birds

Shorebirds, such as loons, grebes, plovers, yellowlegs, sandpipers, and phalaropes are common in ponds, lakes, streams, and marshy habitats in the region. Raptors in the Fairbanks area include the Bald and Golden Eagle; Northern Harrier; Osprey; Red-tailed (Harlan's race), Rough-legged, Swainson's, and Sharp-shinned Hawk; Goshawk; Gyrfalcon; Peregrine Falcon; Merlin; Kestrel; and Great Grey, Snowy Hawk, Boreal, and Short-eared Owl (Armstrong 1991, West and DeWolfe 1974). Most raptors are summer migrants. Alpine tundra and low-shrub habitats provide forage and cover for the Willow Ptarmigan; however, this area is extensively hunted, and Ptarmigan numbers have apparently been reduced at the site (Woodward-Clyde 1995f).

Bird life at the Murphy Dome LRRS is typical of interior alpine tundra and low-shrub habitats. Species potentially occurring at the LRRS include the Common Raven, Orange-crowned Warbler, Varied Thrush, White-crowned Sparrow, Alder Flycatcher, Cliff Swallow, Rosy Finch, Snow Bunting, Savannah Sparrow, American Pipit, and Horned Lark. Creeks at the base of Murphy Dome LRRS may provide limited habitat for waterfowl during spring migration. The first spring migrants in the area usually appear in the third week of April (Boyer undated(b)).

Ten bird species were observed at Murphy Dome LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included confirmation of nesting Alder Flycatchers and White-crowned Sparrows. Bank and Cliff Swallows; Black-capped Chickadee; American Pipit; Savannah and Fox Sparrows; and Dark-eyed Juncos were also observed.

5.4 Threatened and Endangered Species

No threatened, endangered, or sensitive species have been reported within the boundaries of Murphy Dome LRRS. However, the delisted American Peregrine Falcon (USFWS 2004b) potentially occurs within the vicinity of Murphy Dome. American Peregrine Falcon information discussed for Indian Mountain LRRS (Appendix 3.0-Indian, Section 5.4) also applies to Murphy Dome LRRS.

5.5 Wetlands

On mountain slopes and ridges many well-drained rocky areas are likely to be NWI Uplands. The most common wetland types at Murphy Dome LRRS are saturated palustrine areas dominated by shrubs mixed with persistent emergent vegetation and seasonally flooded palustrine areas of broad-leaved deciduous scrub-shrub, as well as areas classified as NWI Uplands. Other common wetland types are saturated palustrine, forested, broad-leaved deciduous and needle-leaved evergreen. Wetland areas at the Murphy Dome LRRS are moderately well-drained to well-drained, depending primarily on soil type, microtopography, and landscape position. Dominant plant species in these areas include *Alnus crispa, Salix pulchra, S. scouleriana, S. alaxensis, S. arctica, Betula nana, Vaccinium uliginosum, Dryas octapetala, Spirea stevenii [beauverdiana]) B. glandulosa, Dryopteris dilitata, Empetrum nigrum, Calamagrostis canadensis,* as well as tree species *Betula papyrifera*, *Picea glauca*, and *P. mariana* (Schick *et al*. 2004).

The general Murphy Dome LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Murphy Dome LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (157.40 acres). Figure 5.5 shows wetlands on Murphy Dome LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

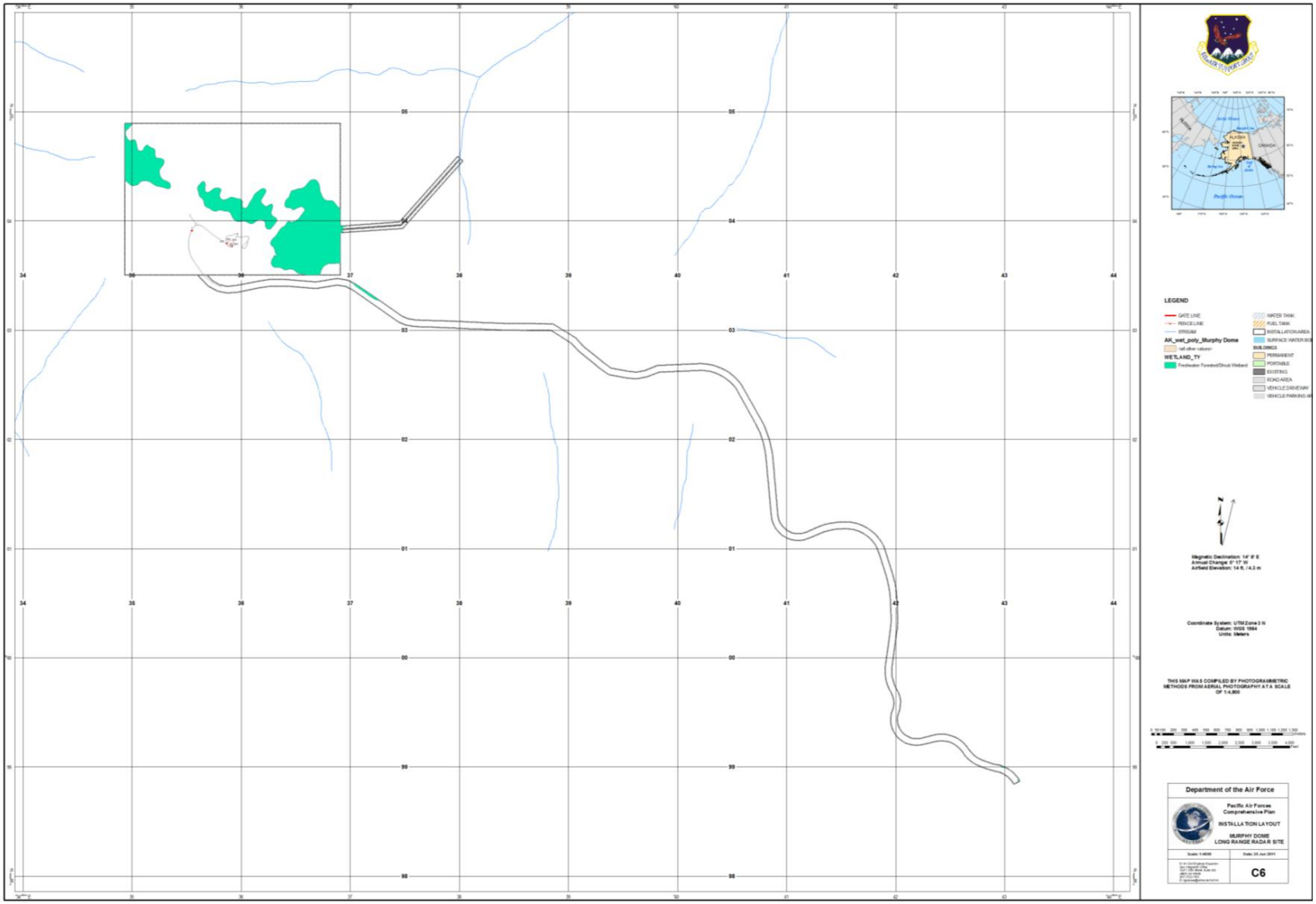
Braund and Associates (2004) reported known subsistence information from areas adjacent to 611 ASG sites. This report did not include Murphy Dome. However, subsistence gathering, including hunting and fishing, likely occurs in the vicinity of Murphy Dome LRRS.

5.6.2 Outdoor Recreation

The area surrounding the LRRS provides Ptarmigan hunting, target shooting, hiking and backpacking, wildlife viewing, and ATV riding opportunities. Most hunting is done by local residents; little hunting or fishing is done by installation personnel. The close proximity of Murphy Dome to the population center of Fairbanks and easy access afforded by public roads to the installation facilitate heavy use of the site by local residents for recreational ATV riding. ATV use has completely eliminated vegetation in some areas, destroying wildlife habitat and creating dust sources. The following recommendations are designed to establish a protocol for protecting natural resources on the LRRS (Woodward-Clyde 1995f).

- Determine well-used trails that provide direct access to outlying destination points that would be difficult to close. Allow these trails to remain open, rerouting them around sensitive habitats, such as wetlands and areas where habitat destruction is extensive.

Figure 5.5 Murphy Dome LRRS Wetlands, 2011



- Close infrequently used trails and trails through sensitive habitats using physical barriers, such as logs, ditching, and brush piles.
- Establish an informal public relations campaign encouraging ATV use of designated roads and areas and discouraging the creation of new trails.

The Murphy Dome area is frequently used for biological and ecological studies by educators from grade-school to university level.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Murphy Dome LRRS structures include a FAA building, two radar domes (one active MAR and one vacant), and a former support building. BOS contractor personnel employed at the LRRS commute from the Fairbanks area. The area is used as a parking lot by nearby private landowners, backpackers and hikers, and bird watchers. The active site, including the MAR and nearby structures, is completely fenced and secured. In 1987 most structures were demolished and buried on site during a general cleanup of the LRRS. An underground fuel storage tank associated with the WACS support building was removed in 1993. There is contamination remaining at the site. A large area of fuel contamination is going through the process to determine how the site should be treated. There is also a small lead-contaminated area being contracted for remediation in 2013 or 2014.

The Air Force has two in-grants from the State of Alaska (a permit for a gravel borrow pit and an easement for the road and electric line). In addition, the Air Force leases space to the Federal Aviation Administration and to the Cold Region Research Engineering Laboratory.

Appendix 3.0 – Oliktok. Oliktok Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Oliktok LRRS

3.1 Location and Area

Oliktok LRRS is about 400 miles north of Fairbanks and about 160 miles southeast of Barrow (INRMP Figure 3.1), accessible by air, barge, or by car via the Dalton Highway and then through Prudhoe Bay and Kuparuk oil fields. Oliktok occupies 832 acres on a peninsula of the Beaufort Sea adjacent to the Kuparuk and Prudhoe Bay oil fields (Figure 3.1).

3.2 Installation History

Oliktok LRRS became operational in August 1957 as part of northern Alaska DEW Line installations. Two contract personnel operate the site with facilities that consist of a multipurpose dormitory/power generation/radio operations building, a warehouse, vehicle maintenance garage, aircraft hangar (now used for storage), an unattended 4,000-foot runway, fuel storage tanks, and several outbuildings. Demolition and debris removal occurred in 2006-2007.

3.3 Surrounding Communities

Oliktok LRRS is 30 miles from the village of Nuiqsut. Nuiqsut has a population of 411 (2005 estimate) persons. The majority of the population is Inupiat Eskimos practicing a traditional subsistence lifestyle.

The Kuukpik Native Corporation, school, borough services, and the store provide most year-round employment in the village. Trapping and craft-making provide some income. Caribou, bowhead and beluga whales, seal, moose and fish are staples of the diet. Polar bears are also hunted (www.dced.state.ak.us 2012). In most winters Nuiqsut is connected to the Oliktok/Kuparuk road system by an ice road. The LRRS is adjacent to the Kuparuk and Alpine oil fields.

3.4 Regional Land Use

At one time Oliktok LRRS grounds were used as a fish camp by the Inupiat villagers of Nuiqsut, located on the Colville River, 27 miles from its delta. Eventually this fishing location was dropped in favor of several offshore islands and the Colville River delta (Martin Marietta 1993). The USAF has occupied the site continuously since it was built during the Cold War. A public land order withdrew the property for military uses; a portion has been determined to be a native allotment.

3.5 Local and Regional Natural Areas

Oliktok LRRS has no special natural areas (*e.g.*, refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate

Oliktok LRRS is within the Arctic Climatic Zone, which is characterized by cold average temperatures and persistent strong winds. Summer temperatures at Oliktok average 30°F to 47°F, while winter temperatures range from -6°F to -24°F. Extreme temperatures range from -49°F to 75°F. Precipitation averages five inches per year, including 19 inches of snow (Woodward-Clyde 1995c. Legare 1998).

4.2 Landforms

Oliktok is located on the Teshekpuk portion of the Arctic Coastal Plain (Wahrhaftig 1965). This area is characterized by low relief with elevations less than 33 feet above msl at the coast and increasing to 500 feet above msl at the base of the Northern Foothills Province. The Coastal Plain is characterized by a gently undulating tundra surface mantled with thousands of small thaw lakes, which, along with the polygonal ground pattern, distinguish smaller-scale features of the physiography. Both the undulating tundra surface and polygonal ground pattern are related to permafrost.

Drainage within the Coastal Plain is from south to north. The LRRS is located in the eastern drainage basin but near the border of the central or Colville River drainage basin. The Colville River adjacent to the site is the largest river in northern Alaska, draining 24,000 miles^2 or 29 percent of the area. Flow of the Colville River water over the ice during spring may reach as far east as Oliktok (personal communication, Walker, USFWS in Woodward-Clyde 1995c).

The coastline trends east-west and is open to the Beaufort Sea to the north. The sedimentary plain extends seaward into the Beaufort Sea, resulting in a mildly sloping shelf (0.1 percent or 0.08^o). Regionally, the shelf is smooth, but offshore barrier islands and submerged shoals with relief of 33 feet occur locally near the site.

4.3 Geology and Soils

The geology of the area is described in terms of bedrock and surficial components. Bedrock consists of Cretaceous and Tertiary marine shales, mudstones, siltstones, and sandstones. No bedrock outcrops occur due to the relatively thick (up to 150 feet) mantle of unconsolidated Quaternary sediments (Woodward-Clyde 1995c).

Figure 3.1 Oliktok LRRS

At Oliktok LRRS these unconsolidated surficial sediments consist of shallow water, marine materials deposited during periods of higher sea levels. Marine deposits are primarily sandy silts containing scattered pebbles and beds or lenses of clay, sand, and fine gravel. Marine sediments are mantled by 6-10 feet of late Pleistocene and Holocene thaw-lake sediments, consisting of peat and muds, commonly with a mixture of coarser pebbles, cobbles, and boulders (Hopkins and Hartz 1978).

Although surficial sediments are unconsolidated, they are perennially bounded by frozen interstitial pore water (*i.e.*, permafrost). Periglacial processes tend to concentrate ground ice in surface sediments in the form of excess pore ice and ice wedges (Sellman *et al*. 1975).

The mainland coast and LRRS consist primarily of low, rapidly eroding tundra cliffs with associated fringing beaches. Accretional landforms occur locally and include small recurve spits, barriers, and deltas. Tundra cliffs are low in height, approximately six feet, and contain significant quantities of ice and peat. Coastal retreat rates of 3-6 feet/year are not uncommon on these cliffs (Cannon 1977, Dygas and Burrel 1976), and retreat rates of up to 30 feet/year have been documented (Lewellen 1977).

4.4 Hydrology

4.4.1 General

Surface drainage on the Arctic Coastal Plain occurs as sheetflow and shallow creek runoff from near the coast. Runoff may also follow natural depressions and improved trenches and ditches. Infiltration may occur to a limited extent down to the upper surface of the underlying permafrost during summer. The presence of permafrost throughout the area precludes the development of groundwater as a drinking water source. As is the case at other northern sites, a large freshwater lake or river with a deep channel provides drinking water. A salt marsh lagoon is east of the LRRS and provides important waterfowl habitat.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. There are no data on flooding in this area caused by rainfall. A severe rainfall could inundate all but the highest ground because drainage is poor.

The greater flood threat comes from coastal storms. All land readily visible surrounding facilities contained flotsam (driftwood), indicating that it had once been inundated. A 1970 storm washed away several hundred feet of runway at Oliktok, with flood waters as high as 10 feet. A 1975 coastal storm surged to 9.5-10 feet msl. Due to limited data, no reliable estimate could be made of the 100-year flood level, but it would be at least 10 feet msl.

All installation activity is situated on gravel pads and roads. Wind-driven rains of coastal storms are severe enough to seriously erode these gravel pads and hinder access to and around the installation. Fill is readily available, so damage could be repaired in days.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Oliktok LRRS. Much information included in INRMP Chapter 5.0 that includes Oliktok LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Oliktok LRRS and the surrounding area. ***Appendix 3.0-Barter***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Oliktok LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 124 Arctic Tundra Province
Description: This province is a broad, level plain with rolling foothills near the Colville River; in summer there are lakes and marshes dotting the landscape. Winter temperatures can go as low as -60F and due to the area's northern location receives differing amounts of sunlight throughout the year. Precipitation is low throughout the year, averaging only seven inches. Due to permafrost there are extensive marshes and lakes in the province. The most widespread vegetation system, cottongrass-tussock, grows along with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. Dominant soils are wet, cold Inceptisols. Upland soils are poorly drained clayey soils. Soils on south slopes and low moraines are well drained and loamy; lowland soils are deep, wet, and silty. Permafrost is continuous throughout the province, reaching depths of 2,000 feet in some areas.

5.2 Vegetation

Estuarine vegetation occurs in the marsh east of the site where large numbers of Brant forage (personal communication, Walker, USFWS in Woodward-Clyde 1995c). Pendent grass is an important emergent species on the shorelines and in the shallowest zones of ponds. A general vegetation map of Oliktok LRRS was presented in Woodward-Clyde (1995c).

Significant improvements in vegetation mapping at Oliktok LRRS were accomplished (using 2000 digital aerial photography) with the preparation of a wildlife habitat map (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) (Schick *et al*. 2004) and flora and fauna surveys.

Wells *et al*. (2010) updated this mapping and data analysis for Oliktok LRRS using 2005 QuickBird aerial photos. Table 5.2 shows changes in acreage between 2000, and. Figure 5.2a shows these habitat classes for 2005. Figure 5.2b shows habitat changes between 2000 and 2005. Figure and table data include USAF property and a 150-meter buffer outside the property boundary.

Table 5.2 Area of Habitat Classes and Differences between Years in Habitat Classes Mapped from 2000 and 2005 Imagery, Oliktok LRRS

Habitat Class	Acres 2000	Acres 2005	Acreage Change*
Artificial (including Artificial Barrens and Artificial Partially Revegetated for 2005)	59.8	59.7	-0.1
Coastal Barrens	22.6	20.0	-2.6
Coastal Brackish Water	100.3	104.0	+3.7
Coastal Salt Marsh	60.9	60.6	-0.3
Coastal Salt-killed Tundra	91.9	67.9	-24.0
Deep Water w/Islands or Polygonized Margins	25.4	25.4	0.0
Lowland Aquatic Sedge Marsh	7.5	6.9	-0.6
Lowland Dwarf Scrub	27.0	27.0	0.0
Lowland Lacustrine Barrens	1.2	6.4	+5.2
Lowland Moist Sedge–Shrub Tundra	204.1	197.1	-2.8
Lowland Nonpatterned Wet Tundra	15.9	15.8	-0.1
Lowland Patterned Aquatic Marsh	0.1	0.1	0.0

Habitat Class	Acres 2000	Acres 2005	Acreage Change*
Lowland Patterned Wet Tundra	213.7	180.2	-13.6
Lowland Wet–Moist Patterned Tundra Complex	32.8	32.8	0.0
Marine Water	176.5	178.7	+2.2
Old Basin Wetland Complex (Ice-rich)	67.6	123.9	+56.3
Riverine Barrens	6.3	7.0	+0.7
Rivers and Streams	8.5	7.5	-1.0
Shallow Water	36.5	37.5	+0.4
Shallow Water w/Islands or Polygonized Margins	17.1	17.1	0.0
Totals	**1,175.6**	**1,175.6**	**0.0**

* Some changes are associated with imagery changes between years and/or altered disturbance regimes or recovery of vegetation. See Wells *et al*. (2010) for data adjustments.

The Oliktok LRRS area encompasses ~ 1,175.6 acres of land area. Wildlife habitats at the LRRS are primarily marine, coastal, lacustrine, lowland, and wetland complex types. There are few riverine habitats and no upland habitats. Marine and coastal waterbodies comprise 20.30%, and lacustrine freshwaters cover 7.23% of the LRRS (Schick *et al*. 2004). Of the waterbodies, Marine Water and Coastal Brackish Water are the predominant types (178.7 acres and 104.0 acres, respectively) (Wells *et al.* 2010). Although small in area, numerous small fresh waterbodies are scattered throughout the LRRS, and this is one of the defining features that separates Oliktok from the other North Warning LRRS. Brackish lakes and ponds occur primarily in northern and northeastern portions of the site where they are infrequently inundated with salt water from storm events. Lacustrine freshwater lakes and ponds occur predominately in the southern portion of the LRRS. Lacustrine fresh waterbodies with islands and/or polygonized margins, which provide preferred habitat for nesting and brood-rearing waterbirds, occupy 4.02% of Oliktok LRRS. An Old Basin Wetland Complex located in the southwestern portion of the property and also considered potential habitat for waterbirds comprises 5.56% of the land area, and Coastal Salt Marsh, a habitat often used by brood-rearing waterfowl, constitutes 5.39% of the area. Of remaining habitats, freshwater marsh and lowland tundra are primary wildlife LRRS habitats and cover 42.07% of the land area (Schick *et al*. 2004). Of tundra habitats, Lowland Patterned Wet Tundra (180.2 acres) and Lowland Moist Sedge–Shrub Tundra (197.1 aqcres) are most common. Artificial LRRS habitats including partially revegetated areas occupy 59.7 acres of the LRRS (5.0%) (Wells *et al.* 2010).

Schick *et al*. (2004) identified 19 wildlife habitat types (Figure 5.2). Six habitats combined covered >70% of the site: Lowland Patterned Wet Tundra (21.4%), Lowland Moist Sedge-Shrub Tundra (20.4%), Coastal Brackish Water (10.0%), Coastal Salt-killed Tundra (9.2%), Old Basin Wetland Complex (6.8%), and Artificial (6.0%). Salt-affecetd habitats comprise a substantial portion of this site (27.2%, chiefly Coastal Brackish Water, Coastal Salt-killed Tundra, and Coastal Salt Marsh).

5.3 Fish and Wildlife

5.3.1 Fish

Anadromous and freshwater fish use nearshore waters of the Beaufort Sea for feeding and migration. Freshwater fish are usually found in association with fresh or brackish waters extending offshore from river deltas. Freshwater species may include Arctic grayling, round whitefish, and burbot. Anadromous species found in the nearshore environment include Arctic char, Arctic cisco, least cisco, Bering cisco, inconnu, rainbow smelt, humpback whitefish, and broad whitefish. Smaller numbers of salmon (chinook, sockeye, and coho), sticklebacks, and lamprey have been recorded along the Alaskan Beaufort seacoast (ADFG 1992).

Figure 5.2a Oliktok LRRS Wildlife Habitat Map, 2005

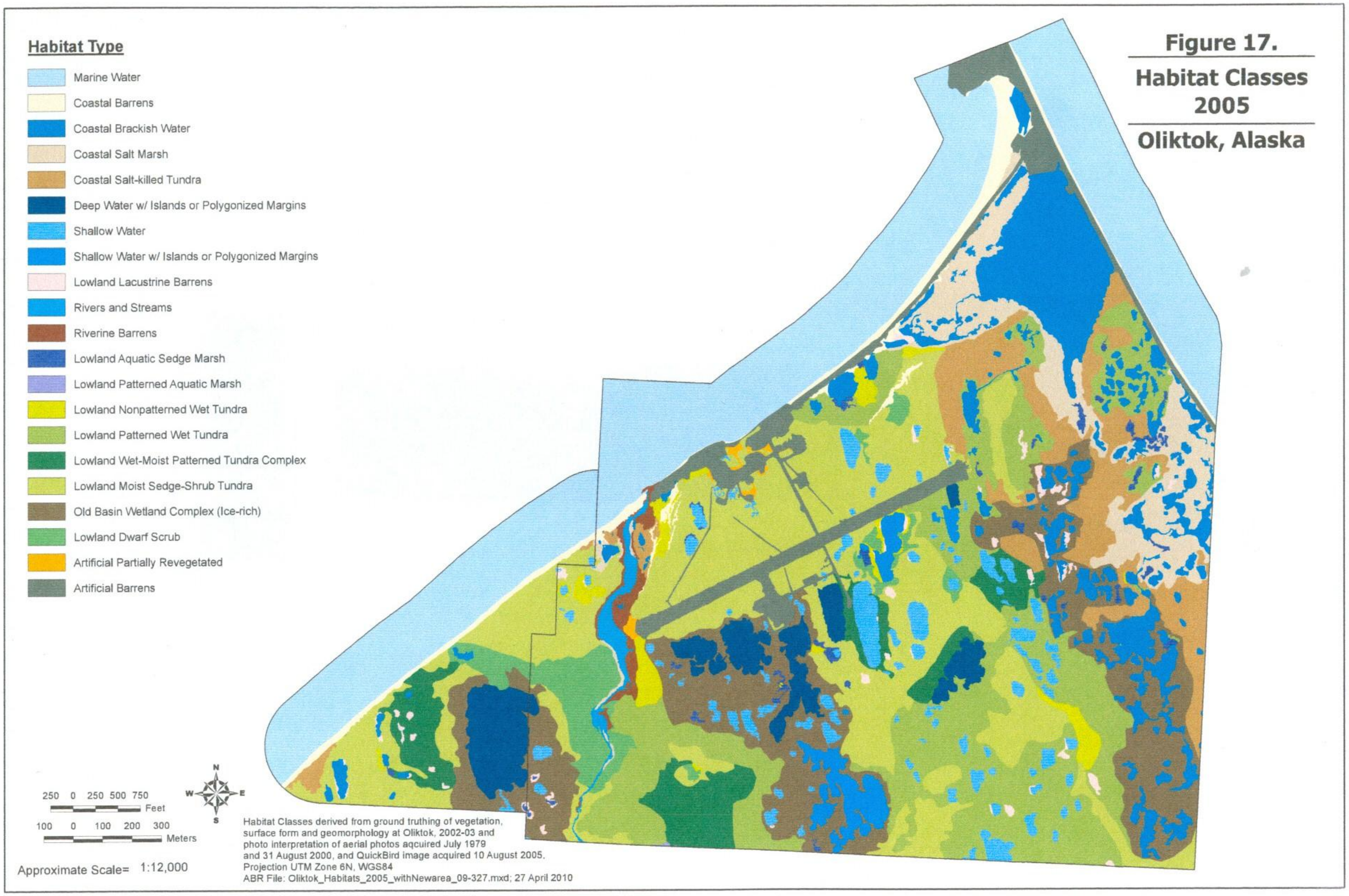
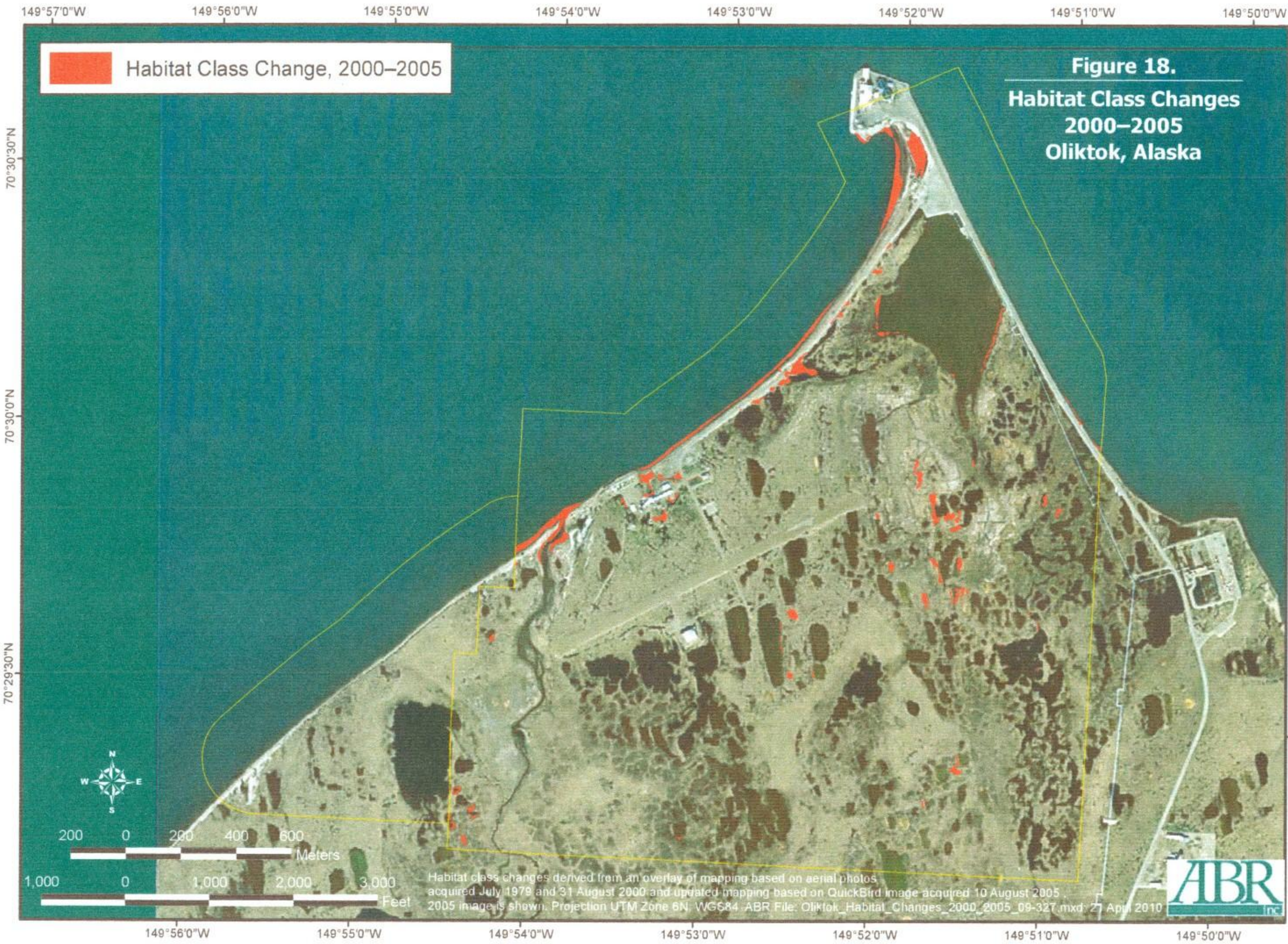


Figure 5.2b Oliktok LRRS Habitat Class Changes, 2000-2005



5.3.2 Mammals

Small mammals, such as Arctic ground squirrels, brown lemmings, and collared lemmings, are commonly seen around the installation. Caribou are the most conspicuous terrestrial mammal occurring in and around the LRRS. The Central Arctic caribou herd moves across the installation periodically throughout the summer. Approximately 8,900 caribou moved through the area in 1993 (personal communication, Booker, USFWS in Woodward-Clyde 1995c). An important calving area for the Central Arctic caribou herd is located just south of Oliktok (Shideler 1986). The Arctic fox, brown/grizzly bear, and short-tailed weasel are also occasionally seen in the area (personal communication, R. Suydam, Wildlife Management Department, North Slope Borough in Woodward-Clyde 1995c).

Marine mammals known or expected to occur in the Beaufort Sea in the vicinity of Oliktok include the endangered bowhead whale. Other summer residents include the gray whale, beluga whale, killer whale, harbor porpoise, threatened bearded seal, and spotted seal.

The polar bear is a winter resident of Oliktok LRRS, and the ringed seal is a year-round resident (Wynne 1993). Although most marine mammals are under the jurisdiction of the NMFS, polar bears are under the jurisdiction of the USFWS. The LRRS is within the range of the polar bear, a protected species under the provision of the MMPA (Bridges 2001). Species uncommon or rare in the area include the harbor porpoise, killer whale, Pacific walrus, and narwhal (personal communication, R. Suydam, Wildlife Management Department, North Slope Borough in Woodward-Clyde 1995c).

5.3.3 Birds

The 2002 survey occurred during July and August, which is outside the nesting period. Thus, 2002 sightings are post-breeding sightings. Thirty-four bird species were recorded at Oliktok LRRS during 2002 aerial and ground-based surveys (Ritchie *et al*. 2003). Waterfowl observed during the 2002 survey include White-fronted Goose, Canada Goose, Brant, Tundra Swan, American Wigeon, Mallard, Green-winged Teal, Northern Shoveler, Northern Pintail, Greater Scaup, King Eider, Common Eider, Longtail Duck, Red-breasted Merganser, and Red-throated and Pacific Loons. During 2002 site visits American Golden Plover, Semipalmated Plover, Ruddy Turnstone, Semipalmated Sandpiper, Pectoral Sandpiper, Dunlin, Long-billed Dowitcher, Red-necked Phalarope, and Red Phalarope were observed. A large influx of passerine birds occurs in summer as a result of hordes of insects that breed and hatch in wetlands. During 2002 site visits Snow Buntings, Savannah Sparrows, and Lapland Longspurs were observed. A noteworthy observation of a Varied Thrush was recorded during the 2002 survey. Other bird species recorded during 2002 survey include Parastic and Long-tailed Jaegers, Glaucous Gulls, and Common Ravens.

The Colville River Delta, just west of Oliktok LRRS, is an important nesting area for waterfowl, such as Brant and Yellow-billed Loons.

The wet tundra environment of the Oliktok LRRS region provides good nesting and foraging habitat for a wide variety of shorebirds, waterfowl, and passerines. Brant use the estuarine marsh east of the site and sites west of the LRRS for resting and foraging (Stickney 1997). During August 2003, 611 CES Natural Resources staff saw evidence of Brant use of the estuarine marsh for foraging. Common Eiders, Arctic Terns, Glaucous Gulls, and Black Guillemots use barrier islands offshore for nesting. Sea ducks that frequent nearshore areas include Longtail Ducks, Scoters, and Red-breasted Mergansers.

Several species of Sandpipers, Red-necked Phalaropes, and Plovers frequent ponds and small lakes in and around the site (personal communication, Booker, USFWS in Woodward-Clyde 1995c). Predatory species, such as Snowy Owls and Jaegers, are common in the area, particularly when lemming and ground squirrel populations are high. The Arctic Peregrine Falcon is known to nest on the Colville River but does not nest on USAF property. However, nonbreeding and migrating Peregrines occur in the area.

5.4 Threatened and Endangered Species

Threatened polar bears and Pacific walruses and the candidate Yellow-billed Loon occurs on Oliktok LRRS, The endangered bowhead whale and threatened ringed seals occur near the site, and the threatened bearded seal may be in the area.

The Spectacled Eider may have nested on the marsh near the LRRS in 1992 (personal communication, Booker, USFWS in Woodward-Clyde 1995c). Day *et al*. (1995) surveyed for Spectacled and Steller's Eiders at remote USAF sites. This 1994 study did not locate either species at Oliktok LRRS, but the remains of an old (1993) nest of what was probably a Spectacled Eider was found at Oliktok LRRS. Oliktok LRRS was identified as one of the four USAF sites with the greatest potential for nesting Spectacled Eiders and little potential for nesting Steller's Eiders. No Spectacled Eiders or Steller's Eiders were observed at Oliktok LRRS during a 2000 survey (Day and Rose 2000); however, a pair of Spectacled Eiders were observed at Oliktok LRRS during a 2001 survey (Kendall *et al*. 2001). The presence of the pair of Spectacled Eiders in the spring may indicate that this species at least attempted to breed at or near the site (Kendall *et al*. 2001). No Spectacled or Steller's Eiders were recorded on Oliktok LRRS during the 2002 survey (Ritchie *et al*. 2003). However, the 2002 survey recorded three Spectacled Eiders at two locations south of the boundaries of the LRRS. No Spectacled or Steller's Eiders were recorded at Oliktok LRRS during prebreeding aerial surveys or ground-based surveys conducted in 2003 (Schick *et al*. 2004). Oasis Environmental, Inc.'s (2008) 2007 monitoring effort did not locate any active nests or observe Spectacled or Steller's Eiders at Oliktok LRRS.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Oliktok LRRS, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller's Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004).

The North American lynx, a former Category 2 Candidate species, is also a potential user of Oliktok LRRS.

5.5 Wetlands

The general Oliktok LRRS vegetation map's wetland features (Woodward-Clyde 1995c) were significantly updated by a NWI map. This was further enhanced by the 2000 and 2005 habitat mapping projects (Schick *et al*. 2004 and Wells *et al*. 20010, respectively. Table 5.2 summarizes wetland acreages on Oliktok LRRS. These sources are used to facilitate decisions regarding facility siting. Oliktok LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (719.39 acres). Figure 5.5 shows wetlands on Oliktok LRRS from 2011 data.

The most common wetland type at the Oliktok LRRS is palustrine, persistent emergent. These areas are typically moist and wet tundra,and are either saturated, seasonally flooded or semi-permanently flooded, depending on microtopography and landscape position. These areas are often dominated by sedges (*Carex* spp.) and cotton grass (*Eriophorum* spp.) and may include include wildlife habitats such as Lowland Moist Sedge–Shrub Tundra, Lowland Patterned Wet Tundra, and Lowland Nonpatterned Wet Tundra. Other palustrine wetlands include deep or shallow ponds and seasonally flooded emergent areas mixed with mosses and/or lichens. Estuarine habitats are common in the northeastern part of the site and include estuarine, subtidal, unconsolidated bottom areas, bordered by estuarine, intertidal emergent vegetation that is irregularly flooded (Schick *et al*. 2004).

Though the construction of a possible new access road to the LRRS would destroy wetlands and migration would be considered in the process to evaluate and permit the project, it would decrease impacts to high value estuarine marsh that is affected each time the current road is damaged by storm waves.

Figure 5.4 Spectacled Eider Habitat Assessment at Oliktok LRRS

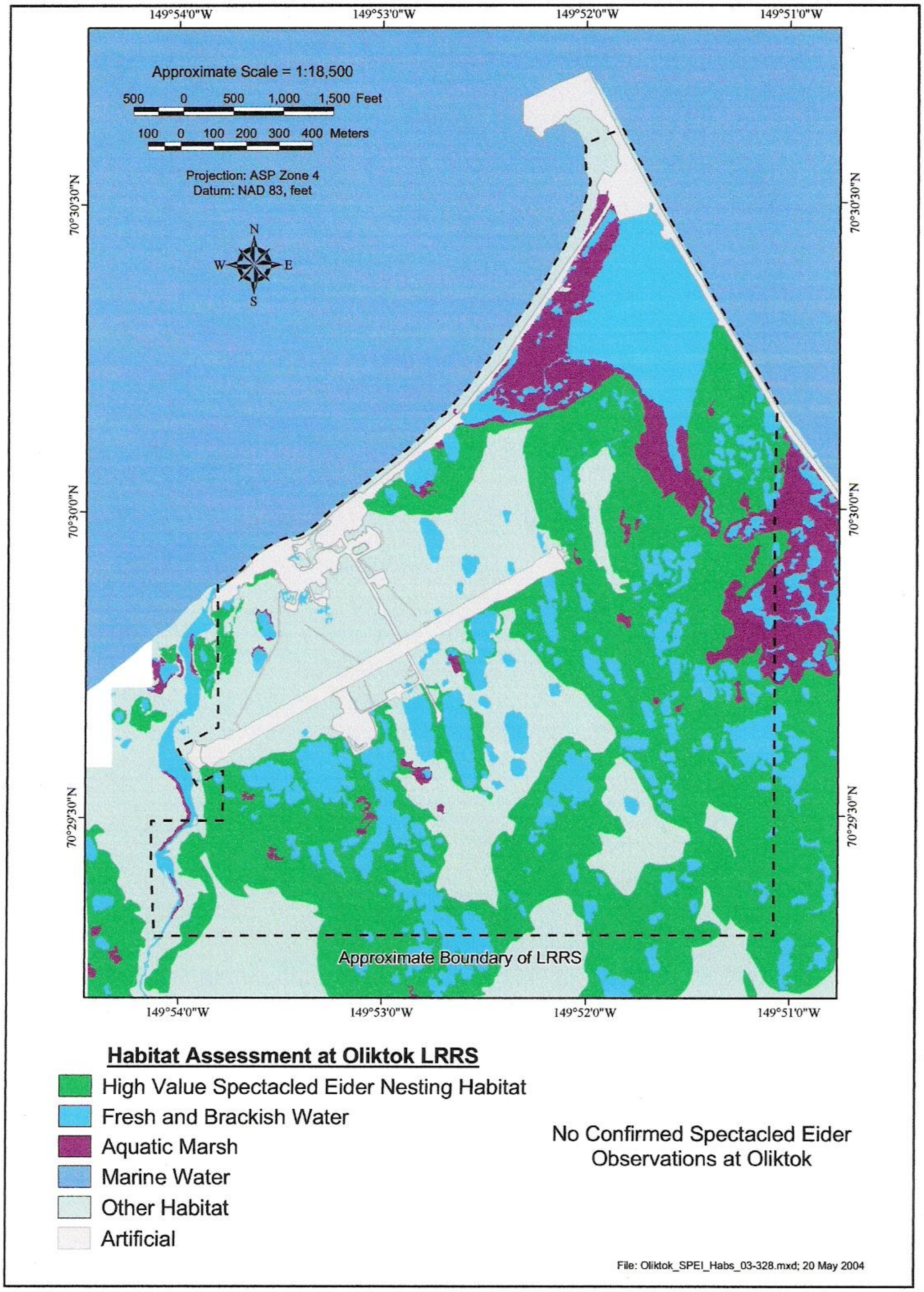
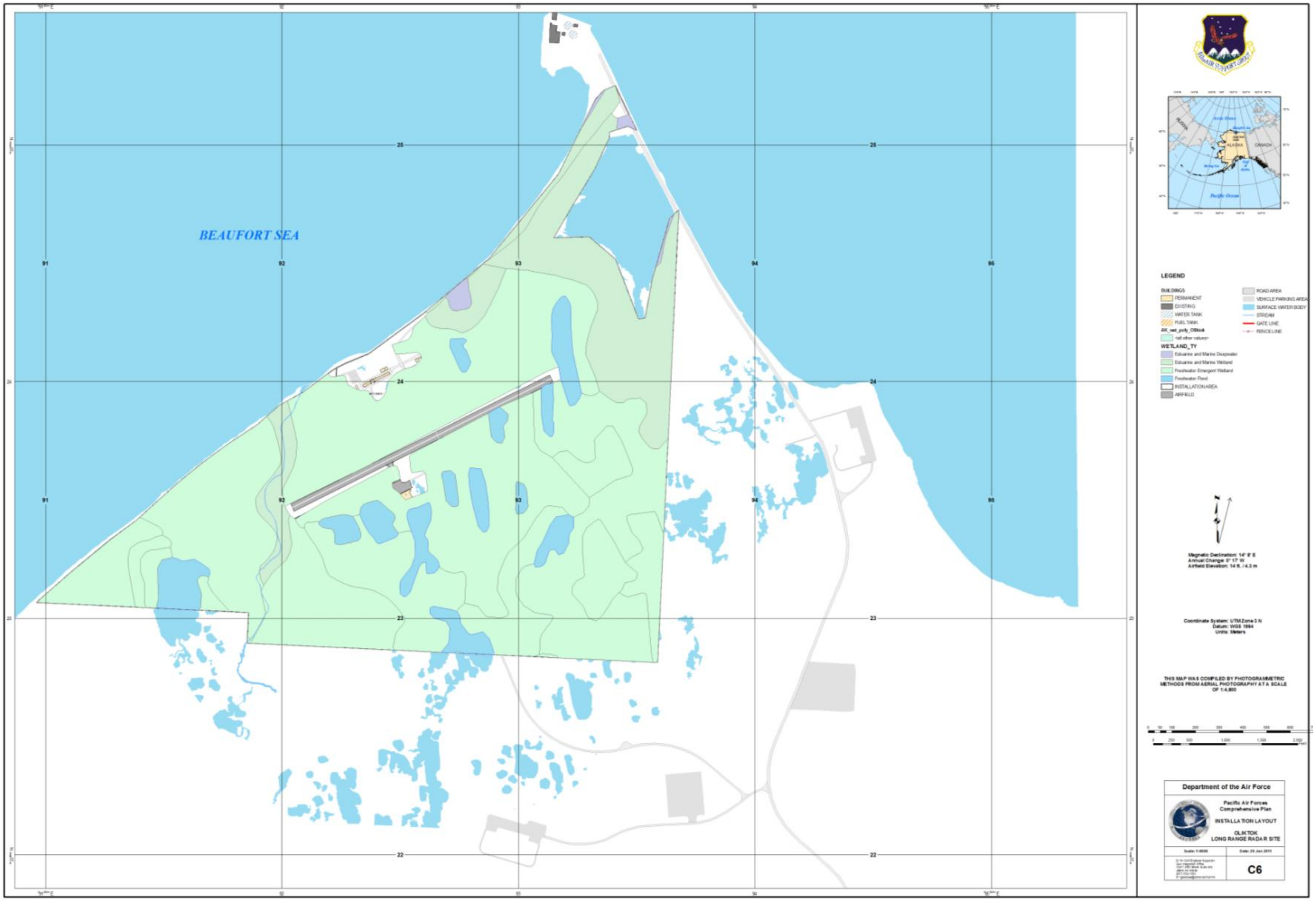


Figure 5.5 Oliktok LRRS Wetlands, 2011



5.6 Other Natural Resource Information

5.6.1 Subsistence

Traditional subsistence activities in the Nuiqsut area have revolved principally around caribou and fish. Marine mammals, moose, waterfowl, and furbearers have also been important although secondary. Nuiqsut is one of 10 Alaska Eskimo Whaling Commission communities; whaling is based from Cross Island, a considerable travel distance from Nuiqsut (Oliktok is approximately midway between). The Nuiqsut subsistence use area includes the area between Harrison and Camden bays. Of primary importance is the Colville River area. Three species, caribou, whitefish, and bowhead whale account for about 88 percent of Nuiqsut's annual subsistence harvest in terms of edible pounds. Subsistence activities are an important component of the Nuiqsut economy and the local Inupiat culture (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Natural resources uses at Oliktok LRRS consist primarily of non-organized activities, such as fishing. Caribou infrequently move through the installation in large herds. Recreational fishing occurs in streams and rivers near the site and in the Arctic Ocean for whitefish, cisco, salmon, and Arctic char. The adjacent oil development is open to hunting; however, access is controlled (personal communication, P. Cooley 2007).

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities at Oliktok LRRS include a petroleum, oils, and lubricants tank storage area, warehouse, radome, vehicle maintenance garage, several deactivated Ultra High Frequency towers, a hangar, and a 4,000-foot runway, which is no longer maintained. Maintenance includes buildings, roads, grounds, antenna structures, utility plants, and systems of supply, generation or disposition of electricity, water, sewage, and refuse.

Primary access to the site is through oil company roads. Emergency landings at the Oliktok LRRS airfield are permitted (personal communication, N. Hilton with G. Augustine 1999). Since site access is primarily achievable through land controlled by private oil companies, site personnel and others working temporarily at the site, as a courtesy and imperative if a weapon is being carried, should make prior contact with oil companies' security offices. The BP Exploration (Alaska)-leased Prudhoe Oil Field and the Conoco Philips Alaska Incorporated-leased Kuparuk Oil Field are controlled access areas. Public access ends about 50 miles east of Oliktok at the Deadhorse/Prudhoe Bay state airport and at the end of the Dalton Highway, a state road.

Use of private oil industry roads is not allowed for recreation (personal communication, Capt M. Jordan, BP and Purcell Company Security with G. Augustine 1999). Access is limited to persons with business in the oil companies' leased areas, residents of Nuiqsut and adjacent areas, and persons with official Air Force business at Oliktok LRRS via the oil field road system (personal communication, Capt J. Tangy, ARCO Kuparuk Security with G. Augustine 1999).

Authorization from the Kuparuk Airport Manager is required prior to scheduling a flight to the private oilfield airport, 20 miles from Oliktok LRRS. Access to the site from the airport is further complicated since there are no rental vehicles available at the Philips Petroleum Kuparuk Camp.

The AF has two out-grants at Oliktok, an easement to Conoco Phillips and a Right-of-Way to Kerr-McGee.

Appendix 3.0 – Barrow. Point Barrow Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Point Barrow LRRS

3.1 Location and Area

Point Barrow LRRS is located on the Chukchi Sea coast, six miles north of the town of Barrow, the northernmost United States city (INRMP Figure 3.1). Point Barrow LRRS is leased by permit from the BLM and occupies 266 acres (Figure 3.1) adjacent to the former Naval Arctic Research Laboratory.

3.2 Installation History

Point Barrow was selected as the headquarters for construction of the DEW Line system. During World War II the Navy established a camp at this northernmost point of our nation. All essentials of a working headquarters and base of supply for the DEW Line project were available, including a landing strip, warehouses, and barracks. It was in the heated hangar at Point Barrow that the first module, the basic building block of the DEW Line station, was assembled and mounted on sledlike bases for transport to more than 18 sites, located at approximately 50-mile intervals. During construction of the DEW system, there were the obstacles of logistic resupply in remote areas, travel across the tundra, extreme weather, and placing buildings on permafrost soils. The resupply and movement of supplies and materials were resolved by airlifting to Barrow (Denfeld 1993).

The two main DEW stations in Alaska were at Point Barrow and Barter Island (Denfeld 1993). In the mid-1980s the Point Barrow DEW Line site was upgraded into a North Warning LRRS. Three contract maintenance and operations personnel and two Air Force personnel work and live at Point Barrow LRRS. Clean Sweep demolition and debris removal at Point Barrow LRRS occurred in 2011.

3.3 Surrounding Communities

The city of Barrow is the largest native community in Alaska with a population of 4,212 (2010 estimate) persons. The suburb of Browerville is a smaller community located between Barrow and the LRRS. Most residents are Inupiat Eskimos. Traditional marine mammal hunts and other subsistence practices are an active part of the culture. Bowhead, gray, killer, and beluga whales migrate near Barrow each summer (www.dced.state.ak.us 2012).

Barrow was incorporated as a first-class city in 1974 and has a council-manager form of government. Barrow is the economic center of the North Slope Borough, the city's primary employer. The Arctic Slope Regional Corporation and offices of several subsidiaries are based in Barrow. A number of federal agencies maintain facilities at Barrow, including the National Weather Service, FAA, Bureau of Indian Affairs, and Public Health Service (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Traditionally, Barrow is known as Ukpeagvik (place where owls are hunted). The ancient town site included at least two villages, Ukpeagvik and nearby Nuwuk on Point Barrow. The Inupiat (northern Eskimo) of the area have traditionally depended on marine mammal hunting, supplemented by fishing and trapping.

In 1881 the U.S. Army established a meteorological and magnetic research installation near Barrow. At the turn of the century the Cape Smythe Whaling and Trading Installation was established at present-day Browerville. In 1923 the Naval Petroleum Reserve (now National Petroleum Reserve - Alaska) was established, followed by the establishment of the Naval Arctic Research Laboratory, three miles north of Barrow. With exception of about 680 acres (still under Navy responsibility), the former Naval Arctic Research Laboratory is under private ownership and is called Ukpeagvik Inupiat Corporation Naval Arctic Research Laboratory after the owner, Ukpeagvik Inupiat Corporation.

3.5 Local and Regional Natural Areas

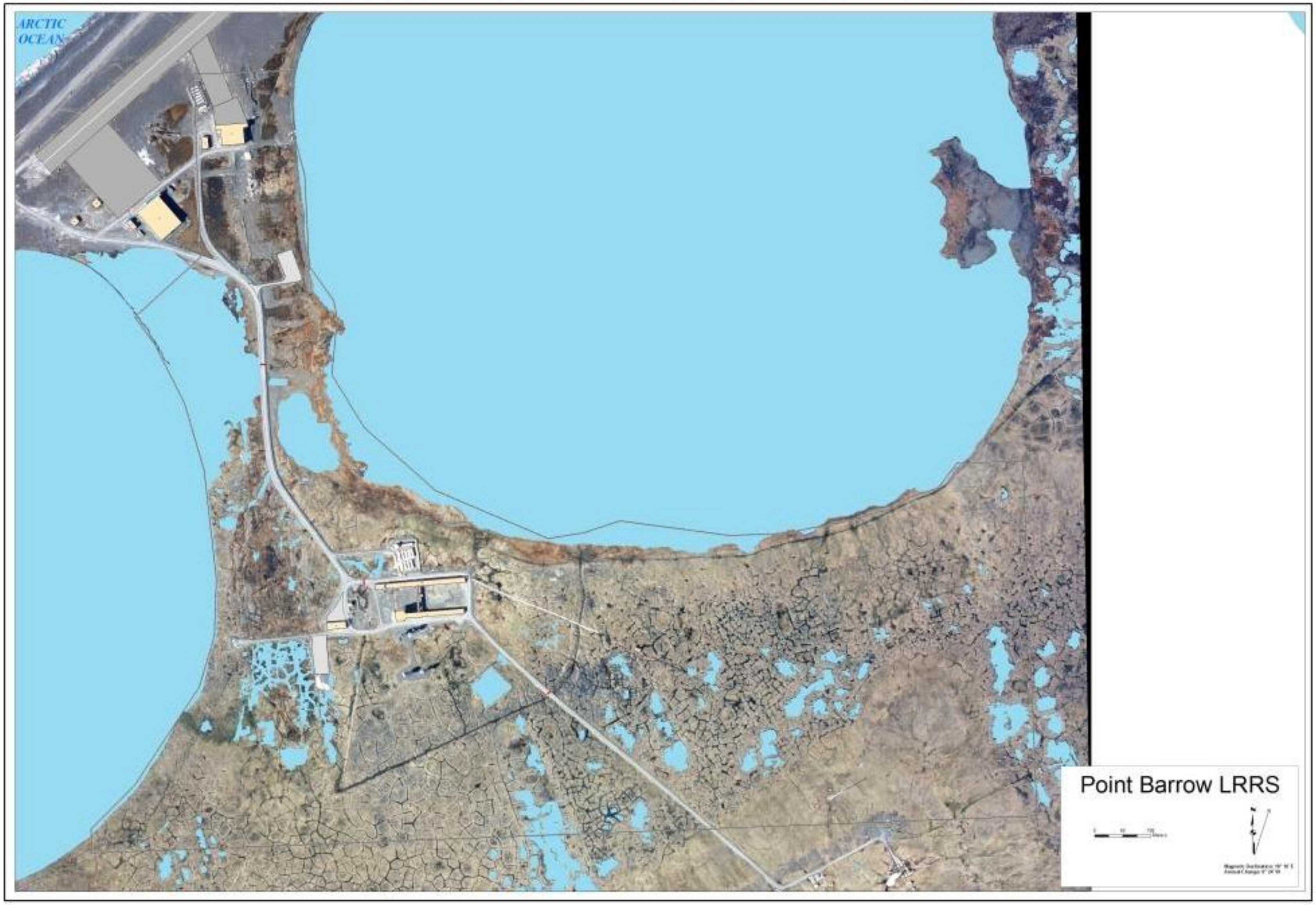
Portions of the Alaska Maritime NWR are near Point Barrow LRRS. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

With the Arctic Ocean to the west, north, and east and flat tundra stretching 200 miles to the south of Point Barrow, there are no natural barriers to the persistent cold easterly winds that blow around the edge of the high pressure area over the North Pole. The climate of Barrow is arctic. Temperatures range from -56 to 79 °F, with an average temperature of 40 °F during summer.

Figure 3.1 Point Barrow LRRS



The sun does not set between May 10th and August 2nd each summer and does not rise between Nov. 18th and January 24th each winter. The daily minimum temperature is below freezing 324 days of the year. Prevailing winds are easterly and average 12 mph. The Chukchi Sea is typically ice-free from mid-June through October (www.dced.state.ak.us 2012).

Table 4.1 Barrow, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	-7ºF	-8ºF	-6ºF	9ºF	26ºF	41ºF	47ºF	44ºF	36ºF	22ºF	6ºF	-2ºF
Average Low	-19ºF	-20ºF	-19ºF	-5ºF	17ºF	31ºF	35ºF	34ºF	29ºF	13ºF	-5ºF	-14ºF
Mean	-13ºF	-14ºF	-13ºF	2ºF	22ºF	36ºF	41ºF	39ºF	33ºF	18ºF	1ºF	-8ºF
Record High	54ºF (1930)	36ºF (1982)	34ºF (1998)	42ºF (1936)	47ºF (1996)	72ºF (1996)	79ºF (1993)	76ºF (1968)	62ºF (1995)	43ºF (1954)	39ºF (1937)	34ºF (1932)
Record Low	-53ºF (1975)	-56ºF (1924)	-52ºF (1971)	-42ºF (1924)	-19ºF (1984)	4ºF (1969)	22ºF (1936)	20ºF (1975)	1ºF (1957)	-32ºF (1970)	-38ºF (1992)	-55ºF (1924)
Average Precipitation	0.13 inches	0.14 inches	0.09 inches	0.16 inches	0.18 inches	0.32 inches	0.98 inches	1.05 inches	0.72 inches	0.41 inches	0.21 inches	0.14 inches

Source: www.weather.com (January 16, 2012)

Most annual precipitation occurs as rain in July and August. Snowfall occurs every month of the year and averages 28 inches annually. Most snow occurs during September through November, and the least falls in July and August (Legare 1998). Precipitation is light year-round, averaging about 4.5 inches annually (www.weather .com).

Prevailing winds are easterly and average nearly 12 mph with very little annual variation; however, October and November winds are the strongest. Maximum steady wind speeds of 35 mph have been reported every month of the year, and an extreme steady wind of 58 mph was reported in March 1960. Gusts have had much greater speeds, but no record of extreme gusts exists (CH2M Hill 1981).

4.2 Landforms

Point Barrow LRRS is located in the extreme northwestern portion of the Arctic Coastal Plain on the coast of Chukchi Sea, southwest of Point Barrow and four miles northeast of the town of Barrow. The low relief of the Point Barrow area and the presence of permafrost have promoted the formation of ice wedge polygons, large elliptical lakes, and thaw lakes. The Barrow area is conspicuous for its lack of pingos.

4.3 Geology and Soils

Soils in the Barrow vicinity formed on flat to very gently sloping topography under cold, moist conditions, which favored the accumulation of organic matter. Soils typically have a histic, or organically rich, surface layer. Typically, a secondary layer of clay to silty loam, which often contains organic materials, is present with a perennially frozen, organically rich insulation layer. Incorporation of organics into lower soil layers is often facilitated by frost churning and/or burial through processes involved with the thaw lake cycle.

Two soil types common in the area are Tundra and Bog soils. Tundra soils (pereglic cryaquepts) consist of a thick layer of fibrous substrate. Bog soils (pereglic cryohemists) consist of a thick layer of fibrous peat. Tundra soils are the most common soils, but Bog soils may occupy up to 20 percent of the Arctic Coastal Plain. The Arctic Slope is underlain by thick continuous permafrost. The depth of permafrost near Point Barrow is 600-800 feet below ground surface and nearly 2,000 feet deep near the town of Barrow. The ice content of permafrost soils in the Barrow region commonly approaches 50 percent. Where the ground surface has not been disturbed, the depth of the active layer is generally limited to the top 20 inches. In disturbed areas, the depth of the active area can extend to five feet.

4.4 Hydrology

4.4.1 General

Point Barrow LRRS lies between two water bodies, Imikpuk Lake to the west and North Salt Lagoon to the east, which are separated by less than 700 feet. Surface drainage originating from the installation flows either to the lake or the lagoon.

The Barrow groundwater regime is controlled by an extensive permafrost layer underlying the entire region. Groundwater use is limited due to the ephemeral nature of the active zone and because much of the groundwater is brackish. Suprapermafrost groundwater, groundwater occurring above the permafrost zone, occurs only in summer thaw months and extends to a maximum depth of 20 inches. With saturated conditions that exist during portions of the summer thaw period, it is difficult to delineate between surface water and this groundwater.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. There is no data on flooding caused by rainfall at this site. A severe rainfall could inundate all but the highest ground due to poor drainage. The greatest flood threat comes from coastal storms. The flood of record was the coastal storm of October 3, 1963, which caused a surge to 12 feet msl. Several other storms in the 20th Century were recorded with storm surges to 10 feet msl. The 100-year flood level is 12 feet msl. Essentially all natural terrain of Point Barrow LRRS is within the 100-year flood plain.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Point Barrow LRRS. Much information included in INRMP Chapter 5.0 that includes Point Barrow LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Point Barrow LRRS and the surrounding area. ***Appendix 3.0-Barter***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Point Barrow LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M121 Brooks Range Tundra-Polar Desert Province
Description: The province's landscape varies from rugged peaks of 9,000 feet to U-shaped valleys, braided stream channels, and rolling plateaus. The climate is similar to the arctic coastal plain, but at higher altitudes, precipitation increases. Since the province is above the Arctic Circle, it gets several days of 24-hour sunlight in June and sunless days in December. Precipitation averages 7-15 inches. Higher elevation consists of low mats of shrubby flora species, lower elevations are covered by mats of sedge and shrub. Soils for the province are rocky and poorly developed; Inceptisols are found on lower slopes.

5.2 Vegetation

Elias *et al*. (1996) included Point Barrow LRRS in a study of historical biodiversity at remote USAF sites in Alaska. Inventories included modern plant communities, modern insects, Holocene plant communities, and Holocene insects. The Holocene is the period of geologic time since the last ice age. The study indicated likely significant differences in ancient and modern environments between western (Point Barrow LRRS) and eastern (Barter Island LRRS) regions of the Arctic coast of Alaska, probably caused by varying substrates and different climates.

During the early Holocene (10,500 - 5,600 years before present), vegetation at what would become Point Barrow LRRS was dominated by grasses and heaths. Conditions were probably moister and warmer than during the later Holocene (10,500 years before present to the present). Current plant species richness at Point Barrow LRRS is poorer than during the early Holocene. Current and historic insect assemblages are similar, reflecting mesic tundra environments, such as found today.

A general vegetation map of Point Barrow LRRS was presented in Woodward-Clyde (1995c). Schick *et al*. (2004) made significant improvements in vegetation mapping at Point Barrow LRRS (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Point Barrow LRRS in 2001 and 2005. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth. Table 5.2 shows these acreages and changes over this 4-year period. Figure 5.2a shows habitat classes for 2005, and Figure 5.2b shows changes in habitat classes between 2001through 2005.

Table 5.2 Habitat Class Differences between 2001 and 2005, Point Barrow LRRS

Habitat Class	Acres 2001	Acres 2005	Acreage Change
Barren Land	33.1	24.2	-8.9
Developed, Low Intensity	0.0	29.9	29.9
Emergent Herbaceous Wetlands	5.3	20.1	14.8
Open Water	14.9	11.7	-3.2
Perennial Ice/Snow	28.4	9.8	-18.5
Sedge/Herbaceous	179.8	165.9	-14.0
Totals	**261.5**	**261.5**	**0.0**

Schick *et al*. (2004) described the Point Barrow LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Point Barrow LRRS encompasses 266 acres[1]. Wildlife habitats at the LRRS are primarily coastal, lacustrine, and lowland tundra types with no riverine or upland habitat types present. Of the waterbodies, deep lakes are the predominant type, as two sizable lakes occur in the northern half of the site, but smaller shallow lakes and ponds are scattered throughout the southern portion of the LRRS. Although there is an abundance of waterbodies at the LRRS, freshwater lakes and ponds with islands and/or polygonized margins, which provide preferred habitat for nesting and brood-rearing waterbirds, are rare. Coastal Salt Marsh, a habitat often used by brood-rearing waterfowl, occurs along the shoreline of the brackish lake in the northeastern section of the property.

Freshwater marsh and lowland tundra habitats occur primarily at the southern end of the LRRS. Of the tundra habitats, Lowland Moist Sedge–Shrub Tundra, Lowland Patterned Wet Tundra, and Lowland

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

Figure 5.2a Point Barrow LRRS Wildlife Habitat Map, 2005

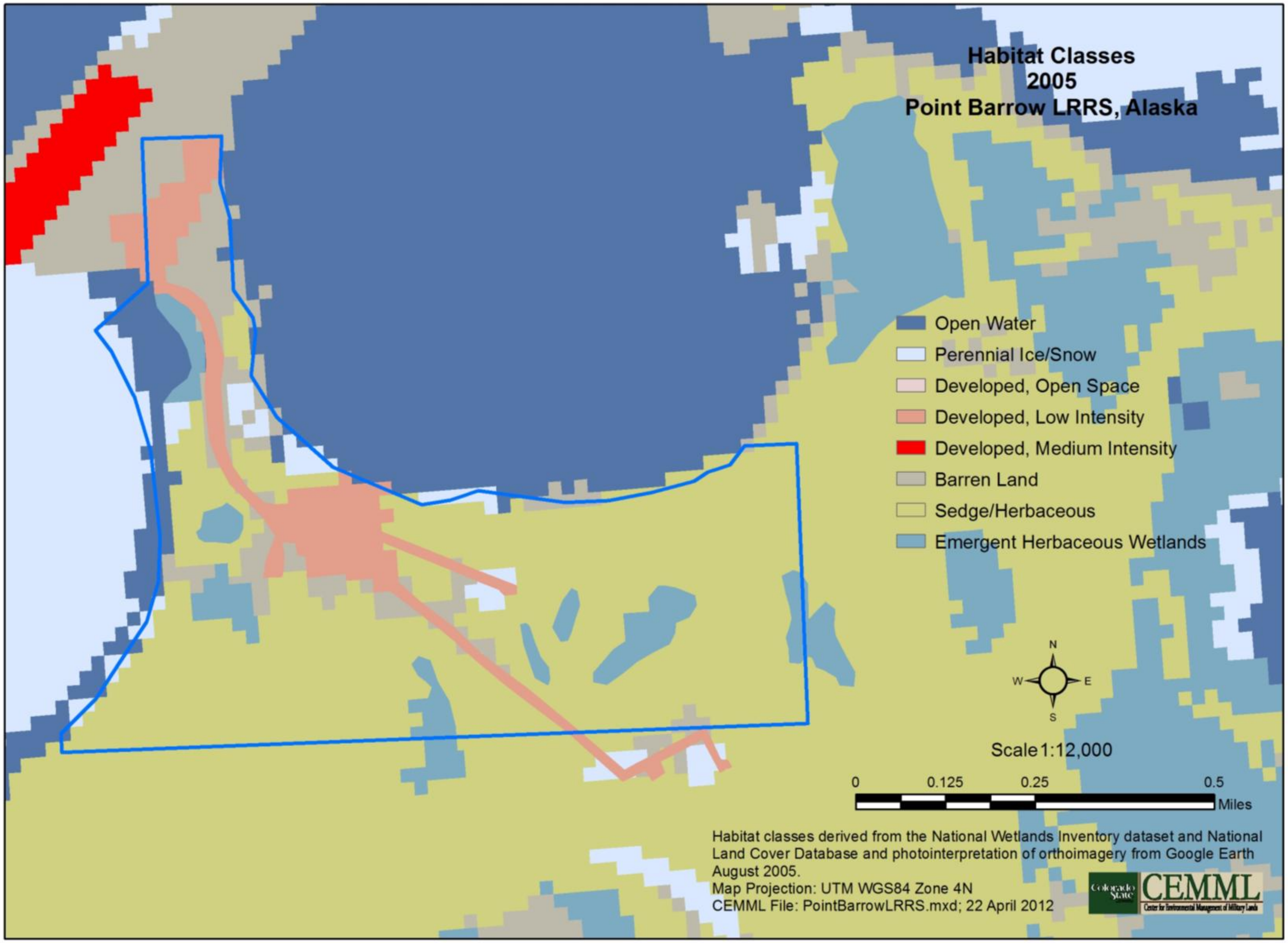


Figure 5.2b Changes in Habitat Classes at Point Barrow LRRS between 2001 and 2005

Nonpatterned Wet Tundra are the most common wildlife habitats. Wetlands of the LRRS are typically dominated by sedges (*Carex* spp.) and cotton grass (*Eriophorum* spp.).

Schick *et al*. (2004) identified 16 wildlife habitat types (Figure 5.2). Five habitats covered >85% of the site: Coastal Brackish Water (37.1%), Lowland Moist Sedge-Shrub Tundra (17.0%), Deep Water (13.3%), Artificial (11.4%), and Lowland Patterned Wet Tundra (8.2%). Other habitats with cover >2% included Coastal Salt Marsh and Lowland Nonpatterned Wet Tundra. Over half of the site is associated with lacustrine open-water habitats.

5.3 Fish and Wildlife

5.3.1 Fish

Fishery resources have been surveyed in freshwater lakes and lagoons in the Point Barrow area. Fish nets set near Brant Point have yielded two species of salmon, pink and chum. Subsistence fishermen harvest several species of cisco, broad whitefish, smelt, Arctic flounder, and cod species. Whitefish account for the highest percentage (10.6 percent) of the total subsistence harvest in terms of edible pounds (Braund and Associates 2004). Trout and grayling are also occasionally taken in a recreational hook-and-line fishery.

5.3.2 Mammals

Brown lemmings are the most obvious terrestrial mammal in the immediate vicinity of the LRRS. This rodent, a staple food for Arctic foxes and avian predators, shows extreme population fluctuations in 3- to 5-year cycles. Collared lemmings are also common. Coastal and meadow environments support other mammal species, such as the collared lemming, weasel (short-tailed and least), caribou, Arctic fox, wolf, and wolverine (personal communication, Craighead George, Wildlife Management Department, North Slope Borough in Woodward-Clyde 1995c). Moose and brown/grizzly bears are uncommon near Point Barrow but are occasionally harvested by hunters. Arctic ground squirrels have been extirpated near Point Barrow for parkas, and no wolves or wolverines occur within 5-10 miles of Barrow for the same reason.
The endangered bowhead whale occurs in nearshore waters of Point Barrow during warmer months. Other marine mammal species occurring during summer include the gray whale, beluga whale, killer whale, minke whale, bearded seal, spotted seal, harbor porpoise, and Pacific walrus. One winter resident to the area is the polar bear; the ringed seal occurs year-round (Wynne 1993, Bridges 2001). Beluga and bowhead whales are harvested by the local native community. The Point Barrow area is within the range of the polar bear (Bridges 2001).

5.3.3 Birds

The wet tundra environment within and adjacent to the LRRS provides nesting and foraging habitat for a wide variety of bird species. Common breeding birds in the area include Red-throated Loon, Pacific Loon, Tundra Swan, Greater White-fronted Goose, Snow Goose, Brant, Canada Goose, Northern Pintail, Greater Scaup, King Eider, Longtail Duck, Lesser Golden Plover, Semipalmated Sandpiper, Pectoral Sandpiper, Baird's Sandpiper, Dunlin, Red-necked Phalarope, Pomarine Jaeger, Parasitic Jaeger, Glaucous Gull, Sabine's Gull, Black Guillemot, Snowy Owl, and Lapland Longspur (Norton *et al*. 1993).

The 2002 site visits occurred during July and August, which is outside the nesting period. Thus, 2002 sightings are post-breeding sightings. Twenty-two bird species were observed at Point Barrow LRRS during the 2002 ground-based survey (Ritchie *et al*. 2003).

The Point Barrow area is frequented by large numbers of waterfowl during the post-breeding molt and fall migration. Waterfowl are hunted by local natives at Point Barrow throughout the summer at "Duck Camp," located north of the LRRS (personal communication, Craighead George, Wildlife Management Department, North Slope Borough in Woodward-Clyde 1995c). Waterfowl species recorded during 2002 surveys include the King Eider, Northern Pintail, Longtail Duck, White-fronted Goose, and Pacific and Yellow-billed Loons. The barrier islands offer protection from predators for nesting Common Eiders and Glaucous Gulls. Barrier islands near Point Barrow LRRS support a nesting colony of Black Guillemot (USFWS 1978). The Barrow area is the only known nesting area for Steller's Eiders in North America (personal communication, Fleutsch, USFWS in Woodward-Clyde 1995c). The Barrow area is the only breeding location for Steller's Eiders in Alaska known to be currently in regular use (Obritschkewitsch *et al*. 2001). The species is known to nest near Imikpuk Lake and near small ponds in the area.

A few marine species are commonly seen in the Point Barrow area, including the Arctic Tern, Ross' Gull, Ivory Gull, Black-legged Kittiwake, Murres, Black Guillemot, Tufted Puffin, and Glaucous Gull, which are known to nest near Imikpuk Lake. Glaucous Gulls were observed at Point Barrow LRRS during the 2002 site visit. Passerine species that use the tundra in the area include sparrows, Snow Buntings, Lapland Longspurs, and Redpolls (personal communication, Fleutsch, USFWS in Woodward-Clyde 1995c). Lapland Longspurs, Snow Buntings, and Common Redpolls were observed during the 2002 site visit. Shorebirds observed include the Semipalmated Plover; Semipalmated, Baird's, and Pectoral Sandpipers; Dunlin; Red-necked Phalarope; and Red Phalarope. Other species observed include Pomarine, Parasitic, and Long-tailed Jaegers; Snowy Owls, and Common Ravens.

An abandoned tropospheric communication tower on the site provides nesting habitat for Ravens in the Barrow area. Twenty Snowy Owl nests were identified in the Point Barrow area by researchers from the Owl Research Institute in 1993. The Long-tailed Jaeger and Short-eared Owl are also occasionally abundant, corresponding to lemming population cycles.

In response to the high lemming populations, Snowy Owls and Pomarine Jaegers were the most obvious predators seen during a 1993 site visit (Woodward-Clyde 1995c). Sandpipers were the most obvious shorebird group noted during the 1993 site visit.

The USFWS breeding bird survey (Andres and Brann 1997) on an Army National Guard training area at Barrow is a valuable addition to the database for the Point Barrow LRRS area. This four-day study confirmed 45 species.

5.4 Threatened and Endangered Species

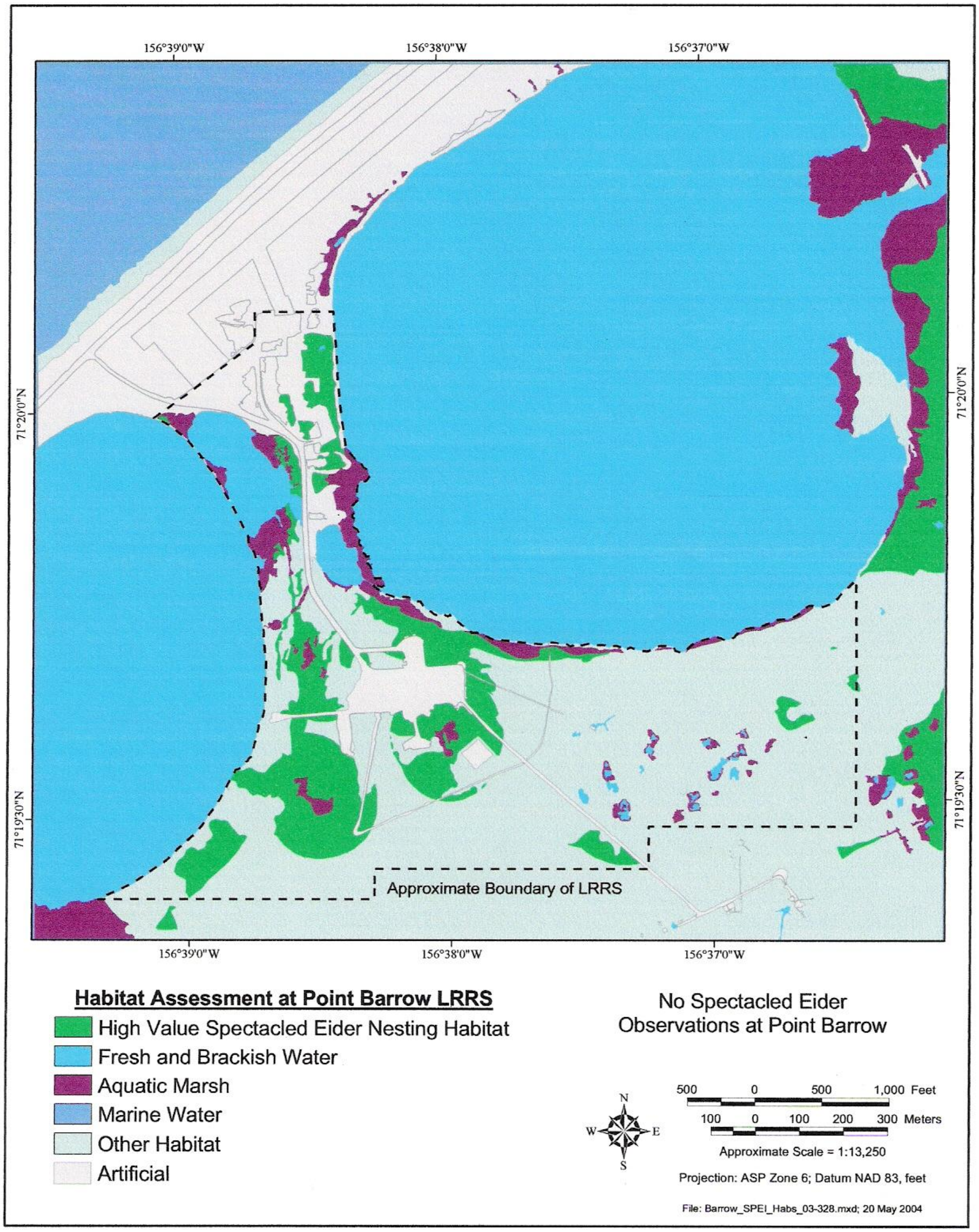
A records search conducted by the Alaska Natural Heritage Program[2] and discussions with the USFWS revealed several protected species occurring within the vicinity of Point Barrow. The Spectacled Eider, a threatened species, is known in the area, and the Steller's Eider, also threatened, nests in the vicinity of the LRRS. Day *et al*. (1995) surveyed for Spectacled and Steller's Eiders at remote USAF sites. This 1994 study did not locate either species at Point Barrow LRRS, but Point Barrow LRRS was identified as one of the four USAF sites with the greatest potential for nesting Steller's Eiders and Spectacled Eiders. No Spectacled Eiders or Steller's Eiders were observed at Point Barrow LRRS during a 2000 survey (Day and Rose 2000), a 2001 survey (Kendall *et al*. 2001), a 2002 survey (Ritchie *et al*. 2003), or a 2003 survey (Schick *et al*. 2004). Oasis Environmental, Inc.'s (2008) 2007 monitoring effort did not locate any active nests or observe Spectacled or Steller's Eiders at Point Barrow LRRS.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Point Barrow LRRS, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller's Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004).

Candidate Yellowed-billed Loons and Pacific walruses are confirmed, and the candidate Kittlitz's Murrelet may also occur in the area. The threatened polar bear is known at the site, and endangered

[2] Letters from E.W. West (May 11) and Rob Lipkin (May 16), Alaska Natural Heritage Program, 1993.

Figure 5.4 Spectacled Eider Habitat Assessment at Point Barrow LRRS



bowhead whales and threatened ringed and bearded seals are also known in the area (www.fws.gov 2012). A former Category 2 Candidate species that may occur in the area is the North American lynx.

The 611 ASG Natural Resources Manager has conducted visual bird survey in June 2011 and 2012 at the site. These surveys emphasize eiders and are a requirement of informal consultation with the USFWS for a restoration project.

5.5 Wetlands

Wetlands of Point Barrow LRRS include both tidal and non-tidal wetlands. Tidal wetlands at the site include estuarine subtidal with unconsolidated bottom areas bordered by estuarine, intertidal, persistent emergent vegetation that is irregularly flooded. Non-tidal wetlands at Point Barrow are predominately palustrine emergent areas that are saturated, seasonally flooded or semi-permanently flooded. These areas are typically moist and wet tundra, and are either saturated or seasonally flooded, depending on microtopography and landscape position. These areas are typically dominated by sedges (*Carex* spp.) and cotton grass (*Eriophorum* spp.) and may include wildlife habitats such as Lowland Moist Sedge–Shrub Tundra, Lowland Patterned Wet Tundra, and Lowland Nonpatterned Wet Tundra (Schick *et al*. 2004).

The general Point Barrow LRRS vegetation map's wetland features (Woodward-Clyde 1995c) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Point Barrow LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (243.37 acres). Figure 5.5 shows wetlands on Point Barrow LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Barrow is one of 10 Alaska Eskimo Whaling Commission communities. Hunting bowhead whales is a key activity in the organization of social relations in the community. Of all subsistence activities, bowhead whaling represents one of the greatest concentrations of effort, time, money, group symbolism, and significance. The Barrow subsistence use area includes a large geographic area extending from Wainwright to Nuiqsut. Barrow residents rely heavily on large land and marine mammals and fish. Bowhead whale, caribou, walrus, and whitefish account for about 85 percent of Barrow's annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

5.6.2 Outdoor Recreation

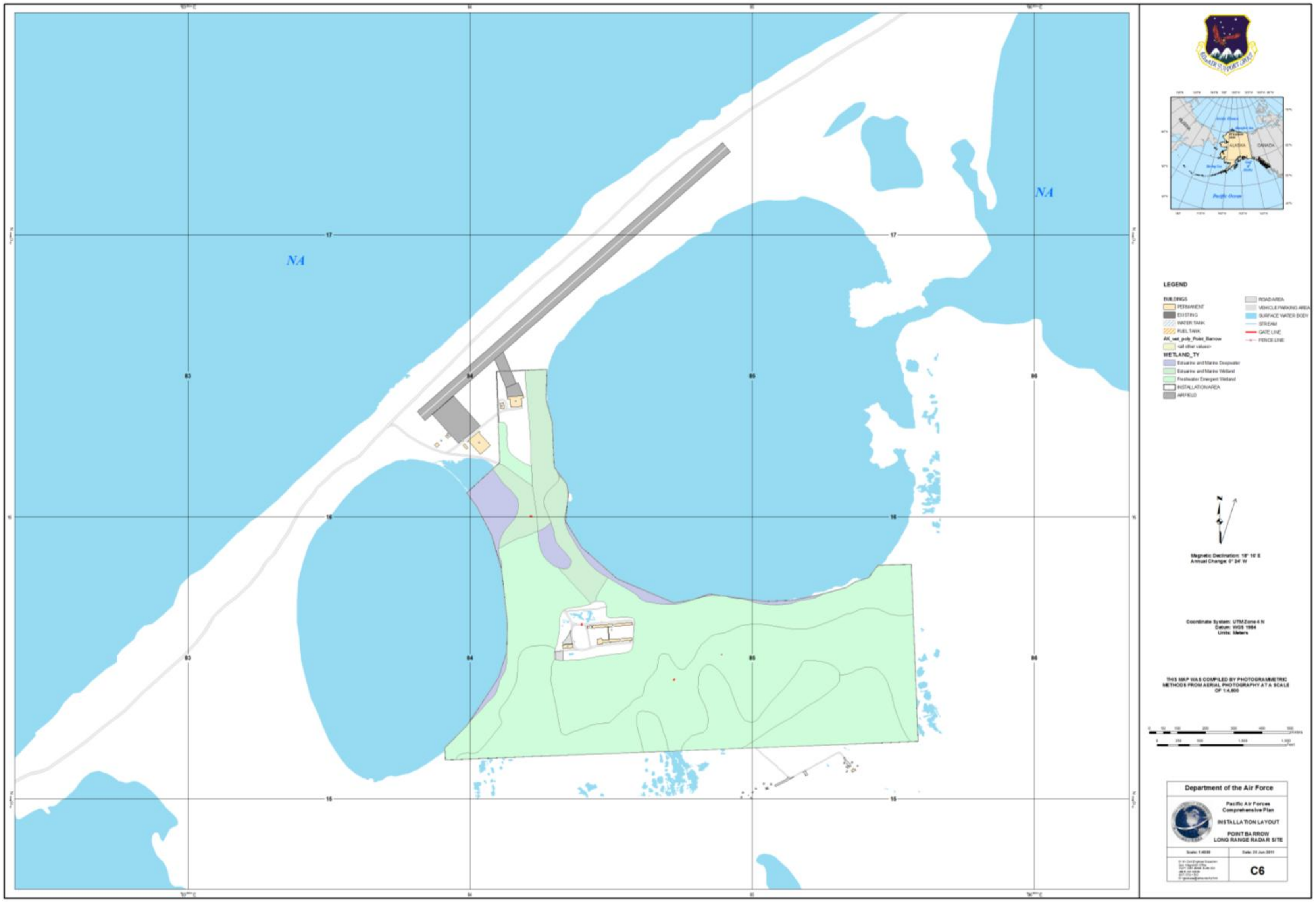
Point Barrow LRRS is one of the few LRRSs located near a major community that offers alternative (indoor) recreational opportunities. Outdoor recreation opportunities available at or near Point Barrow LRRS include access to game and waterfowl hunting, ATV routes, open space for non-consumptive use of natural resources such as, running or hiking, bird watching, photography, and limited fishing opportunities in lakes near the facility.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Property occupied by Point Barrow LRRS is managed by the BLM on the former National Petroleum Reserve - Alaska. A BOS contractor is responsible for maintenance of buildings; roads; grounds; utility

Figure 5.5 Point Barrow LRRS Wetlands, 2011

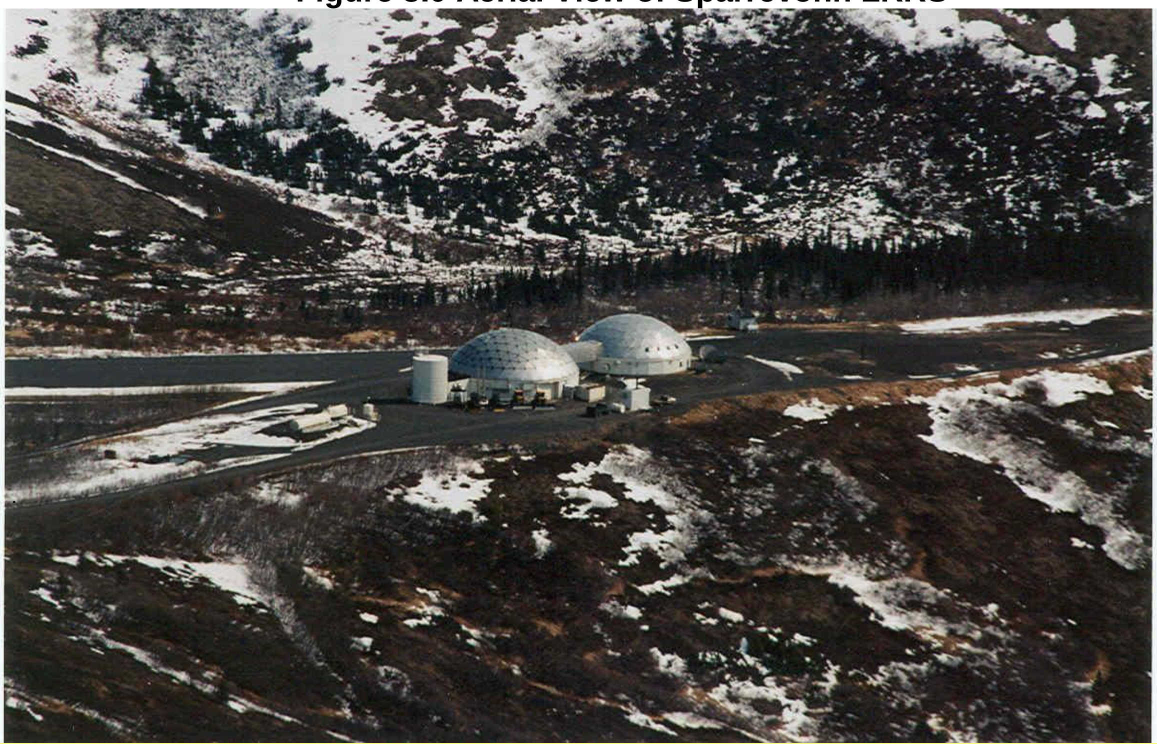


plants; and systems of supply, generation, or disposition of electricity, water, sewage, and refuse. The runway at the LRRS (Navy-owned) has been closed. The LRRS uses Barrow electricity and pays for water trucked to the site and sewage disposal trucked from the site by the Borough. Human uses of natural resources near the LRRS include hunting and fishing, as well as outdoor recreational activities.

Appendix 3.0 – Sparrevohn. Sparrevohn Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Sparrevohn LRRS



3.1 Location and Area

Sparrevohn LRRS is located about 200 miles west of Anchorage (INRMP Figure 3.1) on 1,179 acres on the top and south slopes of a northeast-southeast trending ridge, informally referred to as Sparrevohn Mountain (USAF 1999b). The ridge is located in the western foothills of the Central Alaska Range, which form the transition between the Alaska Range to the east and relatively flat Holitna and Kuskokwim lowlands to the west between Stony River and Hook Creek. The parcel of land is located on the slopes of Sparrevohn Mountain at elevations ranging from 1,500 to 4,246 feet above msl (Figure 3.1). The installation previously maintained a satellite camp (Fish Camp) for the recreation of personnel. This camp has been abandoned by the USAF and transferred to the BLM, then the state of Alaska. Contractors continue to maintain and use the facility on a personal basis through an agreement with the current owner (personal communication, P. Cooley 2007).

3.2 Installation History

Sparrevohn was one of the original AC&W sites constructed as a part of the air defense system in Alaska. In 1951 the Alaska Air Command decided to add two additional ground-controlled intercept sites to cover radar gaps in interior Alaska. Construction of the installation was performed by the military and was completed in 1952. A mobile radar became operational in 1951, providing temporary and sporadic radar coverage. Communications were provided by a high frequency radio system until 1957 when a WACS was installed. The WACS was deactivated in 1978, and a commercial satellite earth terminal became operational. In 1984 a MAR was installed and remains active. Four contractor personnel are assigned to the site.

3.3 Surrounding Communities

Lime Village, the nearest community, is 18 miles northeast of the installation. Lime Village is a Denaina Athabascan Indian settlement with a population of 29 (2010 estimate). Subsistence activities are essential to Lime Village; there is no store in Lime Village. Salmon, moose, bear, caribou, waterfowl, and berries are utilized. Some seasonal work is available through BLM fire fighting or training (www.dced.state.ak.us 2012). The LRRS is not connected to Lime Village by any road.

3.4 Regional Land Use

Between 1830 and 1840 Russian explorers-traders came up the Kuskokwim River and established a short-lived trading post at the mouth of the Hoholitna River. Another post was built further downstream in 1833. A third post was built across the Kuskokwim in 1842 and was named Kolmakov's Redoubt. The remains of this post are located in Sleetmute (Gutleber undated(c)).

By 1838 Russians had penetrated the middle Yukon, establishing a trading post at Nulato, which was destroyed 13 years later in one of the few Alaskan Native uprisings on record. The Russian influence in both of these areas was transitory and remained little known until the gold rush and geological exploration of the 1890s (Gutleber undated(c)).

The purchase of Alaska by the United States in 1867 had minimal effect on the region. The Alaska Commercial Company maintained a post at the village of Mumtrekhlogamute (today Bethel) on the Kuskokwim River, but generally trade in this region was very low. The delta area was periodically visited by missionaries and traders, but upper reaches of the drainages remained virtually unknown until the turn of the century (Gutleber undated(c)).

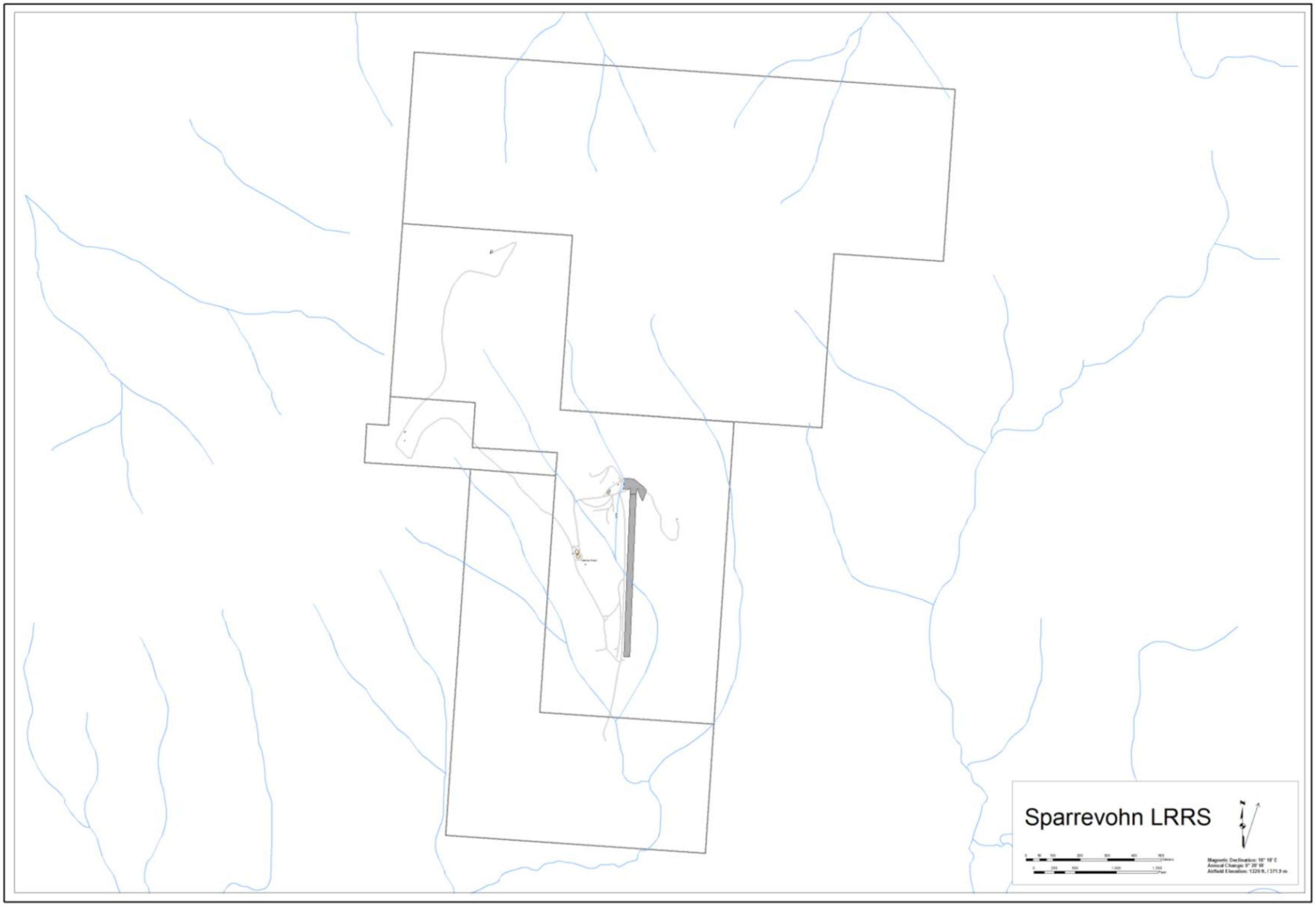
In 1906 E.W. Parks established a quicksilver mine at Sleetmute. The next year gold strikes were made in the Kuskokwim region, and a stampede began. About the same time, irregular trade between Bethel and Seattle was established, and the Kuskokwim River became a major trade artery to interior Alaska. As further gold finds were made on the Takotna and Tulaksak rivers and on the north and east forks of the upper Kuskokwim River, prospectors poured into the region and several major settlements developed (Gutleber undated(c)).

By 1911 the entire drainage was transversed by prospectors, but the Kuskokwim gold boom was on the decline. The 30-odd gold operations started in the four-year boom scaled down operations during the 20s and early 30s. In the following few years, gold operations took a roller coaster ride. This fluctuation was contributable to many factors, most notably the federal government's influence in raising the price of gold and expansions of the area's transportation links. Transportation expansion included construction of two regional federal airports at Aniak and McGrath, which were completed in 1939, presumably under the impetus of World War II (Gutleber undated(c)).

The war was the turning point in Kuskokwim gold and mineral operations, initiating a permanent decline. By the late 1950s, gold mining was abandoned in the Kuskokwim except for small-scale placers at Nyac and Ophir (Gutleber undated(c)).

The military presence in this region continued after World War II. The Korean War and the succeeding Cold War necessitated the development of an air defense early warning system (Gutleber undated(c)).

Figure 3.1 Sparrevohn LRRS



3.5 Local and Regional Natural Areas

Sparrevohn LRRS has no special natural areas (*e.g.*, refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate

Sparrevohn LRRS is situated in the Transitional Climatic Zone. This climate is between dry extremes of the Continental Climatic Zone and the wet moderate temperature of the Maritime Climatic Zone. Temperatures range between -47 and 82 °F. Annual precipitation averages 22 inches, with snowfall of 85 inches per year. The Kuskokwim and Stony Rivers are ice-free from mid-June through October (www.dced.state.ak.us 2012). Wind speeds average eight miles per hour (mph) from the south, and extreme east-southeasterly winds have been recorded at over 100 mph (Woodward-Clyde 1991(f)).

4.2 Landforms

Sparrevohn LRRS lies between Stony River and Hook Creek, immediately south of Cairn Mountain. Sparrevohn LRRS contains a Lower Camp at 1,700-foot elevation and a radar dome situated on a 3,300-foot mountain, 1.5 miles to the north. The surrounding area has numerous isolated hills and rounded ridges separated by wide river and stream channels. It is a transition zone between the central Alaska Range to the east and broad, flat Hoholitna and Kuskokwim lowlands to the west (Woodward-Clyde 1991(b)).

4.3 Geology and Soils

The southwestern region of Alaska is part of an active mountain-building belt that trends northeast-southeast through central and southwestern Alaska. Principal fault systems of the region follow an arcuate trend roughly paralleling the zone of crustal plate collisions. The most significant fault in the region is the Togiak Fault, a southwest extension of the Denali Fault system (Woodward-Clyde 1991(b)).

The backbone of the Alaska-Aleutian Range is a quartz-rich batholith. Flanks and foothills of the Alaska Range are composed of moderately folded and faulted Mesozoic and Cenozoic sedimentary and volcanic rock. Pleistocene glaciers scoured the landscape, creating broad stream and river valleys and leaving extensive till and moraine deposits (Woodward-Clyde 1991(b)).

Bedrock in the region of Sparrevohn LRRS is situated on rounded hills composed of steeply-dipping, interbedded layers of Cretaceous graywacke and shale bedrock. Broad stream and river valleys in the area consist of modified glacial outwash deposits (Woodward-Clyde 1991(b)). More detailed information is available in the Remedial Investigation Report (USAF 1999a).

The surficial geology of Sparrevohn LRRS Upper Camp is dominated by a thin veneer of broken weathered shale, 1-3 feet thick. Outcrops of shale and graywacke bedrock are common along the ridgetop. The geology of Lower Camp and airfield areas consists of mixed talus and alluvial deposits approximately 20 feet thick. These materials include sand, gravel, cobbles, and boulders which have been washed downslope from the ridgelines. Thin alluvial deposits of silt, sand, and gravel have accumulated in the stream channel of the southward-flowing Hook Creek tributaries. It is presumed that weathered bedrock, similar to that exposed at Upper Camp, underlies the alluvium at shallow depths in the Lower Camp area (Woodward-Clyde 1991(b)).

Soils throughout the LRRS are shallow to bedrock, with occasional deeper pockets of loamy, gravelly till material. Soils are very stony to extremely stony and are generally steeply sloping. Permafrost occurs as isolated masses in this region of Alaska. The location, thickness, and depth of permafrost at Sparrevohn LRRS are not known (Woodward-Clyde 1991(b)).

4.4 Hydrology

4.4.1 General

The Kuskokwim River and its tributaries, which dominate the region, compose the second largest drainage system in the State of Alaska. Lowlands are characterized by braided meandering river channels and tributaries. Highlands, near the Alaska Range, are characterized by broad, glacially fed drainage, isolated rounded hills, and ridges and rugged peaks. Discharge rates of local rivers fluctuate with seasons, reaching a peak in late spring. Mean annual runoff rates for the area are low. Chemical quality of surface waters is good (Woodward-Clyde 1991(b)). More detailed information is available in the Remedial Investigation Report (USAF 1999b).

Sparrevohn LRRS is 15 miles south of Stony River, a glacially-fed tributary of the Kuskokwim River. The confluence of the two rivers is 80 miles northwest of the installation at the community of Sleetmute. Hook Creek, a tributary of the Hoholitna River, runs directly south of the installation. Three large lakes, the largest of which is Tundra Lake, are 10 miles north of the installation. Surface water draining from the installation flows south into an unnamed tributary of Hook Creek. Unconsolidated surface sediments overlying bedrock are shallow and restricted to overland flow (Woodward-Clyde 1991(b)).

Groundwater in small to moderate amounts is found almost everywhere in the region. More reliable and larger quantities are found in river and streambed alluvium. Groundwater, which probably follows local topography, occurs at the installation as shallow and unconfined occurrences in the streambed alluvium of the single unnamed stream flowing through the LRRS (Woodward-Clyde 1991(b)).

Sparrevohn LRRS obtains drinking water from a gallery well installed into streambed alluvium 18 feet below the surface. Groundwater percolates through the alluvium and into the storage pipe, where it is pumped for year-round installation use (Woodward-Clyde 1991(b)).

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Rainfall from all but the most severe storms would be contained within drainage ditches and natural watercourses. During severe storms some smaller channels may overflow. Except for one location, these overbank flows would be minor and more characteristic of heavy localized runoff than of an identifiable flood plain. The one area at risk would have overland flow caused by a culvert restricting the natural channel. Flow depths in the flood plain would be a foot or less but would threaten two buildings at the site.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Sparrevohn LRRS. Much information included in INRMP Chapter 5.0 that includes Sparrevohn LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Sparrevohn LRRS and the surrounding area. ***Appendix 3.0-Yukon***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Sparrevohn LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M131 Yukon Intermontane Plateaus Tayga-Meadow Province
Description: Hills interspersed with valleys and low mountains make up this province. The area experiences mild winters and cool summers with the climate transitioning from maritime to extreme continental. Average precipitation is 16 inches with the heaviest occurring in late summer. Dominant vegetation for the province is black spruce forest, but many hills and ridges consist of sedges and shrubs. At higher elevations are alpine meadows. Dominant soils for the area are Inceptisols.

5.2 Vegetation

Six principal vegetation/cover types occur at Sparrevohn LRRS: alder/willow stands, upland spruce/hardwood, relatively pure stands of white and black spruce, alpine tundra, disturbed vegetation, and residential/industrial areas. Upper Camp was built in an unspoiled natural area of alpine tundra and barren ground. The habitat is comparatively arid due to the drying effect of the wind and shallow, well-drained loams on ridges, steep slopes, and mountain tops. Plants in the barren windswept areas include various lichens, lupine, aster, and cinquefoil. Other plants in slightly protected areas are alpine azalea, Arctic willow, mountain avens, and moss campion. Many steep slopes are microterraced, and a decayed mat of moss with scattered tufts of grasses, sweet coltsfoot, and yarrow can be found on the flattened steps. Bearberry and cranberry grow in some slightly protected areas, such as in the lee of a rock. A pattern of discontinuous heath is found in slight depressions where crowberry predominates (Gutleber undated(c)).

Lower Camp is located at treeline; above the camp is alpine tundra; below is open spruce forest. The forest just below treeline is upland spruce/hardwood forest, characterized by a mixture of very open-grown black and white spruce, an occasional tamarack, and some paper birch and balsam poplar. This type has a dense, low brush understory of resin birch, Labrador tea, blueberry, and willows, with a dense groundcover of feather mosses and lichens (Gutleber undated (c)). Other minor vegetation types are dispersed throughout Lower Camp.

During summer 1999 the BLM and University of Alaska Fairbanks conducted a vegetative survey of Sparrevohn LRRS. The preliminary list of 207 vascular plants (Parker 2000) is included in Appendix 3.0-Yukon, Appendix A (Table A1).

A general vegetation map of Sparrevohn LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995f). Schick *et al*. (2004) made significant improvements in vegetation mapping at Sparrevohn LRRS (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Sparrevohn LRRS in 2001 and 2010. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth and, if available, 2009-2010 SPOT-5 satellite imagery (http://www.alaskamapped. org/ortho). Figure 5.2a shows habitat classes for 2010, and Figure 5.2b shows changes in habitat classes between 2001through 2010. Table 5.2 shows these acreages and changes over this 9-year period.

Figure 5.2a Sparrevohn LRRS Wildlife Habitat Map, 2010

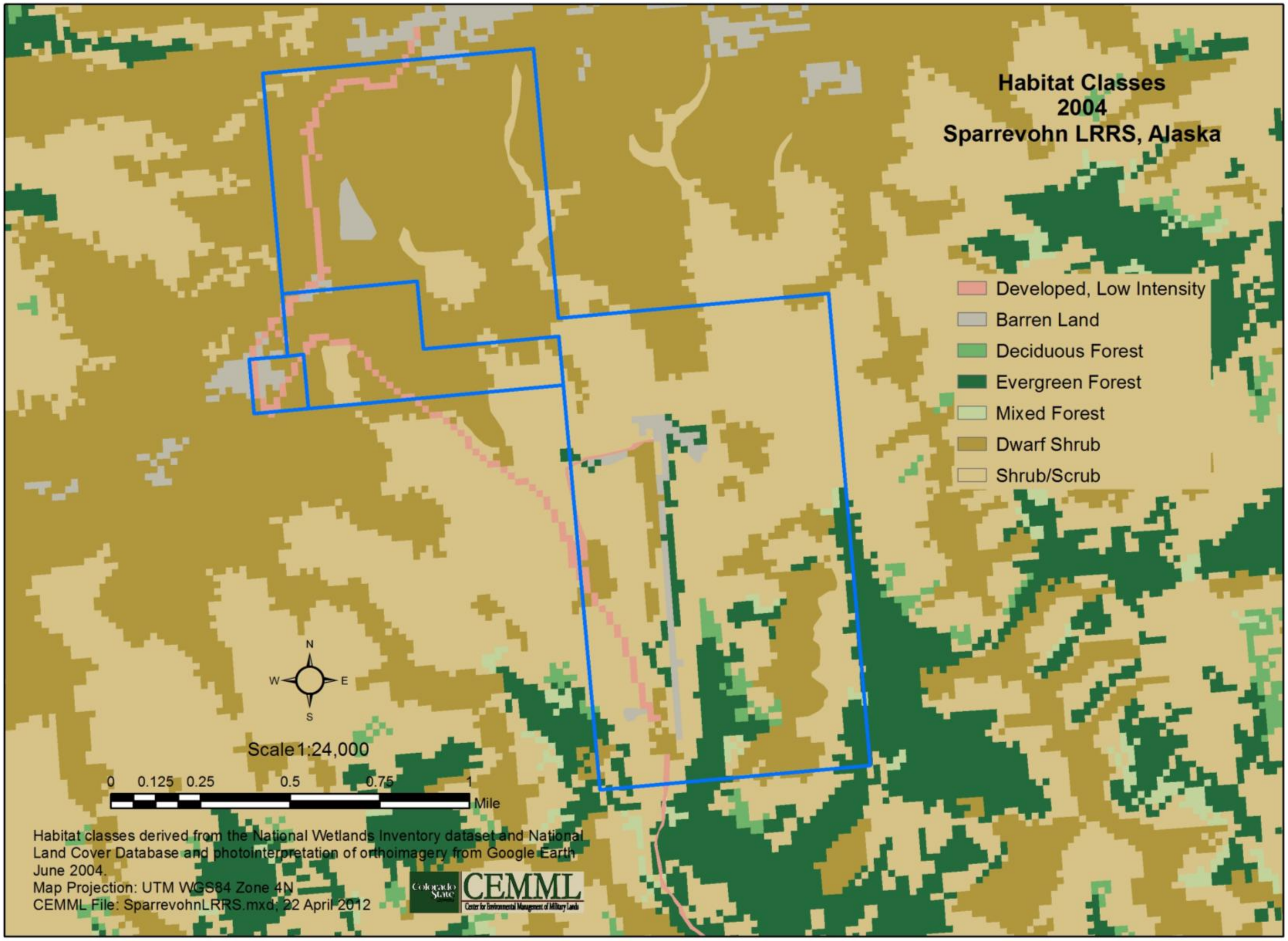


Figure 5.2b Changes in Habitat Classes at Sparrevohn LRRS between 2001 and 2010

Table 5.2 Habitat Class Differences between 2001 and 2010, Sparrevohn LRRS

Habitat Class	Acres 2001	Acres 2004	Acreage Change
Barren Land	22.6	34.0	11.4
Deciduous Forest	8.7	8.7	0.0
Developed, Low Intensity	26.6	30.0	3.5
Dwarf Shrub	523.1	508.8	-14.2
Evergreen Forest	67.5	67.4	0.0
Mixed Forest	5.1	5.1	0.0
Shrub/Scrub	459.1	458.5	-0.5
Totals	**1,112.6**	**1,112.6**	**0.0**

Schick *et al*. (2004) described the Sparrevohn LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Sparrevohn LRRS encompasses 1,179 acres[1] of steep upland, subalpine, and alpine mountainous terrain. Overall, the area is well-drained, and there are no wet, and few moist tundra habitats. Much of the LRRS is above tree line and is strongly dominated by Upland Dwarf Scrub and occurs along mountain ridges and higher elevation slopes. This type is primarily used by ground-nesting passerines (*e.g*., American Pipits, Savannah Sparrows, Lapland Longspurs, and Horned Larks) and Ptarmigan, as well as by raptors, like Golden Eagles. Mammals, such as Arctic ground squirrels and black bears, also use Upland Dwarf Scrub.

The next most common wildlife habitats at the Sparrevohn LRRS are Upland Tall Open Scrub and Upland Low Open Scrub. These habitat types occur primarily on steep mountainous slopes just above tree line and provide habitat for some shrub-nesting passerine species (*e.g*., Gray-cheeked Thrush, Fox Sparrow, White-crowned Sparrow).

Other common habitats at the Sparrevohn LRRS include Upland Open Needleleaf Forest, which is used by many spruce tree dependent passerines species and red squirrels, and Riverine Tall Open Scrub, used by American Robins, thrushes, sparrows, and many other common passerines. A riverine and upland forest, scrub, and herbaceous habitats occur at the LRRS; yet these each cover <2% of the mapped area, but possibly provide additional habitat for some passerine species.

5.3 Fish and Wildlife

5.3.1 Fish

Surface water channels on the hillsides upgradient from Lower Camp are probably intermittent and therefore are not likely to contain fish. Aquatic invertebrates are likely to be present when channels contain water. Lower Camp drainages may be ephemeral with exceptions of bogs located immediately downstream from the facility boundary. No surveys have been performed within any of these systems (USAF 1999b).

The upper Kuskokwim River basin supports a variety of anadromous and freshwater fish. Coho (silver), sockeye (red), chum, and chinook (king) salmon occur in Hook Creek (ADFG 1990b). East of the LRRS in Stony River and its tributaries, chum, chinook, sockeye, and coho salmon are the most abundant. Spawning areas have been identified for these species in Cairn Creek and Necons River, as well as in the area of Stony River between these tributaries. In general, these salmon species enter freshwater from the

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

ocean on their spawning runs in the summer-fall period and return to the ocean during spring-early summer as juveniles. Arctic grayling, burbot, and white fish provide good to excellent sport fishing in various tributaries and sidestreams. Suckers and black fish occur in many oxbow sloughs, ponds, and lakes (Gutleber undated(c)). Common fish species harvested by installation personnel at Fish Camp include chinook and coho salmon and Arctic grayling.

5.3.2 Mammals

A wide variety of mammals occupy the terrestrial environment surrounding Sparrevohn LRRS. Caribou are fairly common along oothills of the Alaska Range and the Kuskokwim Mountains. The Mulchatna and McKinley herds range into the area. The area in and around Sparrevohn LRRS is used predominately by the Mulchatna Herd. Stony River is a major spring route for migrating caribou. The Sparrevohn area has been identified as part of this herd’s winter range. Caribou can occur at or near Sparrevohn LRRS; their numbers vary throughout the year; possibly the largest caribou concentrations occur in summer months (personal communication, J. Denton, BLM 1999 with G. Augustine).

Depending upon food abundance, moose are found in the shrub zone in higher elevations and at lower elevations in most drainages. Most moose taken north of the area are used as food by local Lime Village residents. However, a growing number of nonresident hunters and Alaska resident hunters from outside the area are seeking the moose of this region (personal communication, J. Denton, BLM 1999 with G. Augustine).

Brown/grizzly bears range throughout the foothills and mountain valleys. Wolves and wolverines can be found around Sparrevohn LRRS. Black bears inhabit open forests and adjacent areas of most types of mixed vegetation, depending upon food sources. The area’s primary furbearers are mink, muskrat, beavers, otters, martins, lynx, coyotes, wolves, and foxes. Muskrats, mink, weasels, lynx, and otters are relatively common in most drainages. Smaller mammals include snowshoe and Arctic hares (personal communication, J. Denton, BLM 1999 with G. Augustine).

5.3.3 Birds

The upland (interior) habitat of Sparrevohn LRRS is well-suited for Willow, Rock, and White-tailed Ptarmigan. Ptarmigan are common in mountain valleys. Grouse (Spruce, Ruffed, and Sharp-tailed) inhabit birch and spruce areas bordering river valleys and lake shores. While the adjacent Kuskokwim Delta supports most waterfowl and shorebird populations of this region, the Sparrevohn area supports diverse populations of passerine species. The Lapland Longspur and Savannah Sparrow are the most abundant of these avifauna during summer. Other common species include Common Raven, Tree and Cliff Swallows, Gray Jay, Boreal Chickadee, American Dipper, American Robin, Varied and Gray-cheeked Thrushes, Northern Waterthrush, Wilson’s Warbler, Common Redpoll, White-crowned and Golden-crowned Sparrows, and Snow Bunting. Most small birds leave the area by mid-September, but the Snow Bunting commonly winters here (Gutleber undated(c)).

This interior area, with its abundance of nesting habitat and food sources, is attractive to raptors. The most common raptors found in the region are Bald and Golden Eagles. The hilly to mountainous topography of the region and the availability of fish and waterfowl for Bald Eagles and small mammals and grouse for Golden Eagles provide abundant food resources. Other raptors likely to occur include the Gyrfalcon, Rough-legged Hawk, Goshawk, Merlin, and Great Horned Owl (Gutleber undated(c)).

Fourteen bird species were observed at Sparrevohn LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included species, such as Golden Eagle, Rock Ptarmigan, Horned Lark, American Robin, American Pipit, Dark-eyed Junco, and Lapland Longspur.

5.4 Threatened and Endangered Species

No threatened and endangered species occur at the LRRS. However, the delisted American Peregrine Falcon (USFWS 2004b) potentially occurs within the vicinity.

During 1999 BLM and University of Alaska Fairbanks botanists surveyed the area for potentially sensitive plant species. Two taxa being tracked by the Alaska Natural Heritage Program were found. *Draba stenopetala* (G3G4/S3S4) was found in scattered abundance on rocky summits in the vicinity of the radar domes and dishes, including previously disturbed areas. *Mertensia eastwoodae* (G3/S3) was growing in a mesic meadow with scattered tall shrub willow just north of the airstrip (Parker 2000).

5.5 Wetlands

Wetlands at Sparrevohn LRRS are dominated by well-drained, steep-sloping areas classified as jurisdictional Uplands and as wetter saturated or seasonal flooded palustrine areas. The most common wetland type at Sparrevohn is palustrine, broad-leaved deciduous and evergreen scrub-shrub, which can be mixed with emergent vegetation and/or lichens. Other common wetlands include palustrine, broad-leaved deciduous scrub-shrub and saturated or seasonally flooded and palustrine shrubs mixed with persistent emergent vegetation. These areas of moist dwarf scrub and tall shrubs can be saturated, moderately well-drained, or well-drained, depending primarily on soil type, microtopography, and landscape position. Dominant dwarf scrub species include *Empetrum nigrum*, *Vaccinium uliginosum, V. vitis-idaea, Ledum decumbens*, *Dryas octopetala*, *Arctostaphylos alpina*, and *Salix rotundifolia*. Tall shrub areas are primarily dominated by *A. crispa* with common associates of *Salix pulchra, Spiraea stevenii (beauverdiana), Betula nana, B. glandulosa, Vaccinium uligonosum, Dryopteris dilitata, Empetrum nigrum,* and *Calamagrostis canadensis* (Schick *et al*. 2004)

The general Sparrevohn LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Sparrevohn LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (136.50 acres). Figure 5.5 shows wetlands on Sparrevohn LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Lime Village residents depend on year-round hunts for large land mammals, particularly moose. In mid- to late spring, residents travel to lakes to fish and hunt waterfowl and muskrat. From the end of June through August, residents concentrate their efforts on harvesting salmon. Between August and October, residents harvest berries and plant materials for food, medicine, handicrafts, and construction projects. In late summer and early fall, residents return to the lakes to harvest whitefish and waterfowl and travel extensively while hunting large game animals. In winter, the hunt for large game animals is punctuated by trapping and ice fishing (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Guided sport hunting and fishing by private lodges and/or fly-in charter services are commercial endeavors occurring in the area. Hunting, trapping, and fishing are common outdoor recreation activities occurring in the Sparrevohn LRRS area. Common sport fish harvested from Hook Creek include chinook (king) and coho (silver) salmon, Dolly Varden, and Arctic grayling. Hook Creek is off the installation.

Installation personnel use hunting, trapping, and fishing resources in the Sparrevohn area. The area is also commonly used by military personnel for hunting. DoD personnel can fly into the area but hunt on BLM lands, not on installation property. Moose and caribou are the most common species hunted. This practice is expected to continue. There are provisions for them to use certain inactive facilities at Sparrevohn. Land surrounding the LRRS is managed by the BLM.

The BLM indicates that there is considerable controversy in the user-days of subsistence hunting, non-resident sport hunting, and resident sport hunting of large mammal wildlife on the surrounding BLM lands. Though no hunting is allowed on the LRRS, hunting in the area is popular in mid- to late August each year. Numerous caribou of the Mulchatna Herd, as well as moose and bear, are hunted by BOS contract personnel stationed at Sparrevohn, temporary duty personnel during free time, DoD personnel who travel to the site for recreation, and subsistence hunters from Lime Village. There have also been management issues in dealing with recreational hunting from the LRRS. Hunters are not permitted to use most LRRS resources.

The area surrounding Sparrevohn LRRS provides big game and grouse hunting, furbearer trapping, fishing, hiking, and ATV riding opportunities. Furbearer trapping has been conducted primarily as a recreational pursuit by site personnel. Few animals are trapped, and little impact to furbearer populations occurs. Species commonly trapped include beavers, martins, wolverines, and an occasional wolf. ATV riding is a primary recreation of site personnel.

Policies regarding recreational access and related activities at remote USAF sites in Alaska are particularly pertinent to outdoor recreation at Sparrevohn LRRS since much of them were developed specifically for this LRRS. The application for military and DoD civilian recreational access to remote radar sites is available from the Alaska Radar System Program Management Office and lists a number of responsibilities for hunters. Also attached to the application is a policy letter, which must be adhered to. Included for Sparrevohn are established limits of 12 personnel and four aircraft. The NDB (old weather) building is available for lodging on a first come, first served basis at Sparrevohn. The Sparrevohn storage hut is available to hang, package, and store meat until departure. Each person must cleanup and dispose of any/all animal waste he/she generates by transporting it out of the Sparrevohn off-limits area.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

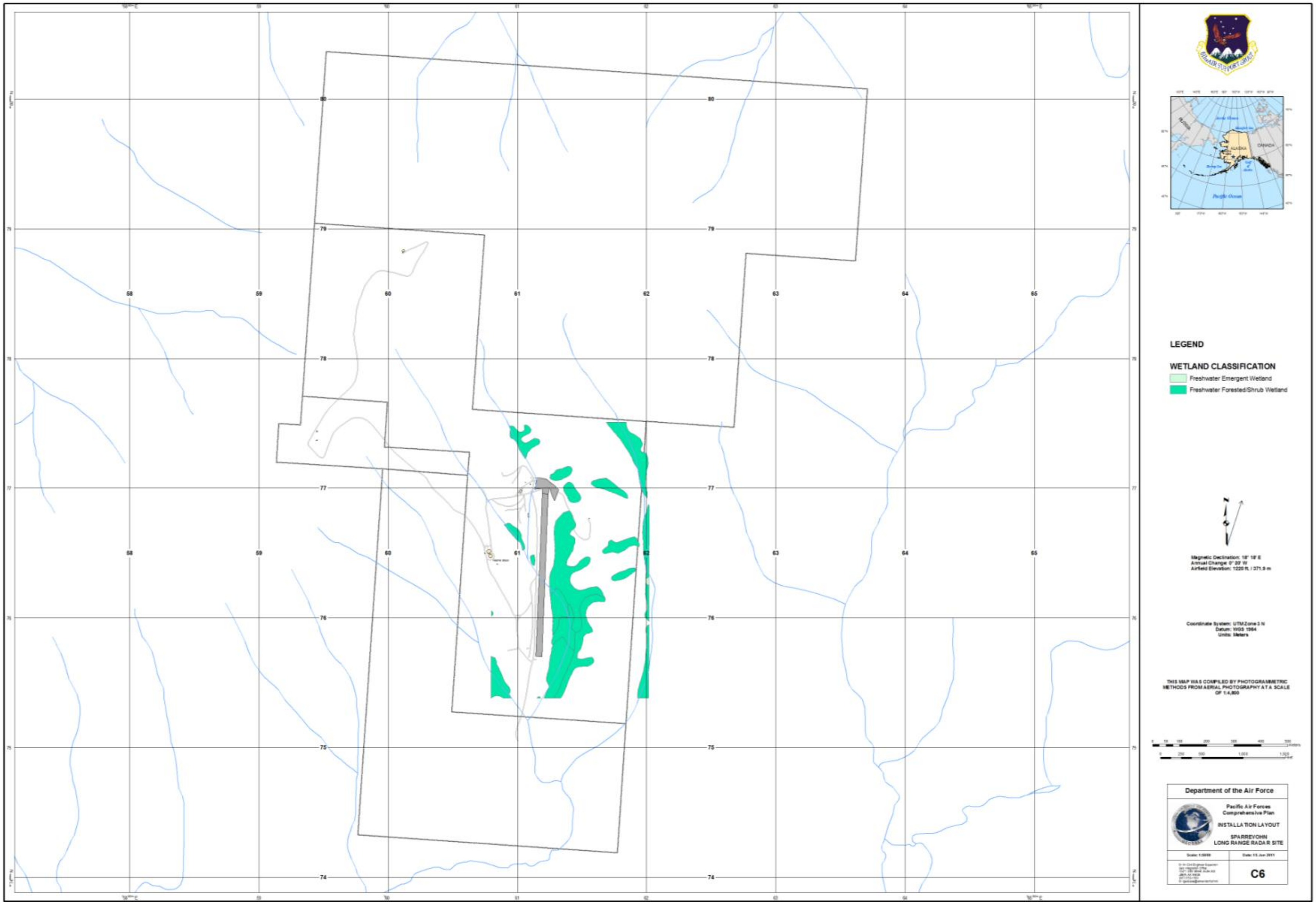
6.1 Land Use

A MAR is the only facility at Upper Camp. Temporary living facilities, used when weather restricts access, are included in the MAR facility for BOS contractor personnel attending the radar. Lower Camp has an industrial and a residential dome, a landing field, POL bulk storage, a power plant for both camps, and other facilities to support Upper Camp operation. In recent years a new gravel quarry for maintenance purposes has been established at the top end of the runway and a lift to the landfill occurred. A non-directional beacon was installed at Sparrevohn in 2006.

Rehabilitation of abandoned roads and revegetation of the former WACS are land use issues BLM informally requested included in the previous INRMP (Gene Stout and Associates and Blythe & Trousil, Inc. 2007a). These issues will be included in Clean Sweep activities, for which building demolition and debris removal started in 2011 and is being completed in 2012.

Portions of land at Sparrevohn LRRS is leased to the State of Alaska and National Oceanic and Atmospheric Administration for research purposes. Land is also leased to the Federal Aviation Administration and AT&T for public air travel and general communications.

Figure 5.5 Sparrevohn LRRS Wetlands, 2011



Appendix 3.0 – Tatalina. Tatalina Long Range Radar Site

3.0 Installation Overview

Figure 3.0A Aerial View of Tatalina LRRS

3.1 Location and Area

Tatalina LRRS is located 240 miles northwest of Anchorage (INRMP Figure 3.1) on 4,970 acres of land (Figure 3.1). The Tatalina River flows through the southeastern part of the installation near the landing strip. A 16-mile road connects the installation with Sterling Landing, a boat landing on the Kuskokwim River where barges deliver fuel and other supplies for the installation.

3.2 Installation History

Tatalina LRRS was one of the original AC&W sites built in the 1950s in Alaska for an air defense system. In 1952 installation construction was completed, and the facility became operational as a ground-controlled intercept site. Communications were initially provided by high frequency radio. A WACS replaced the radio communications in 1957. In 1979 the WACS was deactivated and replaced with a commercial satellite earth terminal. A MAR unit was installed in 1985 and remains active. There are four BOS contract employees assigned to the facility.

3.3 Surrounding Communities

Two communities are located near the installation. Takotna is six miles north-northwest of the site on the Takotna River, and McGrath is 14 miles east of the site on the Kuskokwim River. Tatalina LRRS and Takotna are connected by a road that is usable in winter and can be used by passenger vehicles after it has dried out in the summer and fall. The population of Takotna is 52 (2010 estimate) and the population of McGrath is 346 (2010 estimate) (www.dced.state.ak.us 2012).

Takotna is a mixed population of non-Natives, Ingalik Athabascans, and Eskimos. The economy is a combination of cash and subsistence. Employment is through the School District, post office, clinic, local businesses, and seasonal construction. McGrath's population is slightly more than half Athabascan and Eskimo. McGrath is a regional center, which offers a variety of employment opportunities, but subsistence remains an important part of the local culture. About 10 families in town have dog teams that are entered in the Iditarod, Kuskokwim 300, and Mail Trail 200 sled dog races. McGrath functions as a transportation, communications, and supply center in Interior Alaska. However, many families rely on subsistence. Salmon, moose, caribou, bear, and rabbits are utilized. Some residents trap and tend gardens (www.dced.state.ak.us 2012).

3.4 Regional Land Use

The Tatalina area is inhabited by members of an Athapaskan society known as the Kolchon who speak a language related to Tanana Athapaskan. They were historically bordered by the Tanana to the south, the Koyukon to the north, the Ingalik to the west, and the Tanana to the east (Gutleber undated(d)).

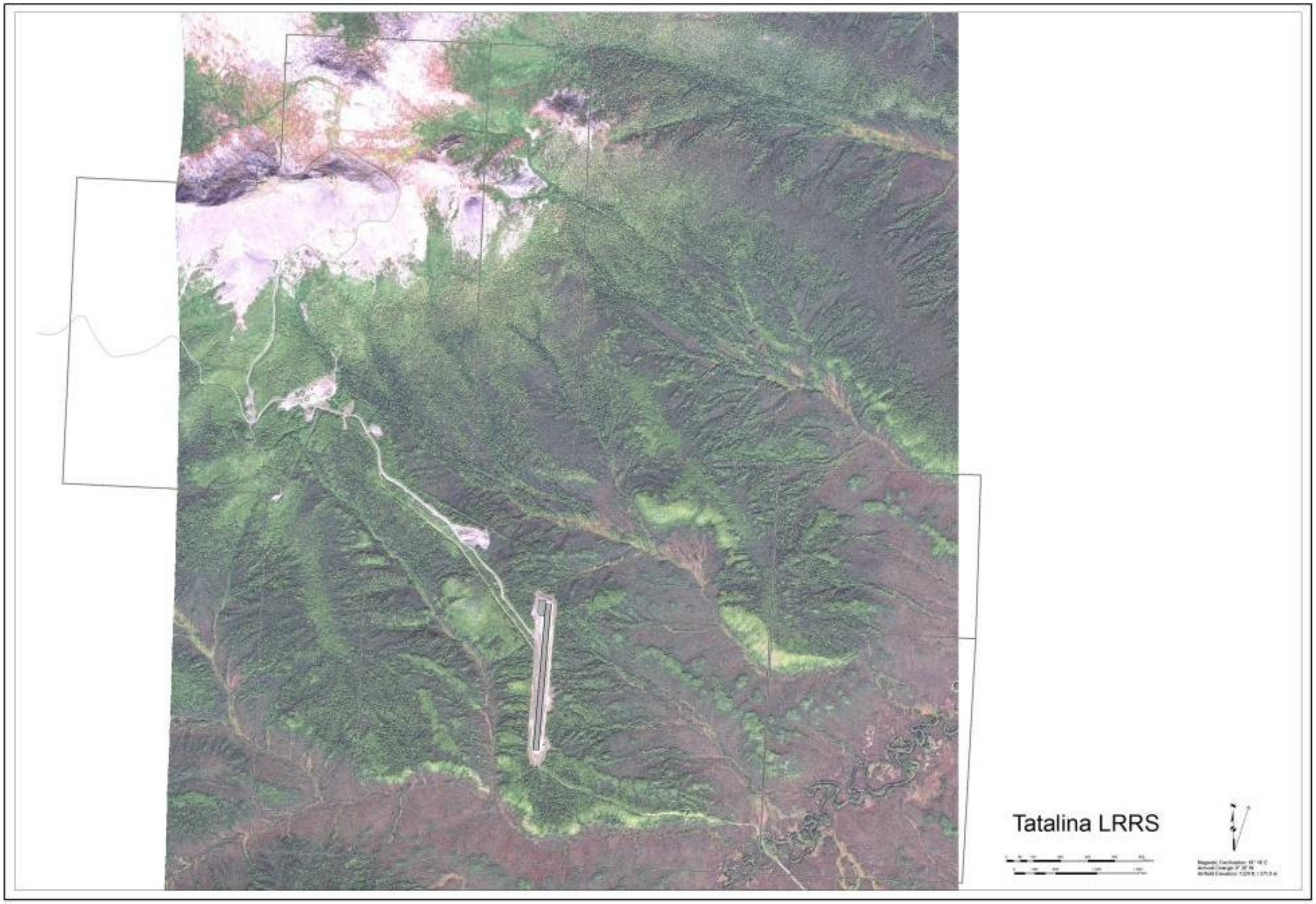
Between 1830 and 1840 Russian explorers/traders came up the Kuskokwim River and established a short-lived trading post at the mouth of the Holitna River. A second post was built further downstream in 1833. A third post was built across the Kuskokwim River in 1842 and was named Kolmakov's Redoubt. The remains of this post are located in Sleetmute (Gutleber undated(d)).

By 1838 the Russians had penetrated the middle Yukon, establishing a trading post at Nulato which was destroyed 13 years later in one of the few Alaskan Native uprisings on record. Russian influence in both areas was transitory and remained little known until the gold rush and geological exploration of the 1890s. Russian influence in the area is reflected primarily in the reconcentration of numbers of aboriginal people around centers, which provided opportunity for trade and missionary services (Gutleber undated(d)).

The purchase of Alaska by the United States in 1867 had minimal effect on the region. American fur traders replaced Russians, and the Moravian Church assumed the role of the Russian Church. Difficult terrain, sparse population, and a paucity of fur resources that had limited Russian interests in the region also discouraged American interests. The Alaska Commercial Company maintained a post at the village of Mumtrekhlogamute (today Bethel) on the Kuskokwim, but trade in this region was generally very low. The delta area was periodically visited by missionaries and traders, but upper reaches of the drainage remained virtually unknown until the turn of the century (Gutleber undated(d)).

In 1906 E.W. Parks established a quicksilver mine at Sleetmute. The next year gold strikes were made in the Kuskokwim region, and a stampede began. About the same time irregular trade between Bethel and Seattle was established, and the Kuskokwim River became a major trade artery to the interior of Alaska. The Alaska Commercial Company derived significant profits from this river trade. As further gold finds were made on the Takotna and Tulaksak rivers and on the north and east forks of the upper Kuskokwim, prospectors poured into the region, and several major settlements developed. McGrath, named after its first U.S. Marshall, Peter McGrath, was established as a small trading installation in spring of 1907 to service gold operations on the Innoko River. Ophir, established one year later 35 miles northwest of McGrath, served diggings on the same river. Ganes Creek, also established in 1908, serviced operations on Ganes Creek. Georgetown started as a trading post in 1910. The ancient Ingalik village of Takotna, in existence since 1838, became the major settlement on the upper Kuskokwim River (Gutleber undated(d)).

Figure 3.1 Tatalina LRRS



By 1911 the entire drainage was traversed by prospectors, but the Kuskokwim gold boom was on the decline. The 30-odd gold operations started in the four-year boom scaled down their operations during the 20s and early 30s. In the following few years, gold operations took a roller coaster ride. This fluctuation was contributable to many factors... most notably the federal government's influence in raising the price of gold and expansions of the area's transportation links. Transportation expansion included the construction of two regional federal airports at Aniak and McGrath, which were completed in 1939, presumably under the impetus of World War II (Gutleber undated(d)).

The war was the turning point in Kuskokwim gold and mineral operations, initiating a permanent decline. Local costs mounted, and resupply and maintenance were hampered by wartime shortages. The $35 per ounce for gold was no longer adequate to provide what most operators felt were reasonable profits, and once again mineral production in the Kuskokwim basin dwindled. By the late 1950s, gold mining was abandoned in the Kuskokwim except for small-scale placers at Nyac and Ophir (Gutleber undated(d)).

3.5 Local and Regional Natural Areas

Tatalina LRRS has no special natural areas (*e.g.*, refuges, parks, preserves) in its immediate area.

4.0 Physical Environment

4.1 Climate

This area has a characteristic continental climate with low rainfall, severe winters, and short, warm summers. There are great diurnal and annual temperature variations. The mean annual temperature varies in the Tatalina/McGrath area from 25° to 30°F. During winters, which are long and cold, temperatures fall well below 0°F, sometimes reaching -50°F or colder. Summers are short, but warm with temperatures reaching into the 80s and occasionally the 90s (Gutleber undated(d)). The mean January temperature in Takotna is -7°F; the mean July temperature is 60°F.

This region between Anchorage and Fairbanks experiences 18 hours or more continuous daylight during short summers and six hours or less daylight during winter. The growing season is approximately 120 days, although frost can occur during any month (Gutleber undated(d)).

Annual precipitation is about 17 inches. Despite low precipitation in winter, snowfall accumulation is usually quite heavy, averaging 75 to 80 inches. Thundershower activity is common during summer. Average winds are from the north at 4.3 knots, and extreme winds have been recorded from the south at 65 knots (Gutleber undated(d)).

Table 4.1 Takotna, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	2ºF	13ºF	25ºF	41ºF	57ºF	68ºF	69ºF	63ºF	53ºF	32ºF	13ºF	5ºF
Average Low	-15ºF	-9ºF	-2ºF	19ºF	36ºF	47ºF	51ºF	48ºF	36ºF	18ºF	-2ºF	-12ºF
Mean	-7ºF	-2ºF	12ºF	30ºF	47ºF	58ºF	60ºF	55ºF	45ºF	25ºF	6ºF	-4ºF
Record High	54ºF (1945)	55ºF (1943)	55ºF (1998)	68ºF (2009)	82ºF (1993)	90ºF (1969)	89ºF (1977)	89ºF (1977)	76ºF (1957)	66ºF (2006)	49ºF (1997)	49ºF (1977)
Record Low	-75ºF (1989)	-64ºF (1947)	-51ºF (1966)	-40ºF (1985)	-2ºF (1945)	27ºF (2006)	31ºF (2003)	25ºF (1984)	2ºF (1992)	-28ºF (1982)	-53ºF (1990)	-67ºF (1961)
Average Precipitation	1.00 inches	0.97 inches	0.81 inches	0.74 inches	1.09 inches	1.52 inches	2.38 inches	2.80 inches	2.49 inches	1.44 inches	1.41 inches	1.29 inches

Source: www.weather.com (January 16, 2012)

4.2 Landforms

Tatalina LRRS is located in the upper reaches of the Kuskokwim Bay subregion of the 109,000 square mile southwestern region of Alaska. This vast region drains into the Bering Sea and extends south from Norton Sound to Bristol Bay and 1,400 miles out to the western tip of the Aleutian Islands. The Kuskokwim Bay subregion contains 58,000 square miles - the area between Kuskokwim Bay to the southeast and the crests of the Alaska Range, the Nushagak-Big River Hills, and the Kuskokwim Mountains to the east, south, and west (Gutleber undated(d)).

4.3 Geology and Soils

A variety of events including tectonism, volcanism, sedimentation, and erosion have shaped the landscape, rocks, soils, and minerals of the area. Continental and oceanic crusts of unsure origin apparently came together to form the Kuskokwim Bay region. In the Jurassic Period, about 150 million years ago, a drifting continental platform ascended over the Pacific Ocean floor, marked by the Aleutian Trench. Movements of these plates caused mountains and volcanoes to form. Subducting plates carried and scraped ocean-deposited sediments into the crust, and obducting plates dragged up ultramafic rock (*i.e.*, rock rich in iron and magnesium). After Jurassic subduction, uplift occurred in the area of the present day Kuskokwim Mountains and the Alaskan-Aleutian Range (Gutleber undated(d)).

The Precambrian and early Paleozoic history of the southwest subregion is virtually unknown. During late Paleozoic and early Mesozoic era, seas occupied this widespread area where sediments were deposited in deep basins adjacent to volcanic islands. Older rocks in the Bristol Bay and Kuskokwim subregions are characteristically rich in volcanic material. In the middle Jurassic time an intrusion of a large mass of igneous material, called a batholith, formed the backbone of the southern Alaska Range; deformation accompanied and followed this intrusive activity, producing a mountainous upland approximately where the Kuskokwim Mountains and Alaska-Aleutian Range now stand. These uplifted regions were eroded and produced sediments that were deposited on adjoining shallow marine shelves and in adjacent basins (Gutleber undated(d)).

During the Tertiary period much of the Bristol Bay and Kuskokwim areas were being slowly eroded, and thick sequences of sediments were being deposited on the adjacent Bering Sea lowland. The development of much of the present landscape took place in Quaternary times, when extensive ice fields and a large glacier scoured and modified the landscape. Unconsolidated materials comprise surficial deposits that accumulated on the land surface during the glacial period. As glaciers advanced and retreated, a complex and interrelated series of deposits were produced by the interplay of three main agents: glacial ice, flowing water in streams or on deltas, and still water in ponds, lakes, and marine estuaries. The most common glacial deposits are moraines, which are composed of glacial till (gravel, sand, silt, and clay) laid down at the sides and in front of the glaciers (Gutleber undated(d)).

Tatalina is located within the Minchumina Basin, which contains the upper basin of the Kuskokwim River. This broad basin is the direct result of an extensive ice field and glaciers. The region is characterized as a vast lowland of meandering rivers, scattered oxbow and pothole lakes, and marshy tundra. Bedrock in the Tatalina area is composed of interbedded layers of graywacke and shale and local areas of basalt flows. Soils were probably formed in gravelly or sandy materials, thereby providing good surface drainage (Gutleber undated(d)).

Tatalina LRRS is underlain by moderately thick to thin permafrost and predominantly fine-grained deposits. Maximum depth to base of permafrost is about 600 feet. Temperature of permafrost ranges from 23° to 30°F, but temperatures may be higher locally. Surface disturbance resulting from construction may have altered the upper limit of permafrost by reducing insulation of the surface layer (Gutleber undated(d)). IRP remedial investigations and feasibility studies have more current drilling logs with detailed information on permafrost depth.

4.4 Hydrology

4.4.1 General

The Kuskokwim Bay subregion has two disparate areas tied together by the Kuskokwim River. The Kuskokwim Valley is a wide, flat basin approaching 75 miles in width in some places, with occasional knobs and benches and numerous small ponds and lakes. Near the river, which trends toward the western edge of the basin, is a wide, alluvial flood plain interlaced with sloughs, lakes, and oxbows typical of meandering glacial-fed rivers of Alaska. This meandering is especially marked at the North Fork of the Kuskokwim River to the north of McGrath where the river drops very gently (Gutleber undated(d)).

Tatalina LRRS is in the upper reaches of the Kuskokwim River, one of the principal waterways in Alaska and second only to the Yukon River in size and length. Tatalina LRRS lies on an upland area between the Takotna River and the Tatalina River.

Tatalina LRRS obtains its water supplies from a gallery constructed into highly permeable mixed-talus and alluvial deposits of the Lower Camp area. These deposits form the area's shallow aquifer and occur at ground surface. The gallery consists of a one-foot diameter vertical pipe installed to a depth of 23 feet below grade, connected to a lateral 285-foot-long pipe. The lateral pipe has been constructed along the alignment of an unnamed stream extending through the Upper Camp area (Gutleber undated(d)).

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. The installation is well above any 100-year flood plain. The Tatalina River flows in a broad river valley, which would flood during the 100-year flood. The 100-year flood level was not determined as the river was not gauged.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Tatalina LRRS. Much information included in INRMP Chapter 5.0 that includes Tatalina LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Tatalina LRRS and the surrounding area. ***Appendix 3.0-Yukon***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Tatalina LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M131 Yukon Intermontane Plateaus Tayga-Meadow Province
Description: Hills interspersed with valleys and low mountains make up this province. The area experiences mild winters and cool summers with the climate transitioning from maritime to extreme continental. Average precipitation is 16 inches with the heaviest occurring in late summer. Dominant vegetation for the province is black spruce forest, but many hills and ridges consist of sedges and shrubs. At higher elevations are alpine meadows. Dominant soils for the area are Inceptisols.

5.2 Vegetation

Tatalina LRRS was built in an unspoiled natural area of upland spruce/hardwood forest. This vegetation type is fairly dense, interior upland forest comprised of evergreen and deciduous trees, such as white and black spruce, quaking aspen, balsam poplar (cottonwood), and paper birch. The upland spruce/hardwood forest occurs on the slopes of the Kuskokwim Mountain Range, including Tatalina LRRS. White spruce is the predominant tree species in the lower hills immediately adjacent to the Kuskokwim River near McGrath. Open, black spruce/aspen forests are located on dry ridges of extensive areas of sand dunes and old river terrace remnants adjacent to the Kuskokwim River (Gutleber undated(d)).

White spruce, ranging 30-70 feet in height and up to 16 inches in diameter, form pure stands along streams and grow with scattered birch or aspen on moderate south-facing slopes and well-drained soils at the LRRS. Black spruce, ranging 15-40 feet in height and 3-6 inches in diameter, form pure stands on north-facing slopes and poorly drained flat areas. Aspen range 20-50 feet in height and 3-12 inches in diameter and generally grow, following forest fires, in pure and mixed stands on well-drained soils. Paper birch, ranging 30-60 feet in height and 6-12 inches in diameter, grow in clumps, usually mixed with aspen. Balsam poplar range 40-60 feet in height and 1-2 feet in diameter, have deeper roots, and occur in small scattered groves along streams. Forest undergrowth consists of spongy moss and low brush on cool, moist slopes; grass on dry slopes; and willow, alder, and dwarf birch in high, open forests near timberline (Gutleber undated(d)).

Upper Camp, where steep slopes rise to 2,500 feet or more above msl, has an alpine tundra characterized by isolated areas of a discontinuous carpet of prostrate shrub consisting of mountain avens, crowberry, alpine bearberry, and mountain cranberry. Plant species occurring in alpine tundra include Arctic poppy and dwarf fireweed. Mosses are common where snow accumulates, and lichens may be common on wind-exposed ridges (Gutleber undated(d)).

A general vegetation map of Tatalina LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995f). Schick *et al*. (2004) made significant improvements in vegetation mapping at Tatalina LRRS (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Tatalina LRRS in 2001 and 2010. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth and, if available, 2009-2010 SPOT-5 satellite imagery (http://www.alaskamapped. org/ortho). Table 5.2 shows these acreages and changes over this 9-year period. Figure 5.2a shows habitat classes for 2010, and Figure 5.2b shows changes in habitat classes between 2001through 2010.

Table 5.2 Habitat Class Differences between 2001 and 2010, Tatalina

Habitat Class	Acres 2001	Acres 2010	Acreage Change
Barren Land	246.3	348.2	101.9
Deciduous Forest	848.0	831.3	-16.8
Developed, Low Intensity	61.6	117.8	56.2
Developed, Medium Intensity	27.8	27.8	0.0
Developed, Open Space	3.8	3.8	0.0
Dwarf Shrub	644.7	551.2	-93.5
Evergreen Forest	925.4	923.5	-1.9
Mixed Forest	1,284.1	1,276.8	-7.3
Shrub/Scrub	921.3	882.6	-38.7
Totals	**4,963.0**	**4,963.0**	**0.0**

Schick *et al*. (2004) described the Tatalina LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Tatalina LRRS encompasses 4,970 acres[1] of lowland river valley flats and gently sloping uplands to steep subalpine slopes and rocky mountainous terrain. The area is well-drained, and there are few wet or moist tundra habitats. Artificial and Upland Rock habitats also cover little of the LRRS, and most of the area provides vegetated habitats that provide for a diversity and abundance of wildlife. Even artificial structures, such as Lower Camp dome facilities are used by Cliff Swallows for nesting.

Tatalina LRRS is predominately upland forest types, including Upland Open Needleleaf Forest, Upland Closed Broadleaf Forest, Upland Open Broadleaf Forest, and Upland Open Mixed Forest, which are used for nesting and foraging by a variety of passerine species, including Thrushes, Sparrows, Chickadees, Ruby-crowned Kinglets, Dark-eyed Juncos, and White-winged Crossbills. Spruce Grouse and Gray Jays also nest in the upland forests, and mammal species, like red squirrels, are common in these habitat types as well.

Other prevalent wildlife habitats include Upland Dwarf Scrub, Upland Tall Open Scrub, and Lowland Open Needleleaf Forest. Upland Dwarf Scrub occurs on slopes in high elevation areas of the LRRS and is used by ground-nesting passerines, like American Pipits, Savannah Sparrows, and likely Ptarmigan. Tall scrub habitats, including upland types that occur primarily on steep slopes above tree line and riverine variants in drainages, provide additional nesting habitat for thrushes, sparrows, warblers, and Alder Flycatchers.

Small acreages of riverine, lowland, and upland scrub and forest habitats are present at the LRRS. Although little open water is present within the area, ducks, such as Green-winged Teal and probably Mallards, and Sandhill Cranes use these areas and lowland habitats along the Tatalina River. Moose and black bears also likely use riverine, lowland, and upland forest types at the LRRS.

5.3 Fish and Wildlife

5.3.1 Fish

The upper Kuskokwim River basin supports a variety of anadromous and freshwater fish. The three most common species of salmon found in this area are: chinook (king), chum, and coho (silver) salmon.
Sockeye (red) salmon are listed in the anadromous catalog for this area but are rarely seen in this section of the Kuskokwim River. In general, these salmon species enter freshwater from the ocean on their spawning runs in the summer-fall period and return to the ocean during spring-early summer as juveniles.

Whitefish, sheefish, rainbow trout, pike, Arctic char, and Dolly Varden are also found in the region. Arctic grayling, burbot, and white fish provide good and excellent sport fishing in various tributaries and their sidestreams. Suckers and blackfish occur in many oxbow sloughs, ponds, and lakes (Gutleber undated (d)). The large river systems, deep lakes, and areas near natural springs provide overwintering habitats for fish that are present throughout the year (USFWS undated(b)). Arctic grayling is the primary fish species used for sport in the Tatalina River.

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

Figure 5.2a Tatalina LRRS Wildlife Habitat Map, 2010

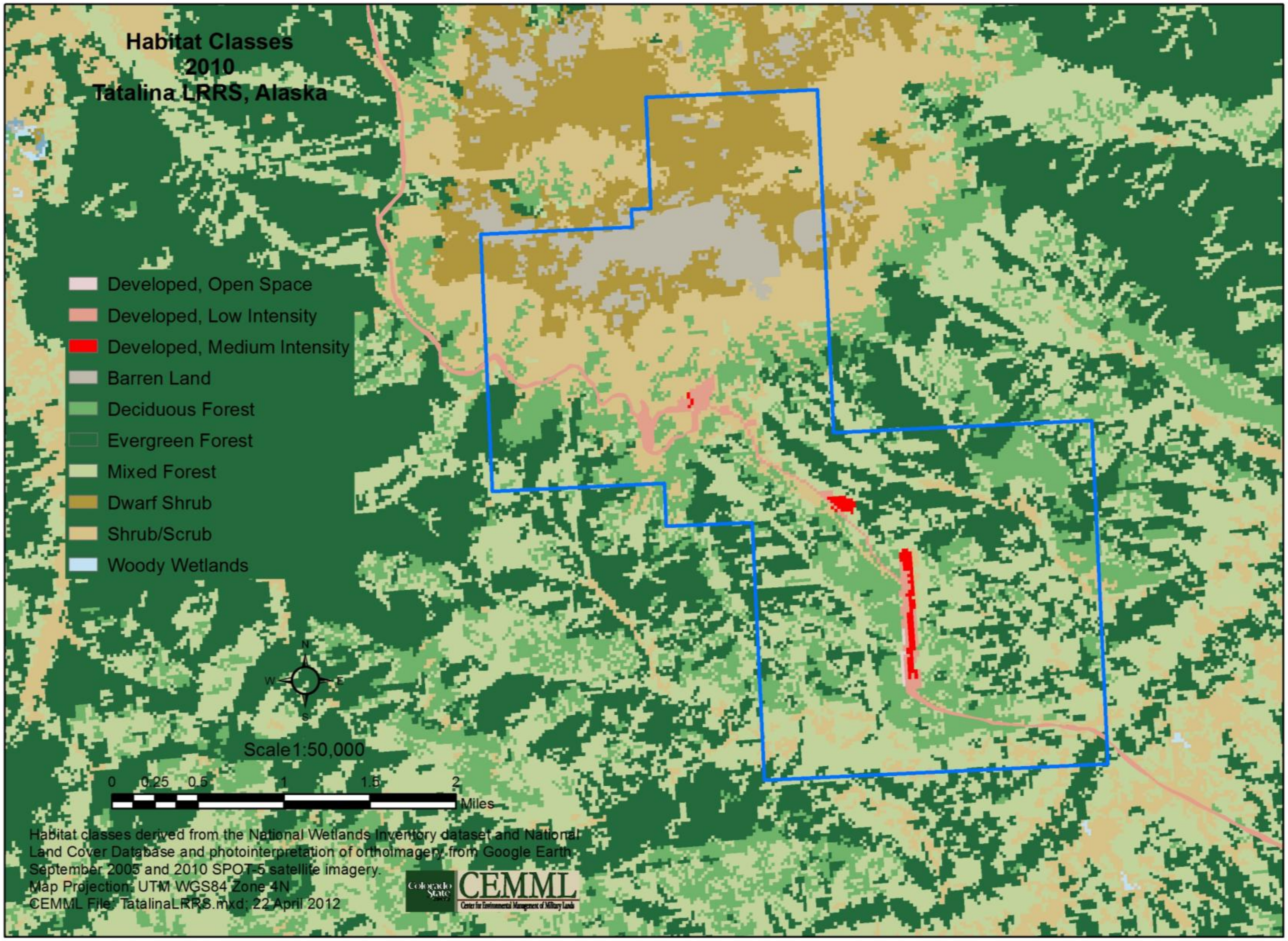
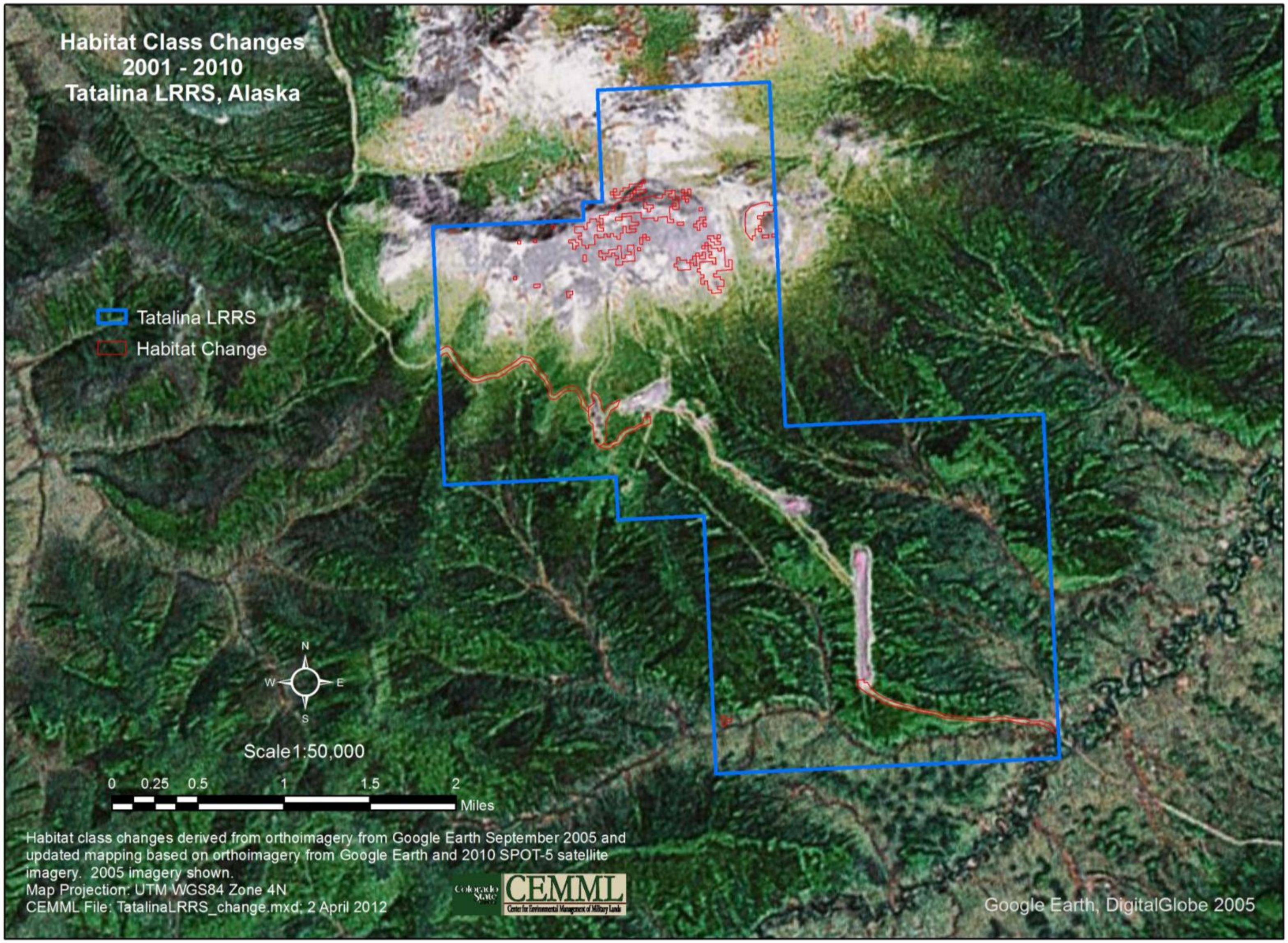


Figure 5.2b Changes in Habitat Classes at Tatalina LRRS between 2001 and 2010



5.3.2 Mammals

A wide variety of animals occupy the terrestrial environment surrounding Tatalina LRRS. There are two herds of caribou that use the Kuskokwim Mountains on a regular basis, the Beaver Mountain Herd and the Sunshine Mountain Herd. In the past, the Mulchatna Herd sporadically used this area. The McKinley Herd, now called the Denali Herd, is not known to use this area, although historically it probably did. The only other herd that may use this area is the Tonsona Herd.

Rich moose habitat, much of it due to wildfire and riverbar succession, is widely distributed at the LRRS. Moose are found at lower elevations in most drainages. Winter range is restricted primarily to river bottoms where timber is often used for winter cover. Most moose taken in the area are for subsistence food by local residents (Gutleber undated(d)).

Brown/grizzly bears range throughout foothills and mountain valleys surrounding the LRRS but only occur sporadically on river flats. Black bears, wolves, and wolverines range throughout the area. Wolves and wolverines can be found in upland and mountainous areas. Black bears inhabit open forests and areas of mixed vegetation. Martens and beavers are the primary furbearers in the area. Muskrats, mink, weasels, lynx, and otters are relatively common in most drainages. Smaller mammals in the area include red foxes and snowshoe and Arctic hares (Gutleber undated(d)).

5.3.3 Birds

Tatalina LRRS is in the upper reaches of the Kuskokwim drainage ecological unit. While this area by itself may not be particularly productive as waterfowl habitat, it is supportive of species using the Kuskokwim Delta, one of the most important nesting areas on the North American continent (Gutleber undated(d)).

The upland habitat of the installation is well-suited for Willow, Rock, and White-tailed Ptarmigan. Ptarmigan are common in mountain valleys. Spruce and Ruffed Grouse inhabit the upland spruce/hardwood forest, particularly areas bordering river valleys. Common birds occurring in the area include Lapland Longspur, Common Raven, Tree and Cliff Swallows, Gray Jay, Boreal Chickadee, Alder Flycatcher, American Dipper, American Robin, Varied and Gray-cheeked Thrushes, Dark-eyed Junco, Orange-crowned and Wilson’s Warblers, Common Redpoll, White-crowned and Savannah Sparrows, and Snow Bunting (Gutleber undated(d), USFWS 1991b). Most small birds leave the area by mid-September, but the Snow Bunting commonly winters here.

This interior area, with its abundance of nesting habitat and food sources, is attractive to raptors. The most common raptors are Bald and Golden Eagles. Other raptors likely to occur in the vicinity of Tatalina LRRS include Gyrfalcon, Rough-legged Hawk, Goshawk, Merlin, and Great Horned Owl.

Starting in 1994 and continuing annually during June a breeding bird survey was accomplish by USFWS Innoko National Wildlife Refuge personnel. The surveys were funded in part by the Air Force for the first four years. Survey sites included the road from Sterling Landing on the Kuskokwin River, through the LRRS’s Lower Camp area, and to the village of Takotna.

Twenty-four bird species were observed at Tatalina LRRS during the ABR, Inc. 2004 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included confirmed nesting Green-winged Teal, Spruce Grouse, and Boreal Chickadee. Other species observed included Sandhill Crane; Ruby-crowned Kinglet; Arctic Warbler; Gray-cheeked, Swainson’s, Hermit, and Varied Thrush; Northern Waterthrush; White-winged Crossbill; and Common Redpoll.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur within the boundaries of Tatalina LRRS. However, the delisted American Peregrine Falcon (USFWS 2004b) potentially occurs in the vicinity of Tatalina (Alaska Natural Heritage Program 1993, Buckle 1993).

5.5 Wetlands

Tatalina LRRS is in an area of moderately hilly terrain removed from the Kuskokwim River and its associated wetlands. The installation lies between two drainage systems, the Takotna River to the north and the Tatalina River to the south. Throughout their meandering courses, both of these rivers are dotted with isolated wetlands, some of which have small lakes and ponds (Gutleber undated(d)).

Wetlands at Tatalina LRRS are dominated by well-drained, steep-sloping areas that are classified as jurisdictional Uplands, shallower sloped areas of wetter saturated or seasonal flooded soils, and fewer areas of permanently flooded water channels. Many common wetland types occur at Tatalina LRRS, including Upland, palustrine- needle-leaved evergreen; palustrine-forested, broad-leaved deciduous and needle-leaved evergreen, palustrine-broad-leaved deciduous and evergreen scrub-shrub, and palustrine, broad-leaved deciduous scrub-shrub; seasonally flooded or palustrine shrubs mixed with persistent emergent vegetation; as well as some riverine lower perennial, unconsolidated bottom; permanently flooded areas of active river. These areas of moist dwarf scrub habitats, tall shrubs, and upland needleleaf and mixed forests can be saturated, moderately well-drained, or well-drained depending primarily on soil type, microtopography, and landscape position. Dominant forest species in these areas include *Picea glauca, P. mariana,* and *Betula papyrifera* with an understory of species like *Salix pulchra*, *S. scouleriana, S. alaxensis, Alnus crispa, Calamagrostis canadensis, Galium triflorum, Linnaea borealis, Mertensia paniculata, Trientalis europaea, Artemisia tilesii*, and *Rosa acicularis.* Tall shrub areas are primarily dominated by *A. crispa* with common associates of *Salix pulchra, Spiraea stevenii (beauverdiana), Betula nana, B. glandulosa, Vaccinium uligonosum, Dryopteris dilitata, Empetrum nigrum,* and *Calamagrostis canadensi*. Dominant dwarf scrub species include *Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea, Ledum decumbens, Dryas octopetala, Arctostaphylos alpina,* and *Salix rotundifolia* (Schick *et al*. 2004).

The general Tatalina LRRS vegetation map's wetland features (Woodward-Clyde 1995f) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Tatalina LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (2,721.08 acres). Figure 5.5 shows wetlands on Tatalina LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

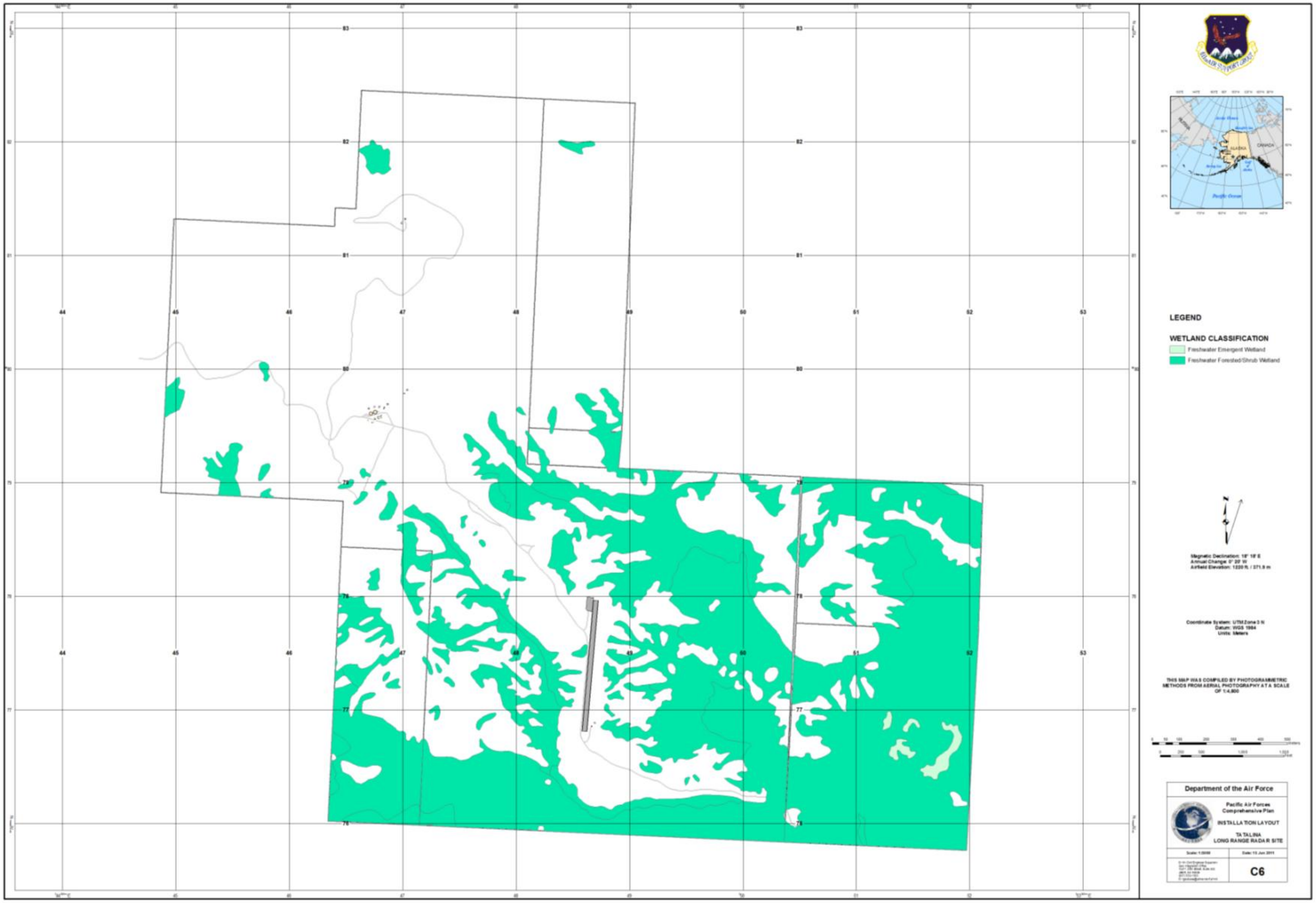
5.6 Other Natural Resource Information

5.6.1 Subsistence

Approximately 80 percent of the residents of Takotna are involved in subsistence activities. Moose are the most important resource, along with small furbearers, migratory waterfowl, and game birds. Takotna and McGrath subsistence use areas include the LRRS (Braund and Associates 2004).

McGrath offers a variety of employment opportunities, but subsistence remains an important part of the local culture. Residents harvest salmon, moose, caribou, bear, and rabbits. Some residents also trap furbearers and tend vegetable gardens. The role and importance of subsistence resources for McGrath is similar to that of Takotna (Braund and Associates 2004).

Figure 5.5 Tatalina LRRS Wetlands, 2011



5.6.2 Outdoor Recreation

The installation provides BOS contractor personnel with excellent hunting and fishing resources in the area. Most hunting, trapping, and fishing, however, is conducted by the rural residents for subsistence. The area surrounding Tatalina LRRS provides big game hunting, primarily for moose and black bears; some fishing; trapping for lynx, martin, fox, wolverine, and weasel; and ATV and snow machine riding opportunities. The village of Takotna is on the Iditarod trail, and LRRS personnel provide assistance for the annual dog sled race.

While DoD personnel may obtain authorization to fly private aircraft to Tatalina LRRS on their own time and at their own cost, it is not common since big game is not abundant. Hunting is done during free time by BOS contract personnel assigned to the LRRS and temporary duty personnel (military, civilian, or contractor) working at the site.

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities include a landing strip near the base of Takotna Mountain; Lower Camp, located two miles upslope of the airstrip; and Upper Camp at the summit of Takotna Mountain. Upper Camp is above 2,500 feet above msl and houses the long range radar equipment. Lower Camp provides support from a residential dome and industrial dome constructed in 1984. Upper Camp and Lower Camp are connected by a winding, gravel road.

Informal discussions with BLM personnel (Gene Stout and Associates and Blythe & Trousil, Inc. 2007a) indicate a concern that all areas not in use on the installation should be contoured and vegetated to minimize erosion. Tatalina LRRS has experienced some difficulty in establishment of vegetation being slow with results often less than satisfactory. Thus, there is the risk of adding to the erosion problem with revegetation attempts. Clean Sweep of abandoned structures began in 2012 at Tatalina LRRS.

The Air Force has a Right-of-Entry to conduct environmental sampling at Sterling Landing. In addition, the Air Force leases space to the State of Alaska Department of Natural Resources, Federal Aviation Administration, National Oceanic and Atmospheric Administration, and AT&T.

Appendix 3.0 – Tin. Tin City Long Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial Views of Tin City LRRS Upper and Lower Camps, Respectively

3.1 Location and Area

Tin City LRRS is located approximately 700 miles northwest of Anchorage and 570 miles west-northwest of Fairbanks, Alaska (INRMP Figure 3.1). The installation has 723 acres near the end of the Seward Peninsula. The installation consists of an Upper Camp, Lower Camp, and a runway. Lower Camp is one-half mile west of the Tin City mine site at the mouth of Cape Creek. Upper Camp is west of Lower Camp, on top of Cape Mountain (Figure 3.1).

3.2 Installation History

Tin City LRRS was one of 12 original AC&W sites built as part of the air defense system constructed in Alaska during the early 1950s. Tin City LRRS, originally known as Cape Prince of Wales but renamed in 1957 for the adjacent mining community, was activated in 1953. Communications were initially provided by high frequency radio. A WACS was activated at the site in 1958 to replace the high frequency radio system. In 1975 the WACS was replaced by microwave relays, and in 1980 the communication system was replaced with a satellite system. The WACS site was turned over to the Navy in 1985.

A MAR system was installed in 1985, which remains active today, and other modifications were made to remotely operate and maintain the radar from Elmendorf Region Operations Control Center. These improvements resulted in a reduction in the amount of necessary staff, which went from the 1953 level of 95 military personnel to 14 non-military contract personnel in 1977 to four operations and maintenance contract personnel from 1998 to present. Facilities include buildings, aircraft facilities, antenna structures, utility plants, and a runway. Some inactive structures were demolished in 1999 and 2000.

3.3 Surrounding Communities

Tin City LRRS is located five miles southeast of the community of Wales. Wales has a population of 145 (2010 estimate) with a strong traditional Kinugmiut Eskimo whaling culture (www.dced.state.ak.us 2012). An undeveloped road connects Wales to Tin City LRRS. When barges were not able to land at Wales, they have landed at Tin City, and materials were trucked to Wales. The road also serves as an emergency alternate access when the Tin City runway cannot be used, but the Wales runway is accessible. Access to the Tin City Trading Post from Wales is also by boat, snowmachine, or ATV.

The economy of Wales is based on subsistence hunting and fishing, trapping, Native arts and crafts, and some mining. A private reindeer herd is managed out of Wales, and local residents are employed to assist in the harvest. Whales, walrus, polar bear, moose, salmon, and other fish are utilized (www.dced.state.ak.us 2012).

Most land surrounding the installation was conveyed in March 1982 to the Bering Straits Native Corporation in conjunction with the Wales Native Corporation. The LRRS is adjacent to the Alaska Maritime NWR.

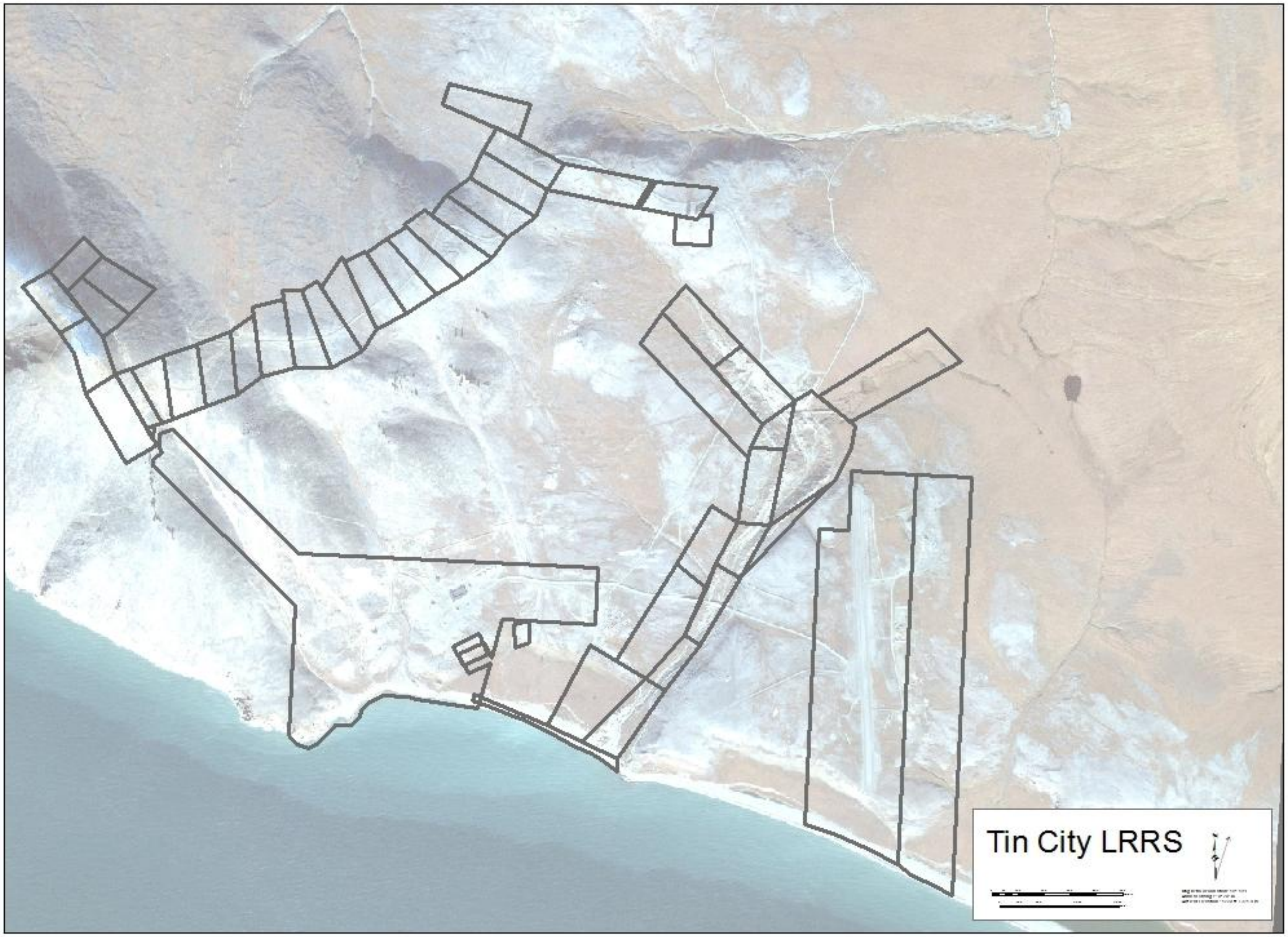
Several mining claims are situated between the two individual installation boundaries along Cape Creek. Two mining claims are within or intersect the installation perimeter near Lower Camp. Both parcels are small (1.6 hectares each), near the installation boundary in Section 23. Title to this land was granted to the Bartels Tin Mining Company in 1911.

Several hundred hectares located three kilometers northeast of the installation are owned by the Alaska Department of Natural Resources, Division of Research and Development. However, installation boundaries do not come into contact with this parcel of land.

3.4 Regional Land Use

Much of the landscape surrounding the LRRS in the Tin City area has been degraded by past mining activities. Tin deposits along stream channels were surface-mined until 1990, leaving scarred and unvegetated stream banks and waste rock piles. Abandoned mining machinery and fuel drums are scattered throughout the area.

Figure 3.1 Tin City LRRS



3.5 Local and Regional Natural Areas

Portions of the Alaska Maritime NWR are adjacent to Tin City LRRS. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

Tin City LRRS lies within the Transitional Climatic Zone. Typical weather conditions at Tin City are cold, damp, foggy, and windy. Average annual precipitation is approximately 12 inches, with most occurring between July and October. Average summer high temperatures range from 43° to 52°F, and average winter low temperatures range between -1° and -8°F. A record high temperature of 73°F was recorded in 1990, and a record low temperature of -44°F was recorded in 1955 and 1989 (www.weather.com).

Table B.1.H Tin City, Alaska Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High	5ºF	7ºF	4ºF	17ºF	33ºF	43ºF	52ºF	51ºF	45ºF	33ºF	22ºF	10ºF
Average Low	-8ºF	-8ºF	-7ºF	5ºF	24ºF	34ºF	43ºF	43ºF	37ºF	26ºF	11ºF	-1ºF
Mean	-2ºF	-1ºF	-2ºF	11ºF	29ºF	39ºF	48ºF	47ºF	41ºF	309ºF	17ºF	5ºF
Record High	53ºF (1963)	47ºF (1957)	42ºF (1984)	48ºF (1956)	56ºF (1990)	67ºF (1991)	72ºF (1972)	73ºF (1990)	65ºF (1991)	54ºF (1954)	45ºF (1991)	44ºF (1983)
Record Low	-44ºF (1989)	-44ºF (1955)	-42ºF (1977)	-32ºF (1975)	-11ºF (1971)	20ºF (1975)	-11ºF (1971)	-11ºF (1971)	-11ºF (1971)	-11ºF (1971)	-28ºF (1956)	-35ºF (1961)
Average Precipitation	0.56 inches	0.63 inches	0.69 inches	0.35 inches	0.49 inches	0.72 inches	1.36 inches	2.45 inches	1.83 inches	1.32 inches	0.69 inches	0.89 inches

Source: www.weather.com (January 16, 2012)

Winds are practically non-stop and average 15 knots. Occasional gusts of more than 70 knots are not uncommon (Woodward-Clyde 1993b).

5.1 Landforms

Tin City is located near the extreme western tip of the Seward Peninsula in western Alaska. The topography in the vicinity of Tin City is relatively flat to the east, becoming steeper to the west. The runway, located east of the Lower and Upper camps, is at an elevation of approximately 250 feet above msl. The elevation at Upper Camp is 2,289 feet above msl. The terrain drops steeply to a height of 250 feet above msl at Lower Camp. The inactive WACS site appears to be located on or very near the Continental Divide, at an elevation about 590 feet above msl (Woodward-Clyde 1993b).

4.3 Geology and Soils

The geology of the Tin City area is dominated by undifferentiated alluvium and slope deposits (talus) common to steeply sloping and mountainous regions. The surficial geology of lower elevations, such as at Lower Camp, consists of thin accumulations of mixed silt, sand, gravel, cobbles, and boulders overlying bedrock. The Upper Camp geology may consist of a thin veneer of residual (weathered rock) soils. Granitic bedrock outcrops are common on steep slopes and eroded mountaintop areas. The Tin City water well log indicates that unconsolidated deposits are only 9.5 feet thick at the well site at Lower Camp. Weathered, fractured granitic bedrock underlies the sediment. Soils are classified as Histic Pereglic Cryaquepts and Pergelic Cryaquepts. They range from silty to gravelly and are poorly drained (Woodward-Clyde 1993b).

The runway, located east of Cape Creek, is situated over limestone bedrock with surficial deposits typically deeper than those found to the west at the Lower Camp area (Woodward-Clyde 1993b).

The geology of the area is economically significant because the contact zone of tin-rich, granitic bedrock and limestone bedrock is situated between the installation runway and Lower Camp. This contact zone between the two rock bodies is a source of lode and placer-type tin deposits and has been mined in the past (Woodward-Clyde 1993b).

Permafrost is most likely intermittent along the coast. Farther inland, it is mostly continuous to a maximum depth of 600 feet and occurs primarily in fine-grained silt and clay soils. The presence of permafrost at the installation is undetermined (Woodward-Clyde 1993b).

4.4 Hydrology

4.4.1 General

Surface water runoff from the installation flows into one of five creeks. Paulina Creek drains Upper Camp; Lagoon Creek drains areas east of the runway; Last Chance and Cape creeks drain the WACS site; and Pauline Creek drains Lower Camp. These creeks flow into Norton Sound (Woodward-Clyde 1993b).

The hydrogeology of Lower Camp consists of a thin layer of mixed talus and alluvium overlying bedrock at shallow depths. Groundwater occurs in secondary openings of local bedrock (*e.g.*, faults, fractures, fissures) at highly variable depths below ground surface. Groundwater is recharged at the installation by infiltration of precipitation and streamflow seepage through highly permeable surficial materials present at or near ground surface. Seasonal groundwater may occur in unconsolidated materials above bedrock. Permafrost is thought to be generally limited to layers of fine-grained sediments that may be present (Woodward-Clyde 1993b).

The hydrogeology of Upper Camp consists of thin gravelly, bouldery residuum overlying bedrock; bedrock crops-out frequently. Groundwater, if present, may occur in secondary openings of local bedrock or may be seasonally trapped in the residual material as perched water (Woodward-Clyde 1993b).

The installation’s water supply comes from a well that was drilled into fractured zones of granitic bedrock. Water is pumped into storage tanks for later use.

4.4.2 Flood Plains

Information presented below is taken from Legare (1998), *Flood Plain Identification of Eighteen Remote Air Force Radar Sites in Alaska*. Installation lands are well above any flood plain, except for the toe of the coastal bluff. Wave runup on the coast will reach about 14 feet.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Tin City LRRS. Much information included in INRMP Chapter 5.0 that includes Tin City LRRS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Tin City LRRS and the surrounding area. ***Appendix 3.0-Lisburne***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Tin City LRRS are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M125 Seward Peninsula Tundra-Meadow Province
Description: The landscape of this province contains broad convex hills and flat divides cut by sharp V-shaped valleys. Rising above coastal lowlands and interior basins are isolated groups of rugged glaciated mountains with elevations of 2,500-4,700 feet. Winters are long and cold followed by short, cool summers. Average precipitation is 18 inches with heavy snowfall in winter and heavier concentrations of rain in summer. At lower elevations are moist and wet tundra communities; alpine tundra communities are found in high mountains. The vegetation is mostly sedge tussocks with scatterings of willows and birches; isolated spruce-hardwood forests also exist. Dominant soils for the province are Inceptisols; permafrost can be found throughout the province.

5.2 Vegetation

Vegetation of the Seward Peninsula belongs to three different zones, according to Young's (1971) floristic zonation for arctic regions. The western tip of the peninsula falls into a transition between Zone 3, a primarily coastal zone, and the floristically poor, high arctic zone (Kessel 1989). In this area barren landscapes extend down to the 200-meter level, and mesic tundra is limited to lower, more protected slopes. Shrubs are primarily dwarf shrubs (at less than 0.4 meters) and are restricted to sheltered ravines and gullies (Kessel 1989).

Vegetation of the Tin City region is typical of the western Seward Peninsula described by Kessel (1989) and consists of alpine and moist tundra with moist tundra occupying extensive areas on the Seward Peninsula (Viereck and Little 1972). Tundra on the Seward Peninsula varies from almost continuous and uniformly developed cotton-grass tussocks, with sparse growth of other sedges and dwarf shrubs, to stands where tussocks are scarce or lacking, and dwarf shrubs are dominant. On exposed ridges and mountain ranges in coastal areas, there is a zone of alpine tundra. Alpine tundra consists of barren rocks, but low mat plants, both herbaceous and shrubby, are interspersed between bare rocks and rubble (Viereck and Little 1972). Low mats of white mountain avens are dominant in northern areas and may cover entire ridges and slopes, along with many mat-forming herbs, such as moss campion, black oxytrope, Arctic sandwort, and several grasses and sedges.

Alpine tundra at Tin City LRRS is generally more barren than other tundra habitats and consists of rock, barren ground, and sparse vegetation. Common species occurring at Tin City LRRS include currant, crowberry, cloudberry, lousewort, glacier avens, and several species of prostrate willow. Ground cover at higher elevations consists entirely of alpine tundra, with increased areas of barren ground and generally low-growing vegetation adapted to severe winds and harsh growing conditions. Common plants at Upper Camp include Arctic poppy, moss campion, and four-angled cassiope.

A general vegetation map of Tin City LRRS was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995d). Schick *et al*. (2004) made significant improvements in vegetation mapping at Tin City LRRS (using 1996 digital aerial photos) with the preparation of a wildlife habitat map (map, acreage analysis, and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys.

In 2012 the Colorado State University, Center for Environmental Management of Military Lands, in cooperation with the 611 GeoBase Program (611 CES/CEPT), compared habitat classes for Tin City LRRS in 2001 and 2004. This project used 2001 National Land Cover Database data (http://www.mrlc.gov/nlcd2001.php) as a baseline for comparison with the most recent imagery found on Google Earth. Table 5.2 shows these acreages and changes over this 4-year period. Figure 5.2a shows habitat classes for 2004, and Figure 5.2b shows changes in habitat classes between 2001through 2004.

Table 5.2 Habitat Class Differences between 2001 and 2004, Tin City LRRS

Habitat Class	Acres 2001	Acres 2004	Acreage Change
Barren Land	395.1	395.3	0.2
Developed, Low Intensity	25.8	26.2	0.4
Dwarf Shrub	157.4	156.1	-1.2
Emergent Herbaceous Wetlands	1.8	1.8	0.0
Open Water	25.1	26.0	0.9
Perennial Ice/Snow	1.2	2.6	1.4
Sedge/Herbaceous	170.9	0.2	-170.7
Shrub/Scrub	2.8	169.0	166.2
Woody Wetlands	1.1	2.8	1.7
Totals	**781.1**	**780.0**	**-1.1**

Schick *et al*. (2004) described the Tin City LRRS area in terms of habitat types used in their analyses. Below descriptions are adapted from this source.

Tin City LRRS encompasses 723 acres[1] of gently sloping, rocky tundra and steep mountainous terrain. The most common wildlife habitats at the LRRS are dwarf scrub and partly barren rock in the mountains, lowland tundra near the coast, upland tundra on gentle mountain slopes, and marine water; relatively little riverine and almost no lacustrine habitat are present. Most riverine barrens in the area are composed of re-worked gravels from earlier mining operations.

Lowland wet and moist tundra and the upland wet and moist tundra may be used by nesting passerines and some shorebirds. By far the most abundant habitat types at the LRRS are Upland Dwarf Scrub and Upland Rock, may be used by nesting passerines and a few widely-dispersed shorebirds. Kittlitz's Murrelets have been recorded nesting in these Upland Rock habitats at Tin City (Day and Stickney 1996). Cliffs along the coast may provide habitat for nesting raptors. Much vegetation along Cape Creek (outside the LRRS) has been disturbed and removed through past mining activities. This activity removed vegetation, soil, and underlying material from stream banks, leaving steep banks devoid of topsoil and vegetation.

1 Official acreage and mapped acreage (Table 5.2 and Figures 5.2) are not necessarily the same due to different methods of calculation.

5.3 Fish and Wildlife

5.3.1 Fish

A variety of fish inhabit coastal waters of the Tin City region, including all five salmon species, Pacific tomcod, Arctic cod, Arctic flounder, and rainbow smelt (USFWS 1988). Freshwater fish habitat is very limited at Tin City LRRS.

5.3.2 Mammals

Terrestrial mammals inhabiting the Seward Peninsula area include northern red-backed, tundra, and Alaska voles; masked and tundra shrews; brown and collared lemmings; snowshoe and tundra hares; Arctic ground squirrels; wolverines; and Arctic and red foxes (Kessel 1989, Bee and Hall 1956). Larger species, such as brown/grizzly bears and wolves, may also occur in the area. Virtually no caribou occur on western Seward Peninsula; however, the area is managed by the BLM for domestic reindeer herding, and reindeer frequently forage on the LRRS. Musk ox are residents in the area and forage on alpine tundra surrounding Upper Camp. Musk ox have been observed by LRRS personnel (Woodward-Clyde 1995d).

Whales, such as the endangered bowhead whale, gray whale, killer whale, and beluga whale may occur in coastal waters in the Tin City area. Several seal species, including spotted, ribbon, ringed, and bearded seals, are harvested by the local native community. The Steller sea lion and Pacific walrus also occur in offshore waters (Wynne 1993). Although most marine mammals present at Tin City are under the jurisdiction of NMFS, walruses are under the jurisdiction of the USFWS. The Tin City area is within the range of the polar bear (Bridges 2001), which is a protected species under provisions of the MMPA.

5.3.3 Birds

Low-lying areas near sea level and adjacent to the LRRS provide breeding and foraging habitat for waterfowl and shorebirds, such as the Northern Pintail and Semipalmated Plover. The most common seabirds found in the area include the Pelagic Cormorant, Black-legged Kittiwake, Common and Thick-billed Murre, Horned Puffin, and Pigeon Guillemot (Kessel 1989). Two seabird colonies exist on sea cliffs west of Tin City. These colonies consist of Pelagic Cormorants, Black-legged Kittiwakes, Horned Puffins, and possibly Kittlitz's Murrelets (Sowls *et al*. 1978).

Fifteen bird species were observed at Tin City LRRS during the ABR, Inc. 2002 survey (Gene Stout and Associates and Blythe & Trousil, Inc, 2007a). Observations included such species as Pelagic Cormorant, Rough-legged Hawk, three species of Sandpipers, Horned Lark, Yellow and White Wagtails, and Lapland Longspur.

Bird species observed at Tin City LRRS during a 1993 site visit (Woodward-Clyde 1995d) include the Red-throated Loon, Pelagic Cormorant, Glaucous Gull, Black-legged Kittiwake, Horned Puffin, Common Raven, Yellow Wagtail, Lapland Longspur, and Snow Bunting. The area around Tin City exhibits a geographic proximity to Asia that accounts for the presence of species not found farther east. Regular breeders along the western Seward Peninsula include the Arctic Loon, Rufous-necked Stint, and Red-throated Pipit (Kessel 1989).

Sandhill Cranes were reported foraging in the vicinity of Tin City LRRS airfield on 17 May 1999, numbering in the hundreds (personal communication, G. Augustine with site personnel). About 20 cranes returned to the area on 4 July 1999, suggesting apparent nesting of cranes in the vicinity.

Figure 5.2a Tin City LRRS Wildlife Habitat Map, 2004

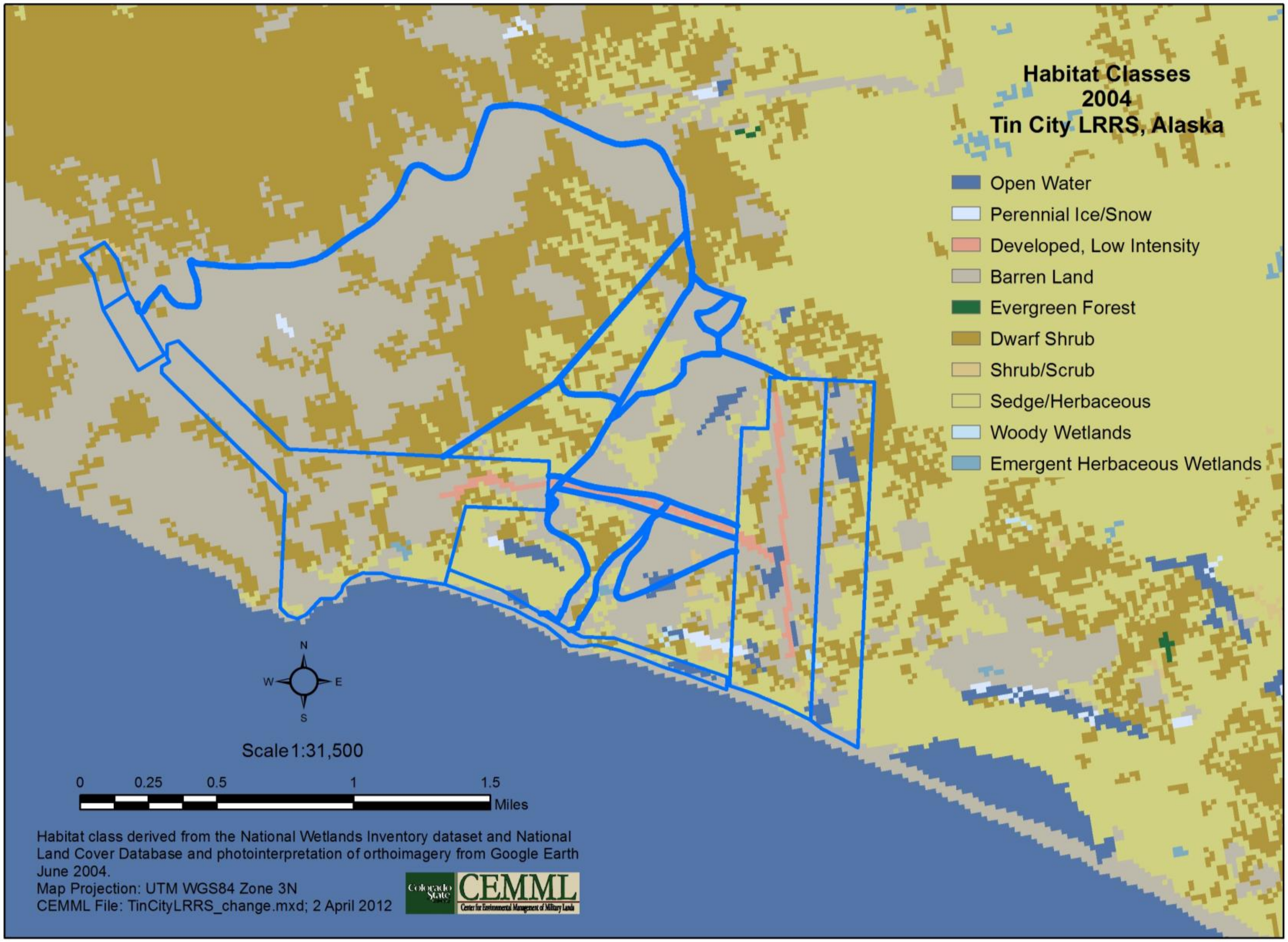


Figure 5.2b Changes in Habitat Classes at Tin City LRRS between 2001 and 2004

5.4 Threatened and Endangered Species

Fourteen federally-protected species are known or may occur in the Tin City area. Threatened Spectacled Eiders and polar bears, endangered Steller sea lion, candidate Yellow-billed Loon and Pacific walrus, and threatened ringed and bearded seals are known on or near the site. Endangered bowhead, fin, northern right, and humpback whales and threatened Steller's Eiders may be near the site (Alaska Natural Heritage Program 1993, USFWS 1997b, Rappoport 1993, Sousa 1993). There is low potential for either the Spectacled or Steller's Eider to nest at Tin City LRRS. The candidate species, Kittlitz's Murrelet is an important component of the ecosystem at Tin City. The species is a confirmed nester at the LRRS (Day and Stickney 1996).

Rumex (*Rumex krausei),* a former Category 2 plant, is known to occur at the western end of the Seward Peninsula (Murray and Lipkin 1987). Rumex was not found at Tin City in 1996, but Chukchi primrose (*Primula tschuktschorum*), another former Category 2 plant, was found in two populations (Lipkin 1999). Both populations of Chukchi primrose were in undeveloped tributary stream valleys above the Lower Camp area and east of the tramway. In 1996 Lipkin also found the Arctic springbeauty (*Claytonia arctica)* on the eastern side of Pauline Creek; it has a similar rare status as the Chukchi primrose, moderately threatened state-wide. A third rare plant, Bering Sea wormwood (*Artemisia senjavinensis*), was found between the Lower Camp area and the lower end of the tramway on sparsely vegetated carbonate outcrops and gravels (including disturbed roadside areas).

Several formerly listed or former Category 2 species (Harlequin Duck, Arctic Peregrine Falcon, North American lynx, and gray whale) are either confirmed or possible near Tin City LRRS. Two gray whales, formerly listed, were observed in coastal waters off Tin City during the 1993 site visit (Woodward-Clyde 1995c).

5.5 Wetlands

The most common wetland type at the Tin City LRRS is palustrine, evergreen broad-leaved scrub-shrub, with or without lichens. The most common wildlife habitat type comprising these wetlands is Upland Dwarf Scrub. Dominant species include *Dryas octopetala*, *Salix rotundifolia*, and lichens. The next most common wetland type at Tin City is palustrine, persistent emergent vegetation with a scrub-shrub component. These areas are typically moist, saturated tundra and are dominated by the Upland Moist Graminoid-Shrub Tundra habitat type (Schick *et al*. 2004).

The general Tin City LRRS vegetation map's wetland features (Woodward-Clyde 1995d) were significantly updated by a NWI map and mapping done by Schick *et al*. (2004). Tin City LRRS's wetland feature delineations were significantly enhanced by the National Wetlands Inventory (NWI) mapping in 2011 (113.92 acres). Figure 5.5 shows wetlands on Tin City LRRS from 2011 data. These sources are used to facilitate decisions regarding facility siting.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Residents of Wales utilize an area encompassing the westernmost portion of the Seward Peninsula southwest of Shishmaref and west of Mary's Igloo for harvest of subsistence resources. Traditional subsistence activates in the Wales area have revolved principally around marine mammals, especially bowhead whales, walrus, and bearded seals. In addition to marine mammals, Wales residents rely, to a lesser extent, on reindeer, moose, various fish species, clams, birds and their eggs, and a variety of greens and berries. Wales is one of 10 Alaska Eskimo Whaling Commission communities. Of all subsistence activates, bowhead whaling represents one of the greatest concentrations of effort, time, money, group symbolism and significance. Five species, bearded seal, bowhead whale, walrus, ringed seal, and chum salmon account for about 77 percent of Wales annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation at Tin City LRRS for installation personnel or Wales residents consists primarily of such activities as beachcombing, mountain biking, whale watching, and ATV riding along trails and beaches. Little potential exists for installation personnel to use hunting and fishing resources in the Tin City area. BOS contract personnel stationed at Tin City, temporary duty personnel during free time, and subsistence hunters from the neighboring area hunt and fish the surrounding area, but little or no demand exists by DoD personnel to travel to the site for recreational purposes. ATV tracks on tundra vegetation were noted in the Tin City area; however, most ATV riding on the LRRS is restricted to designated trails and roads. Mining activities are conducted in the area.

Tin City LRRS provides exceptional wildlife viewing. Musk ox, gray whales, and breeding seabirds frequently are observed from the site. The composite facility, which overlooks the bay and has placement windows, provides an excellent wildlife observation post for site personnel. Breeding seabird colonies are present on small islands and rock outcrops west of Lower Camp. Any wildlife viewing of these colonies should be conducted in a manner that does not disturb nesting birds (*e.g.*, conduct observations from a blind or distant location).

6.0 MISSION AND OTHER IMPACTS ON NATURAL RESOURCES

6.1 Land Use

Facilities include buildings, runway, airfield facilities, antenna structures, utility plants, and fuel storage tanks. A landfill for construction and demolition waste was completed in 1999; since then several inactive structures were demolished, and debris was disposed of in the landfill. A non-directional beacon was installed at Tin City in FY04. The section of Tin City LRRS located to the east of Cape Creek includes the 4,700-foot runway and the weather station. The section located on the western side of Cape Creek includes the main body of the LRRS. A composite building for housing and operations, a tram terminal, an incinerator, and large-capacity fuel tanks are at Lower Camp. Upper Camp facilities include living quarters for radar technicians, the radome, the tram terminal, and one fuel tank.

The water gallery and well are near Pauline Creek above Lower Camp. The gallery, a buried perforated pipe that acts as a collecting pan, intercepts water moving along a fault zone and channels the water into the well. The water is pumped from the well and stored in tanks for use by the LRRS; it is chlorinated before dispensing.

The power plant is located within the composite building and burns diesel fuel to provide electricity for the LRRS. Until 1985 sewage was treated in the sewage lagoon by an extended aeration process; the resulting sludge was deposited in the solid waste landfill. A septic system is now used for treating sewage. The installation switched to a septic system because the sewage lagoon proved impractical for fewer than 10 people.

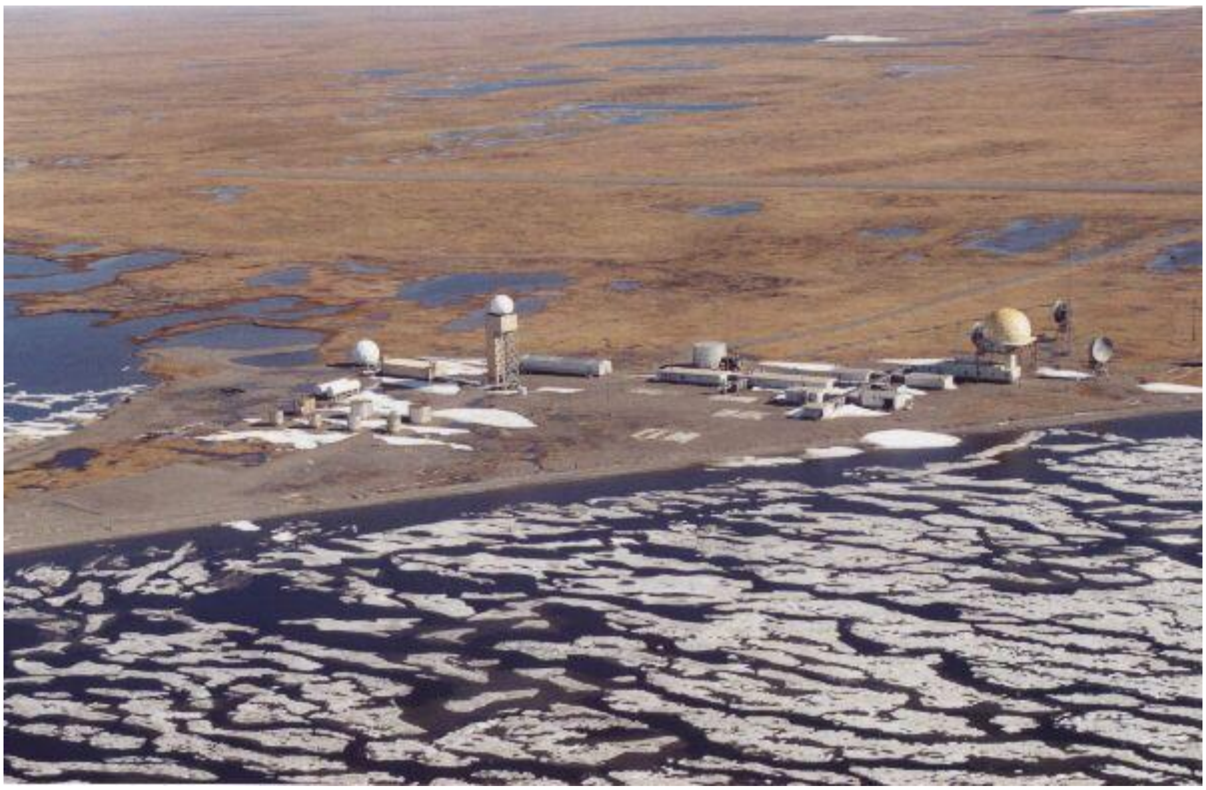
Land at Tin City LRRS is leased to the State of Alaska for remotely-monitored seismic and tsunami equipment, the Federal Aviation Administration for general aviation communication, and AT&T for general communications.

Figure 5.5 Tin City LRRS Wetlands, 2011

Appendix 3.0 - Bullen. Bullen Point (Flaxman Island) Former Short Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Bullen Point Former SRRS



3.1 Location and Area

Bullen Point (Flaxman Island) SRRS (hereinafter called Bullen Point SRRS) (inactive site) is located on the northern coast of Alaska about 35 miles east of Deadhorse, Alaska (INRMP Figure 3.1). The facility encompasses 605 acres (Figure 3.1) of low lying tundra adjacent to the coast on a relatively flat area below a gradual slope.

3.2 Installation History

DEW Line construction began at Bullen Point in 1953. Bullen Point was one of 20 auxiliary stations (Denfeld 1993). The installation was active until 1971. In 1995 construction was completed on the unattended radar (UAR) radome tower, electrical power station, primary distribution line, diesel storage tank, pipeline, satellite communication ground terminal, beacon light, and helicopter pad with airfield special lighting. Demolition and remediation of inactive facilities under the Clean Sweep program occurred in 2006-2007, leaving only a few then-active buildings. Since then, the site has been deactivated. Debris removal is scheduled for 2013.

3.3 Surrounding Communities

Bullen Point inactive site is isolated with no native settlements in the area. The closest community is Deadhorse, about 35 miles west. Deadhorse, the land base for Prudhoe Bay oil drilling, lies 625 miles north of Anchorage, Alaska. Prudhoe Bay is about 35 miles west of the SRRS. Transportation to the SRRS is limited to aircraft, seasonal barges, and extremely limited land travel. No roads connect to the facility. The installation is within the subsistence use area of the villages of Nuiqsut (about 95 miles west) and Kaktovik (about 75 miles east).

3.4 Regional Land Use

Four cultural resources sites, including traditional land use and prehistoric sites, are known to exist in the vicinity of Bullen Point. One archeological site is north of the POL tanks at Bullen Point. The site consists of a wooden, semisubterranean, sod-roofed structure. Most other cultural resources in the area represent Traditional Land Use sites. None of the sites have been evaluated for listing in the National Register of Historic Places (ICF Technology, Inc. 1996b).

Bullen Point was shown on a 1902 manuscript by S.J. Marsh as an Eskimo campsite. The land occupied by Bullen Point SRRS is Public Land Order property managed by the USAF.

3. 5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near Bullen Point.

4.0 Physical Environment

4.1 Climate

Prudhoe Bay, 35 miles west of the SRRS, is the nearest source of meteorological data in the area. The climate of the North Slope is arctic. Prudhoe Bay temperatures range from -56 to 78 °F. Precipitation is light, averaging 5 inches, with 20 inches snow per year (www.dced.state.ak.us 2012). Temperatures average 27°F in July and -31°F in January. The lowest temperature recorded for the period of 1970 to 1977 was -56°F. Strong winter winds are common, and over half the days in January, February, and March have windchills of below -40°F (ICF Technology, Inc. 1996b). Average April wind-packed snow depth is 16 inches. Complete cloud cover occurs 54 percent of the year and fog may be expected 115 days annually (USFWS 1982a).

Prevailing winds are westerly particularly in winter, and often occur with snowstorms. During summer the cold air mass associated with the Arctic Ocean rides over the Arctic Coastal Plain creating temperature inversions with cold air below and warmer air above. These inversions break up when winds from the south or west bring warmer air into the coastal areas (Hart Crowser, Inc. 1987).

4.2 Landforms

The Bullen Point site is situated in the Arctic Coastal Plain physiographic region. The Coastal Plain is a relatively smooth surface showing little relief, sloping downward to the north from the foothills of the Brooks Range. Due to the flat terrain and the continuous occurrence of permafrost, marshes and lakes are abundant. The coastline is characterized by low coastal banks with narrow gravel beaches. Coastal erosion occurs as thermal undercutting of the frozen bank and slumping into the sea (CH2M Hill 1981).

Bullen Point is located on the coast of the Beaufort Sea on a relatively flat area below a gradual slope. Elevations at the site range from 10 to 18 feet above msl. The site contains a wide variety of terrain, including shallow lagoons, numerous and varied stages of thaw lakes, intermediate zones of polygonal ground, and upland areas of relatively flat tundra mat. A chain of barrier islands is located offshore.

Figure 3.1 Bullen Point Former SRRS

4.3 Geology and Soils

Similar to other areas of the Arctic Coastal Plain, Bullen Point was not glaciated. Thus, many periglacial features, such as polygonal ground, sorted circles, pingos, and ice wedges, can be observed in the area. Surficial deposits in the area consist of sand and gravel near the shoreline and along stream channels; silt, sand, and gravel deposits in the inland low areas; and eolian silt and fine sand deposits in upland areas. Oil is present in the region. Numerous oil wells have been drilled offshore on some of the barrier islands, but none have been drilled in the immediate vicinity of the SRRS.

Permafrost is continuous at Bullen Point and is probably hundreds of feet deep. Summer thaw depths in the active layer range from one to six feet in the tundra soils.

4.4 Hydrology

Surface water resources of Bullen Point site are similar to other Arctic coastal areas and include lagoons, thaw lakes, and shallow streams. The drainage pattern is generally to the north and occurs as sheet flow and ephemeral streams and may drain into larger streams or directly to the ocean. A partially captured thaw lake forms a brackish water lagoon east of the site. Abundant thaw lakes and polygonal ground near the site is drained by several small, slow-moving streams.

Lakes in the general area are less than 10 feet deep. While the installation was manned, freshwater was obtained from a reservoir southwest of the facilities that was formed by damming a small stream. The dam has been breached and the reservoir drained.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Bullen Point site. Much information included in INRMP Chapter 5.0 that includes Bullen Point site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Bullen Point site and the surrounding area. Appendix A contains lists of vascular plants (Table A1), mammals (Table A3), and birds (Table A43). Fish species on Bullen Point site and the surrounding area are in ***Appendix 3.0-Barter***, Appendix A, Table A2, combined for brevity purposes. Threatened or Endangered Species that may occur at Bullen Point site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 124 Arctic Tundra Province
Description: This province is a broad, level plain with rolling foothills near the Colville River; in summer there are lakes and marshes dotting the landscape. Winter temperatures can go as low as -60°F and due to the area's northern location receives differing amounts of sunlight throughout the year. Precipitation is low throughout the year, averaging only seven inches. Due to permafrost there are extensive marshes and lakes in the province. The most widespread vegetation system, cotton grass-tussock, grows along with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. Dominant soils are wet and cold. Upland soils are poorly drained clayey soils. Soils on south slopes and low moraines are well drained and loamy; lowland soils are deep, wet, and silty. Permafrost is continuous throughout the province, reaching depths of 2,000 feet in some areas.

5.2 Vegetation

Habitat of the North Slope is generally classified as wet tundra. There are three major habitat types at Bullen Point site: wet sedge meadow, tussock tundra, and riverine/riparian (ICF Technology, Inc. 1996c).

A vegetation survey performed in 1999 (Universe Technologies, Inc. and Gene Stout and Associates 2001a) identified 56 species.

Schick *et al*. (2004) mapped habitat at Bullen Point site using 2000 digital aerial photography and conducted flora and fauna surveys (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a). Wells *et al*. (2010) updated this mapping and data analysis for Bullen Point site using 2006 pan-sharpened Quick Bird aerial photos. Table 5.2 shows changes in acreage between 2000 and 2006. Figure 5.2a shows these habitat classes for 2006. Figure 5.2b shows habitat changes between 2000 and 2006. Figure and table data include USAF property and a 150-meter buffer outside the property boundary.

Table 5.2 Area of Habitat Classes and Differences between Years in Habitat Classes Mapped from 2000 and 2006 Imagery, Bullen Point Site

Habitat Class	Acres 2000	Acres 2006	Acreage Change
Artificial (including Artificial Barrens and Artificial Partially Revegetated for 2006)	38.4	38.4	0.0
Coastal Barrens	28.6	35.2	+6.6
Coastal Brackish Water	5.1	5.2	0.0
Coastal Salt Marsh	20.9	22.9	+2.1
Coastal Salt-killed Tundra	37.9	37.9	0.0
Deep Water	6.5	6.5	0.0
Deep Water w/ Islands or Polygonized Margins	2.0	2.0	0.0
Lowland Aquatic Grass Marsh	6.6	6.6	0.0
Lowland Aquatic Sedge Marsh	2.1	2.1	0.0
Lowland Dwarf Scrub	8.7	8,7	0.0
Lowland Lacustrine Barrens	3.3	3.5	+0.2
Lowland Moist Sedge–Shrub Tundra	384.9	384.7	-0.3
Lowland Nonpatterned Wet Tundra	11.4	11.4	0.0
Lowland Patterned Wet Tundra	19.8	19.8	0.0
Lowland Wet–Moist Patterned Tundra Complex	74.5	74.5	0.0
Marine Nearshore Water (Estuarine)	99.9	91.0	-8.9
Marine Waters	277.2	277.4	+0.2
Riverine Barrens	0.7	1.1	+0.4
Rivers and Streams	3.1	3.0	-0.1
Shallow Water	7.9	8.3	+0.4
Shallow Water w/Islands or Polygonized Margins	6.5	5.9	-0.6
Young Basin Wetland Complex (Ice-poor)	46.0	46.0	0.0
Totals	**1,092.0**	**1,092.0**	**0.0**

The site is characterized by coastal tundra typical of the central Beaufort Sea area. Moist polygon tundra consisting primarily of high-centered polygons with little topographic relief (< 0.5 meters, sometimes referred to as “flat-topped polygons”) cover much of the area. Vegetative cover in these areas is typically about 100% and is dominated by vascular plants, such as *Carex aquatilis*, *Carex bigelowii*, *Salix planifolia*, *Dryas integrifolia*, and various moss and lichen species. These areas provide suitable nesting habitat for several species of *Calidris* sandpiper and Lapland Longspur. Alternating with the polygon tundra are shallow thaw lakes, pond complexes, and drained lake basins. Drained lake basins are wetter than the more elevated polygon tundra and exhibit tundra plant communities dominated by *Carex*

Figure 5.2a Bullen Point Site Wildlife Habitat Map, 2006

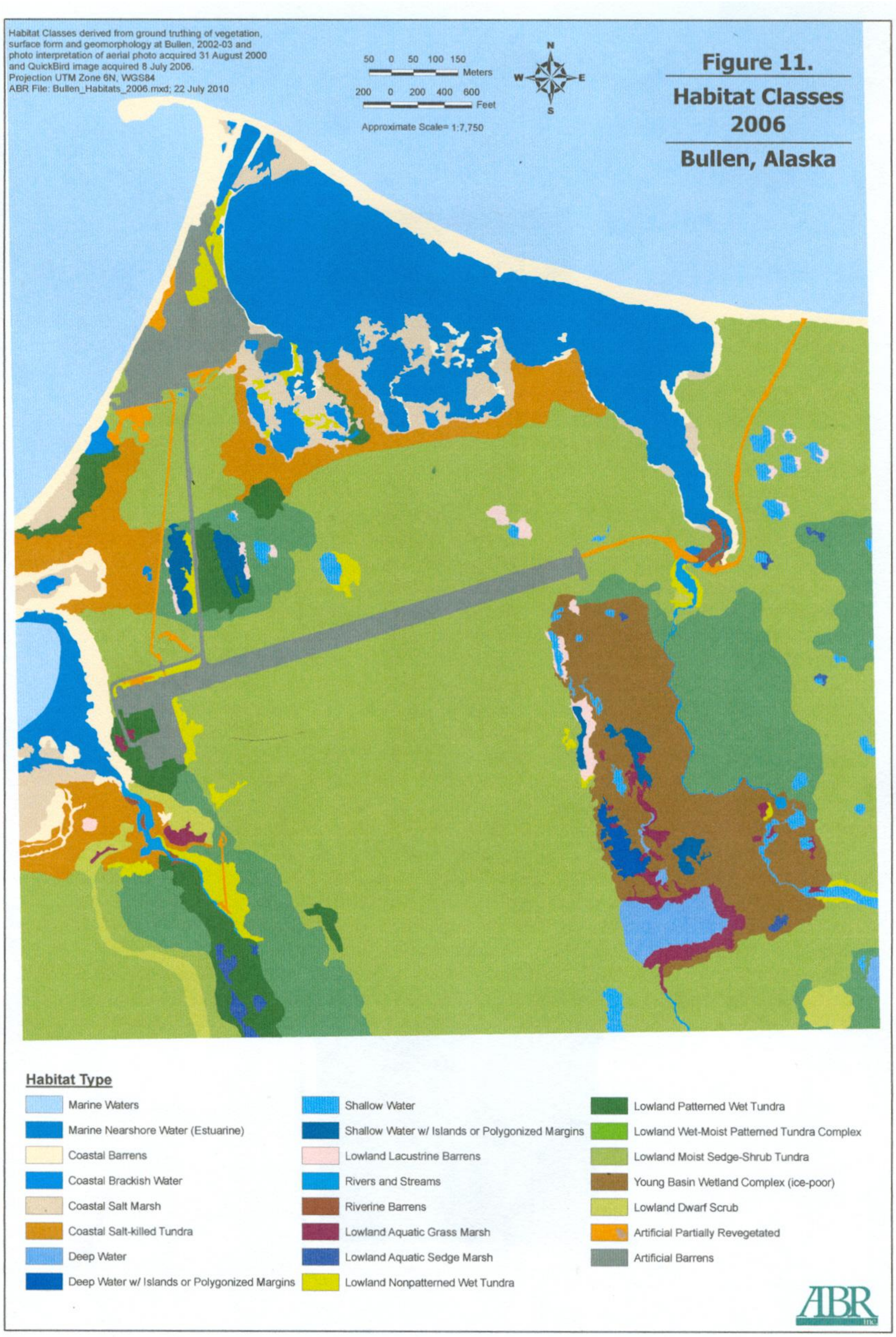


Figure 5.2b Bullen Point Site Habitat Class Changes, 2000-2006

aquatilis and *Eriophorum angustifolium*. These areas provide good nesting habitat for *Calidris* sandpiper and phalarope (Schick *et al*. 2004).

Inland from the coast some small patches of moist tussock tundra dominated by *Eriophorum vaginatum* are present. Along the immediate coastline are areas of moist polygon tundra that are periodically inundated with saltwater during storm surges. These areas have scattered driftwood, patches of bare peat and mud, and a mixture of typical moist tundra plants and more halophytic species, such as *Stellaria humifusa*, *Carex ursina*, and *Salix ovalifolia*. Bullen Point site encompasses a portion of a large saltwater lagoon and sand spit system. Surrounding the lagoon are patches of arctic saltmarsh dominated by *Carex subspathacea* and *Puccinellia phryganodes*. The protected lagoon/saltmarsh area is favored by waterfowl, and is especially good brood rearing habitat in the post-nesting season (Schick *et al*. 2004).

Schick *et al*. (2004) identified 21 distinct wildlife habitat types. Four habitats combined cover >75% of the site: Lowland Moist Sedge-Shrub Tundra (47.2%), Coastal Brackish Water (11.6%), Lowland Wet Sedge Tundra (11.6%), and Lowland Wet Sedge-Willow Tundra (5.9%). Other regularly occurring habitats include Lowland Wet Sedge-Willow Tundra (4.4%), and marine-influenced habitats, such as Coastal Salt-killed/Moist Tundra Complex (5.0%), Coastal Salt marsh (3.4%), Coastal Beach (2.4%), and Estuarine (1.3%). Artificial habitats associated with the facility, access roads, and the landing strip cover nearly 5% of the area.

Habitat ground-truthing surveys conducted in 2003 identified the same number of habitat types as in 2002. However, slight percentage changes were detected. Lowland Moist Sedge-Shrub Tundra covers nearly half of the site (47.3%). An additional 25% of the area is covered by 3 habitat types: Marine Nearshore Water (12.3%), Lowland Wet-Moist Patterned Tundra Complex (9.1%), and Young Basin Wetland Complex (5.6%). Twelve habitat types are limited in areal extent (<2%) (Schick *et al*. 2004).

5.3 Fish and Wildlife

5.3.1 Fish

The most common species of fish found in nearshore habitats of the western Beaufort Sea include Arctic char, Arctic cisco, and fourhorn sculpin (ICF Technology, Inc. 1996b). Other marine species inhabiting nearshore and offshore waters include boreal smelt, Pacific herring, and Arctic cod. Nine-spined stickleback are found in fresh and brackish water habitats along the arctic coast (Hart Crowser 1987). Good spawning habitats are present in streams near Bullen Point site (Arctic Slope Technical Services 1982). Arctic char is the most commonly targeted species for subsistence and recreational fishing. A commercial fishery for broad whitefish occurs annually on the Colville River.

5.3.2 Mammals

The most common small mammals on the Arctic Coastal Plain are brown and collared lemmings. Caribou occur at Bullen Point, with excellent summer range south of the site (ICF Technology, Inc. 1996b). Least weasel, short-tailed weasel, red fox, arctic fox, and arctic ground squirrel occur seasonally in the area (ADFG 1978). Grizzly bear, tundra vole, moose, wolverine, and gray wolf also occur in the Bullen Point area (ICF Technology, Inc. 1996b, 1996c).

Reports of marine mammals near Bullen Point site include beluga and bowhead whales, Pacific walrus, polar bear, ringed seal, and bearded seal (Arctic Slope Technical Services 1982). Six species of whales and five species of seals occur along the Arctic coast. The most common are beluga, bowhead, and gray whales and ringed and bearded seals.

5.3.3 Birds

Habitats of the Arctic Coastal Plain provide nesting and foraging opportunities for a wide variety of bird species. Many of these are shorebirds and waterfowl using migratory corridors that pass through the Bullen Point area. Use of the coastal plain is highly seasonal and associated with avian breeding and migration cycles. Molting, pre-migratory staging, and post breeding movements occur in association with shoreline habitats. These habitats are considered critical by the U.S. Fish and Wildlife Service (USFWS 1982a).

Migratory birds using the area include Brant, Snow Goose, Common Eider, King Eider, Spectacled Eider, White-winged Scoter, Surf Scoter, Common Scoter, Tundra Swan, Canada Goose, Oldsquaw, Red-breasted Merganser, Greater White-fronted Goose, Loons, Scaup, Northern Pintail, and various other ducks, shorebirds, and waterbirds. Several species of Sandpiper and Plover and the Red-necked Phalarope frequent ponds and small lakes in and around the site. Predatory birds that use the Bullen Point area include the Snowy Owl, Short-eared Owl, Pomarine Jaeger, Long-tailed Jaeger, and Parasitic Jaeger.

During a 1999 site visit, the following species displayed breeding behavior and/or nests were observed: Tundra Swan, Canada Goose, Common Eider, Old Squaw, Rough-legged Hawk, American Golden Plover, Semi-palmated Sandpiper, Baird's Sandpiper, Pectoral Sandpiper, Dunlin, Red-necked Phalarope, Red Phalarope, Lapland Longspur, and Snow Bunting.

5.4 Threatened and Endangered Species

Protected species known to occur within the vicinity of Bullen Point include the threatened Spectacled Eider and polar bear, the endangered bowhead whale, the candidate Yellow-billed Loon and Pacific walrus, and threatened ringed and bearded seals. Other protected species that may occur in the vicinity include the endangered fin humpback whale and the threatened Steller's Eider. Bowhead whales are known to pass the Bullen Point site about 20 miles offshore during their westward fall migration (ICF Technology, Inc. 1996b).

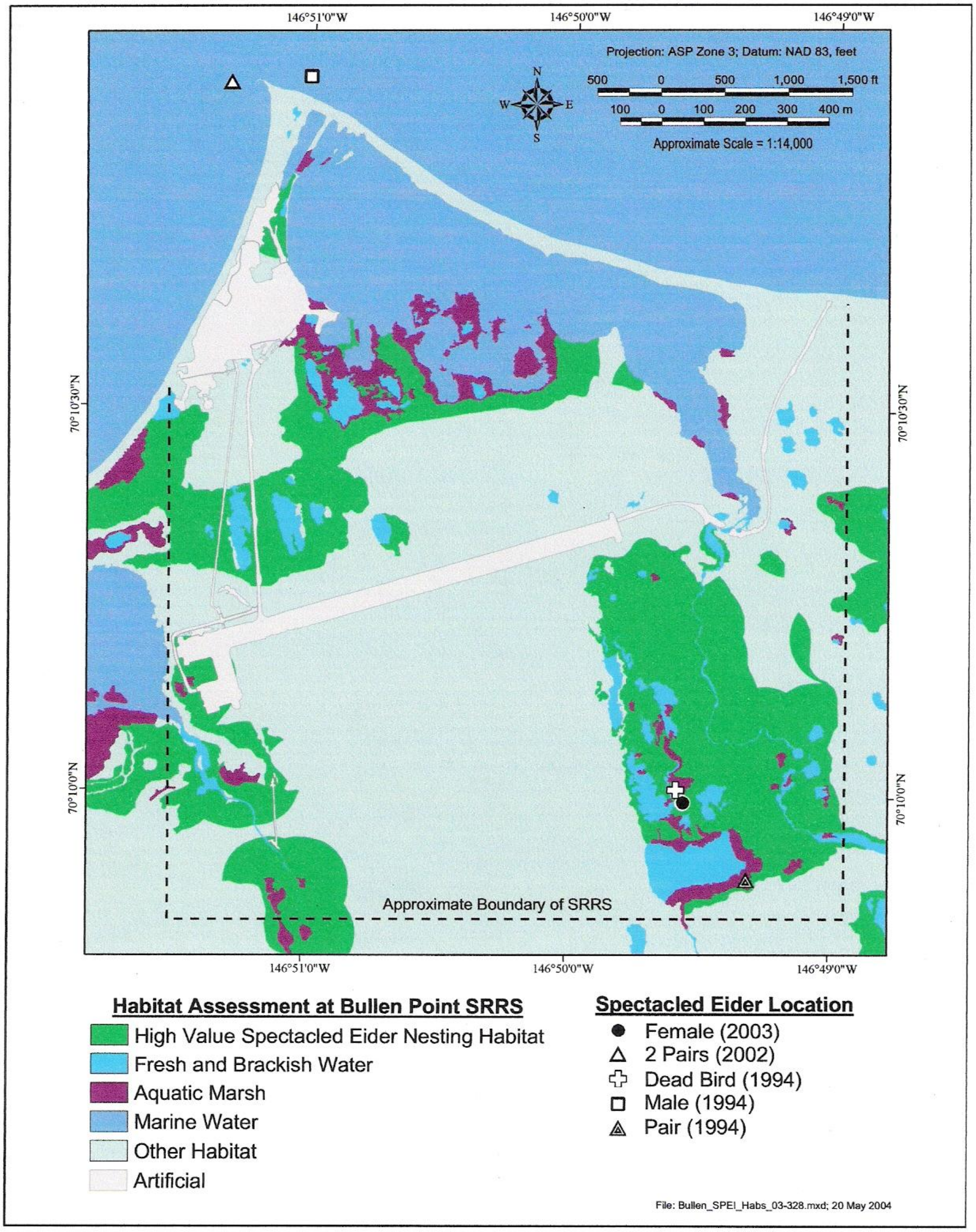
Day *et al*. (1995) surveyed for Spectacled Eider and Steller's Eider at remote USAF sites. During the 1994 study a pair of Spectacled Eiders were observed sitting on the edge of a lake, and a male Spectacled Eider was observed flying along the shoreline. A dead female-plumaged Spectacled Eider was documented on Bullen Point and appeared to have been killed by a raptor. Bullen Point is one of five remote USAF sites with the greatest potential for having nesting Spectacled Eiders and one of four sites with the greatest potential for nesting or brood-rearing based on habitat suitability (Day *et al*. 1995). During 2002 two pairs of Spectacled Eiders were observed near the site, and during a 2003 ground-based survey of the SRRS, no nests were observed, but one Spectacled Eider female was observed at the site (Schick *et al*. 2004). No Spectacled Eider nests have been recorded during any of the five survey years at former Bullen Point SRRS in 1994, 2000, 2002, 2003, 2006 (Day *et al*. 1995, Day and Rose 2000, Ritchie *et al*. 2003, Schick *et al*. 2004, Frost *et al*. 2007). However, Oasis Environmental, Inc. (2008) found a failed Spectacled Eider nest at Bullen Point former SRRS in 2007, as well as observed a Spectacled Eider hen at Bullen Point site.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Bullen Point site, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller's Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004).

5.5 Wetlands

Bullen Point site includes a number of wetland types, including Marine Nearshore Water (Estuarine) (91.0 acres, 8.3 %), Coastal Salt Marsh (22.9 acres, 2.1 %), Shallow Water (8.3 acres, 1.0%), Lowland

Figure 5.4 Spectacled Eider Habitat Assessment at Bullen Point Site



Aquatic Grass Marsh (6.6 acres, 0.6%), and Young Basin Wetland Complex (46.0 acres, 4.2%) (Wells *et al*. 2010, Table 5.2, above). Figure 5.5 shows NWI wetlands (656.59 acres) on Bullen Point site from 2011 data.

5.6 Other Natural Resource Information

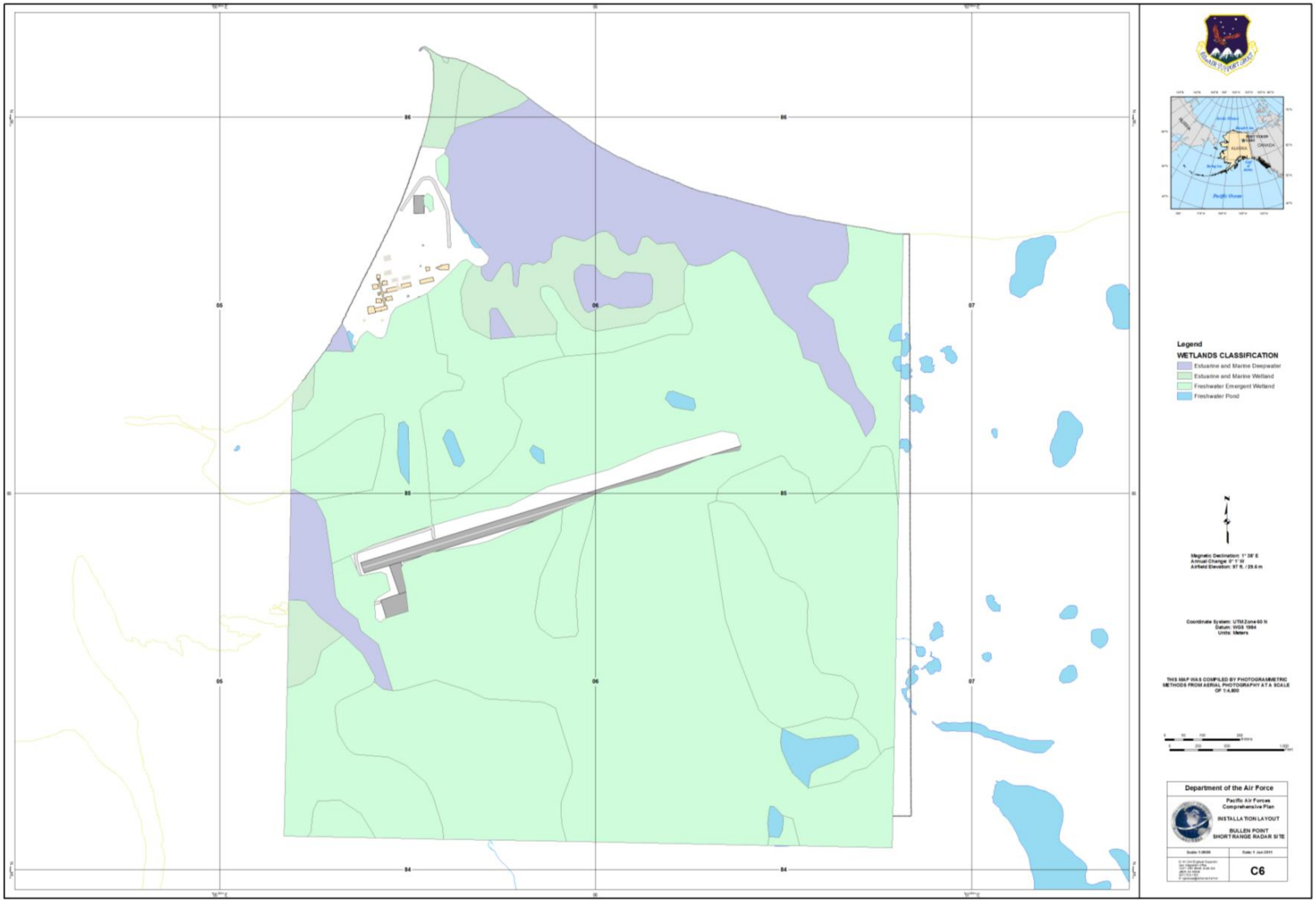
5.6.1 Subsistence

Kaktovik is located about 75 miles east of Bullen Point site. Nuiqsut is located about 95 miles west of Bullen Point site. A discussion of subsistence use by the community of Nuiqsut is under Oliktok LRRS (Appendix 3.0-Oliktok, Section 5.6.1). A discussion of subsistence use by the community of Kaktovik is under Barter Island LRRS (Appendix 3.0-Barter, Section 5.6.1).

5.6.2 Outdoor Recreation

Outdoor recreational activities are limited due to the isolation, location, and extreme climatic conditions of Bullen Point. Access to the site is limited with aircraft providing the only year-round access. Sportsmen occasionally visit Bullen Point from the Prudhoe Bay area for Arctic char fishing in Mikkelsen Bay. Other recreation activities include camping, hiking, and wildlife viewing.

Figure 5.5 Bullen Point Site Wetlands, 2011



APPENDIX A: Natural Resources of Bullen Point and Wainwright Sites

Table A1: Vascular Plant Species Observed or Potentially Occurring On or near Bullen Point and Wainwright Sites

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Shrubs				
Alpine bearberry	*Arctostaphylos alpina*	X	X	
Red-fruit bearberry	*Arctostaphylos rubra*	X	X	
Dwarf Arctic birch	*Betula nana*			W
Lapland cassiope	*Cassiope tetragona*	X	X	W, BP
Bunchberry	*Cornus canadensis*			
Diapensia	*Diapensia lapponica*	X		
White mountain avens	*Dryas octopetala*	X		
Crowberry	*Empetrum nigrum*	X	X	W
Narrowleaf Labrador tea	*Ledum palustre* ssp. *decumbens*	X	X	W
Lapland rosebay	*Rhodedendron lapponicum*	X		
Cloudberry	*Rubus chamaemorus*	X	X	W
Feltleaf willow	*Salix alaxensis*	X	X	
Arctic willow	*Salix arctica*	X	X	W, BP
Barren-ground willow	*Salix brachycarpa*	X	X	
Alaska bog willow	*Salix fuscescens*	X	X	
Grayleaf (northern) willow	*Salix glauca*	X	X	
Richardson willow	*Salix lanata* ssp. *richardsonii*	X	X	W, BP
Oval-leafed willow	*Salix ovalifolia*	X	X	BP
Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X	X	
Diamond-leaf willow	*Salix planifolia ssp. pulchra*	X	X	W, BP
Polar willow	*Salix polaris*	X	X	W
Netleaf (net-veined) willow	*Salix reticulata*	X	X	BP
Least (round-leaf) willow	*Salix rotundifolia*	X	X	BP
Bog blueberry	*Vaccinium uliginosum*	X	X	
Low-bush cranberry	*Vaccinium vitis-idaea*	X	X	W

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Herbaceous Plants				
Alpine foxtail	*Alopecurus alpinus*	X	X	BP
Rock jasmine	*Androsace chamaejasme*	X	X	
Northern jasmine	*Androsace septentrionalis*	X	X	
Pasque flower	*Anemone drummondii*	X	X	
Narcissus-flower anemone	*Anemone narcissiflora*	X		
Northern anemone	*Anemone parviflora*	X	X	
Yellow anemone	*Anemone richardsonii*	X	X	
Pussytoes	*Antennaria friesiana*	X	X	
Cats paws	*Antennaria monocephala*	X	X	
Polar grass	*Arctagrostis latifolia*		X	BP
Pendent grass	*Arctophila fulva*	X	X	W, BP
Tall sandwort	*Arenaria capillaris*	X		
Alpine arnica	*Arnica alpina*		X	
Frigid arnica	*Arnica frigida*	X	X	
Lessing’s arnica	*Arnica lessingii*	X		
Arctic wormwood	*Artemisia arctica*	X	X	W
Northern wormwood	*Artemisia borealis*	X	X	
Purple wormwood	*Artemisia globularia*	X		W, BP
Common wormwood	*Artemisia tilesii*			W
Siberian aster	*Aster sibiricus*	X	X	
Alpine milkvetch	*Astragalus alpinus*	X	X	
Hairy Arctic milkvetch	*Astragalus umbellatus*	X	X	BP
Mountain meadow bistort	*Bistorta plumosa*		X	
Alpine bistort	*Bistorta vivipara*		X	
Moonwort	*Botrychium lunaria*	X		
Purplish braya	*Braya purpurascens*		X	
Bluejoint grass	*Calamagrostis canadensis*	X		
Reed bent grass	*Calamagrostis* sp.			
Marsh marigold	*Caltha palustris*	X	X	

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Bluebell	*Campanula lasiocarpa*	X	X	
Bittercress	*Cardamine digitata*	X	X	
Cuckoo flower	*Cardamine pratensis*	X	X	
Sedge	*Carex aquatilis*	X	X	W, BP
Sedge	*Carex bigelowii*		X	W, BP
Sedge	*Carex capitata*		X	W, BP
Sedge	*Carex* sp.	X	X	
Sedge	*Carex subspathacea*		X	BP
Sedge	*Carex ursina*		X	BP
Elegant paintbrush	*Castilleja elegans*	X		
Paintbrush	*Castilleja sp.*	X		
Chickweed	*Cerastium beeringianum*	X	X	W, BP
Mouse-ear chickweed	*Cerastium jenisejense*		X	
Cushion hawk's beard	*Cerpis nana*	X	X	
Arctic daisy	*Chrysanthemum arcticum*	X	X	
Entire-leaved chrysanthemum	*Chrysanthemum integrifolium*	X	X	
Bering Sea water carpet	*Chrysanthemum wrightii*		X	
Northern water carpet	*Chrysosplenium tetrandrum*		X	W
Mackenzie water hemlock	*Cicuta mackenzienana*		X	
Alaska spring beauty	*Claytonia sarmentosa*	X		
Scurvy grass	*Cochlearia officinalis*		X	W
Coral root	*Corallorrhiza trifida*		X	
Tansy mustard	*Descurainia sophioides*			W
Frigid shooting star	*Dodecatheon frigidum*	X	X	
Ochotsk douglasia	*Douglasia ochotensis*	X	X	
Draba	*Draba alpina*		X	BP
Draba	*Draba pseudopilosa*	X	X	BP
Draba	*Draba lactea*		X	W
Draba	*Draba nivalis*			W
Arctic (mountain) avens	*Dryas integrifolia*	X	X	BP

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Tundra grass	*Dupontia fisheri*		X	BP
Tundra grass	*Dupontia fisheri* ssp. *psilosantha*		X	
Lyme grass	*Elymus arenarius* ssp. *mollis*		X	
River beauty (dwarf fireweed)	*Epilobium latifolium*	X	X	W, BP
Common horsetail	*Equisetum arvense*		X	W, BP
Variegated horsetail	*Equisetum variegatum*		X	
Dwarf fleabane	*Erigeron eriocephalus*		X	
Fleabane	*Erigeron humilis*	X	X	
Arctic fleabane	*Erigeron hyperboreus*	X	X	
Narrow-leafed cotton grass	*Eriophorum angustifolium*		X	W, BP
Russet cotton grass	*Eriophorum russeolum*		X	
Arctic cotton grass	*Eriophorum scheuchzeri*	X	X	
Cotton grass	*Eriophorum triste*		X	
Sheated cotton grass	*Eriophorum vaginatum*		X	W, BP
Arctic forget-me-not	*Eritichum aretioides*	X	X	
Edward’s eutrema	*Eutrema edwardsii*		X	BP
Alpine fescue	*Festuca brachyphylla*	X	X	W, BP
Red fescue	*Festuca rubra*		X	
Glaucous gentian	*Gentiana glauca*	X		W
Glacier avens	*Geum glaciale*	X	X	
Alpine eskimo potato	*Hedysarum hedysaroides*	X		
Alpine holy grass	*Hierochloe alpina*		X	W, BP
Arctic holy grass	*Hierochloe pauciflora*		X	
Mare’s tail	*Hippuris tetraphylla*		X	
Seabeach snadwort	*Honckenya peploides*		X	W, BP
Rush	*Juncus biglumis*		X	
Glaucous weaselsnout (lagotis)	*Lagotis glauca*	X	X	W, BP
Bladder pod	*Lesquerella arctica*	X	X	
Alp lily	*Lloydia serotina*	X	X	

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Alpine azalea	*Loiseleuria procumbens*	X		
Arctic lupine	*Lupinus arctica*	X	X	W, BP
Arctic woodrush	*Luzuca arcuata*		X	
Northern woodrush	*Luzula confusa*		X	W
Many-flowered woodrush	*Luzula multiflora*		X	
Fir club moss	*Lycopodium selago*			W
Bladder campion	*Melandrium apetalum*	X	X	BP
Oysterleaf	*Mertensia maritima*		X	BP
Arctic sandwort	*Minuartia arctica*	X	X	
Alpine forget-me-not	*Myosotis alpestris*	X		
Mountain sorrel	*Oxyria digyna*		X	BP
Blackish oxytrope	*Oxytropis nigrescens*	X	X	W
Lapland poppy	*Papaver lapponicum*	X	X	W
Macoun's poppy	*Papaver macounii*		X	
Northern Grass of Parnassus	*Parnassia palustris*	X	X	
Grass of Parnassus	*Parnassia* sp.			BP
Lousewort	*Pedicularis albolabiata*		X	
Capitate lousewort	*Pedicularis capitata*	X	X	
Wooly lousewort	*Pedicularis kanei*		X	W, BP
Oeder's lousewort	*Pedicularis oederi*	X		
Lousewort	*Pedicularis sudetica*	X	X	W, BP
Whorled leaf lousewort	*Pedicularis verticillata*	X	X	
Frigid coltsfoot	*Petasites frigidus*		X	W
Snowgrass	*Phippsia algida*		X	BP
Siberian phlox	*Phlox sibirica*	X		
Common bluegrass	*Poa alpigena*		X	
Alpine bluegrass	*Poa alpina*	X		
Arctic bluegrass	*Poa arctica*			W, BP
Blue grass	*Poa glauca*	X	X	
Blue grass	*Poa* sp.	X	X	

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	
Boreal Jacob's ladder	*Polemonium boreale*		X	
Bistort	*Polygonum bistorta*	X	X	
Alpine meadow bistort	*Polygonum viviparum*	X	X	BP
Two-flowered cinquefoil	*Potentilla biflora*	X		
Arctic cinquefoil	*Potentilla hyparctica*		X	BP
Marsh fivefinger	*Potentilla palustris*		X	
Bright cinquefoil	*Potentilla pulchella*		X	
One-flowered cinquefoil	*Potentilla uniflora*	X	X	W
Northern primrose	*Primula borealis*	X	X	W, BP
Large-flowered wintergreen	*Pyrola grandiflora*	X	X	
Alkali grass	*Puccinellia andersonii*			BP
Dwarf alkali grass	*Puccinellia langeana*		X	
Creeping alkali grass	*Puccinellia phryganodes*		X	W, BP
Alkali grass	*Puccinellia* sp.			W
Gmelin's buttercup	*Ranunculus gmelinii*		X	
Arctic buttercup	*Ranunculus hyperboreus*		X	
Buttercup	*Ranunculus pedatifidus*			BP
Snow buttercup	*Ranunculus nivalis*		X	W, BP
Pallas's buttercup	*Ranunculus pallasii*		X	
Pygmy buttercup	*Ranunculus pygmaeus*		X	W
Buttercup	*Ranunculus* sp.	X	X	
Roceroot	*Rhodiola integrifolia*		X	
Arctic dock	*Rumex arcticus*	X	X	
Dock	*Rumex graminifolius*	X		
Snow pearlwort	*Sagina intermedia*		X	W
Narrow-leafed saussurea	*Saussurea angustifolia*	X	X	BP
Spotted saxifrage	*Saxifraga bronchialis*	X	X	
Tufted saxifrage	*Saxifraga caespitosa*		X	W, BP
Bulblet saxifrage	*Saxifraga cernua*	X	X	W

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Spiderplant	*Saxifraga flagellaris*	X	X	
Foliolose saxifrage	*Saxifraga foliolosa*		X	
Hawkweed-leafed saxifrage	*Saxifraga hieracifolia*	X	X	W, BP
Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	BP
Cordate-leaved saxifage	*Saxifraga punctata*	X	X	W
Purple mountain saxifrage	*Saxifraga oppositifolia*	X	X	BP
Alpine brook saxifrage	*Saxifrage rivularis*		X	
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*	X		
Roseroot	*Sedum rosea*		X	
Arctic senecio	*Senecio atropurpureus* ssp. *frigidus*		X	BP
Marsh fleawort (mastodon flower)	*Senecio congestus*	X	X	
Black-tipped groundsel	*Senecio lugens*	X	X	
Seabeach scenecio	*Senecio pseudo-arnica*	X		
Alaska-Yukon senecio	*Senecio yukonensis*		X	
Moss campion	*Silene acaulis*	X	X	W, BP
Smelowskia	*Smelowskia calycina*	X		
Goldenrod	*Solidago multiradiata*	X	X	
Fleshy stitchwort	*Stellaria crassifloria*		X	
Low chickweed	*Stellaria humifusa*		X	W, BP
Long-stalked stitchwort	*Stellaria laeta*		X	
Lyrate dandelion	*Taraxacum alaskanum*		X	
Dandelion	*Taraxacum* sp.	X	X	
Wild chamomile	*Tripleurospermum phaecoephalum*		X	
Spiked trisetum	*Trisetum spicatum*		X	BP
Common butterwort	*Utricularia vulgaris*		X	
Capitate valerian	*Valeriana capitata*	X	X	
Mountain heliotrope	*Valeriana sitchensis*		X	

Observation Codes:
W - Wainwright
BP - Bullen Point

Sources:
Elias *et al*. 1996
Hulten 1968
Pratt 1991
Viereck and Little 1972
White 1974
Woodward-Clyde 1995c

Notes:
Species listed alphabetically by scientific name.
Observed species identified during June-July 1999 site visits by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates).

Table A2: Mammal Species potentially Occurring on or near Bullen Point and Wainwright Sites

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Terrestrial				
Brown/Grizzly bear	*Ursus arctos*	X	X	BP
Arctic fox	*Alopex lagopus*	X	X	W, BP
Red fox	*Vulpes vulpes*	X	X	W*, BP*
Wolf	*Canis lupus*	X	X	
Least weasel	*Mustela rixosa*	X	X	
Short-tailed weasel (ermine)	*Mustela erminea*	X	X	
Wolverine	*Gulo gulo*	X	X	
Hoary marmot	*Marmora caligata*	X		
Arctic ground squirrel	*Spermophilus paryi*	X	X	W, BP
Brown lemming	*Lemmus trimucronatus*	X	X	W, BP
Collared lemming	*Dicrostonyx groenlandicus*	X	X	W, BP
Masked shrew	*Sorex cinereus*	X	X	
Red-backed vole	*Clethrionomys rutilus*			
Tundra vole	*Microtus oeconomus*	X	X	W, BP
Moose	*Alces alces*	X	X	
Musk ox	*Ovibos moschaturs*		X	BP
Caribou	*Rangifer taranus*	X	X	W , BP
Marine				
Bowhead whale	*Balaena mysticetus*	X	X	W
Beluga whale	*Delphinapterus leucas*	X	X	
Fin whale	*Balaenoptera physalus*	X		
Humpback whale	*Megaptera novaeangliae*	X		
Minke whale	*Balaenoptera acutorostrata*	X		
Sei whale	*Balaenoptera borealis*	X		
Harbor porpoise	*Phocoena phocoena*	X	X	
Narwhal	*Monodon monoceros*		X	
Ringed seal	*Phoca hispida*	X	X	W

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Bearded seal	*Erignathus barbatus*	X	X	W
Spotted seal	*Phoca larga*	X	X	
Walrus	*Odobenus rosmarus*	X	X	W, WP
Polar bear	*Ursus maritimus*	X	X	W, BP

Observation Codes:
W - Wainwright
BP - Bullen Point
* - Tracks, den site, bones, skull observed.
Species observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during June-July 1999 site visits.

Sources:
Bridges 2001
Day *et al*. 1995
Frost *et al*. 2007 (includes observations from 1994, 2000, 2002-2003 and 2006 surveys; and reported in Hall 1972, Suydam (in litt.), and Gibson (pers. comm.)).
Hart Crowser 1987
ICF Technology, Inc. 1996 f and 1996g
Jones Technology, Inc., and Gene Stout and Associates 1999c
Ohms 2008
U.S. Dept. Interior 1987b
Woodward-Clyde 1995c
Wynne 1993

Table A3: Bird Species Potentially Occurring on or near Bullen Point and Wainwright Short Range Radar Sites

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Red-throated Loon	*Gavia stellata*	X	X	W, BP
Pacific Loon	*Gavia pacifica*	X	X	W*, BP
Yellow-billed Loon	*Gavia adamsii*	X	X	W, BP
Red-necked Grebe	*Podiceps grisegena*		X	
Tundra Swan	*Cygnus columbianus*	X	X	W, BP*
Greater White-fronted Goose	*Anser albifrons*	X	X	W, BP
Snow Goose	*Chen caerulescens*	X	X	
Brant	*Branta bernicla*	X	X	W, BP
Canada Goose	*Branta canadensis*		X	BP*
Green-winged Teal	*Anas crecca*	X	X	W
Mallard	*Anas platyrhynchos*		X	
Northern Pintail	*Anas acuta*	X	X	W, BP
Northern Shoveler	*Anas clypeata*		X	BP
American Wigeon	*Anas americana*		X	BP
Greater Scaup	*Aythya marila*	X	X	
Common Eider	*Somateria mollissima*	X	X	BP*
King Eider	*Somateria spectabilis*	X	X	BP
Spectacled Eider	*Somateria fischeri*	X	X	W, BP
Steller's Eider	*Polysticta stelleri*	X	X	
Long-tailed Duck	*Clangula hyemalis*	X	X	W, BP*
Surf Scoter	*Melanitta perspicillata*	X	X	BP
White-winged Scoter	*Melanitta fusca*		X	
Red-breasted Merganser	*Mergus serrator*		X	BP
Bald Eagle	*Haliaeetus leucocephalus*		X	
Northern Harrier	*Circus cyaneus*		X	
Rough-legged Hawk	*Buteo lagopus*	X	X	BP*
Golden Eagle	*Aquila chrysaetos*		X	
Peregrine Falcon	*Falco peregrinus*	X	X	W, BP
Gyrfalcon	*Falco rusticolus*	X	X	

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Willow Ptarmigan	*Lagopus lagopus*	X	X	W
Rock Ptarmigan	*Lagopus mutus*		X	BP
Sandhill Crane	*Grus canadensis*	X	X	BP
Black-bellied Plover	*Pluvialis squatarola*	X	X	W*
American Golden Plover	*Pluvialis dominica*	X	X	W*, BP*
Semipalmated Plover	*Charadrius semipalmatus*	X	X	W, BP
Eurasian Dotterel	*Charadrius morinellus*		X	
Lesser Yellowlegs	*Tringa flavipes*		X	
Whimbrel	*Numenius phaeopus*		X	
Bristle-thighed Curlew	*Numenius tahitiensis*		X	
Sanderling	*Calidris alba*	X	X	
Ruddy Turnstone	*Arenaria interpres*	X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	W*, BP*
Western Sandpiper	*Calidris mauri*	X		W*
Least Sandpiper	*Calidris minutilla*	X	X	
White-rumped Sandpiper	*Calidris fisciollis*	X	X	
Baird's Sandpiper	*Calidris bairdii*	X		BP*
Pectoral Sandpiper	*Calidris melanotos*	X	X	W*, BP*
Sharp-tailed Sandpiper	*Calidris acuminata*	X		
Dunlin	*Calidris alpina*	X	X	W*, BP*
Stilt Sandpiper	*Calidris himantopus*		X	BP
Buff-breasted Sandpiper	*Tryngites subruficollis*	X	X	BP
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	W*, BP
Wilson's Snipe	*Gallinago delicata*	X		W
Common Snipe	*Gallinago gallinago*	X	X	W
Red-necked Phalarope	*Phalaropus lobatus*	X	X	W*, BP*
Red Phalarope	*Phalaropus fulicaria*	X	X	W*, BP*
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	W, BP
Parasitic Jaeger	*Stercorarius parasisticus*	X	X	W, BP
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	W, BP

Common Name	Scientific Name	Wainwright (W)	Bullen Point (BP)	Observed
Herring Gull	*Larus argentatus*		X	
Glaucous-winged Gull	*Larus glaucescens*	X	X	
Glaucous Gull	*Larus hyperboreus*	X	X	W, BP
Black-legged Kittiwake	*Rissa tridactyla*	X		
Sabine's Gull	*Xema sabini*	X	X	
Arctic Tern	*Sterna paradisaea*	X	X	BP
Aleutian Tern	*Sterna aleutica*	X		
Least Auklet	*Aethia pusilla*	X		
Kittlitz's Murrelet	*Brachyramphus brevirostris*	X		
Short-eared Owl	*Asio flammeus*		X	W
Horned Lark	*Eremophila alpestris*		X	
Barn Swallow	*Hirundo rustica*	X		
Gray Jay	*Perisoreus canadensis*		X	
Common Raven	*Corvus corax*	X	X	W, BP
Yellow Wagtail	*Motacella flava*	X	X	
White Wagtail	*Motacella alba*	X		
Red-throated Pipit	*Anthus cervinus*	X	X	
American Pipit	*Anthus rubescens*		X	
American Tree Sparrow	*Spizella arborea*			W
Savannah Sparrow	*Passerculus sandwichensis*	X	X	W*, BP
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	W
Lapland Longspur	*Calcarius lapponicus*	X	X	W*, BP*
Snow Bunting	*Plectrophenax nivalis*	X	X	W*, BP*
Common Redpoll	*Carduelis flammea*	X	X	W, BP
Hoary Redpoll	*Carduelis hornemanni*	X		W

Observation Codes:
W - Wainwright
BP - Bullen Point
* - Breeding behavior and/or nests observed.

Sources:

Armstrong 1998

Day *et al*. 1995

Frost *et al*. 2007 (includes observations from 1994, 2000, 2002-2003 and 2006 surveys; and reported in Hall 1972, Suydam (in litt.), and Gibson (pers. comm.)).
Garner and Reynolds 1987

Notes:
Species listed by phylogenic order. Breeding behavior observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during June-July 1999 site visits, observations reported by Frost *et al*. (2007), and observed by Oasis Environmental, Inc. (2008).

Gusey 1988 .
Hall 1972
King 1977
Murray 1978
Oasis Environmental, Inc. 2008
Norton *et al*. 1993
Pitelka 1974
Robbins *et al*. 1983
Spindler 1978, 1979
Woodward-Clyde 1995c

Appendix 3.0 – Campion. Campion Air Force Station

3.0 Installation Overview

3.1 Location and Area

Campion Air Force Station (inactive site) is in west central Alaska about six miles east of the City of Galena, Alaska and the former Galena Airport USAF installation (which is no longer USAF property). Galena is about 270 miles west of Fairbanks and 325 miles north of Anchorage, Alaska (INRMP Figure 3.1). The site occupies 2,326 acres on a high terrace above the Yukon River (Figure 3.1).

3.2 Installation History

The site was first called Galena II; it was changed to Campion AFS in 1954 (Cloe 2008). The Campion site was one of 10 original AC&W sites developed as part of the air defense system constructed in Alaska during the early 1950s. In 1958 a WACS became operational on the site. The installation included a composite building, WACS antennas, POL storage and distribution facilities, and an equipment maintenance building. The WACS site was active until 1977 when it was replaced with a commercial satellite earth terminal. In 1984 a MAR unit was installed at the Galena Airport USAF Installation, and the Campion site was deactivated. In 1986 all facilities at Campion were demolished, and building materials were removed and buried. A final study of petroleum contaminated soil is planned for 2008/09 and based on those results a cleanup plan will be developed.

3.3 Surrounding Communities

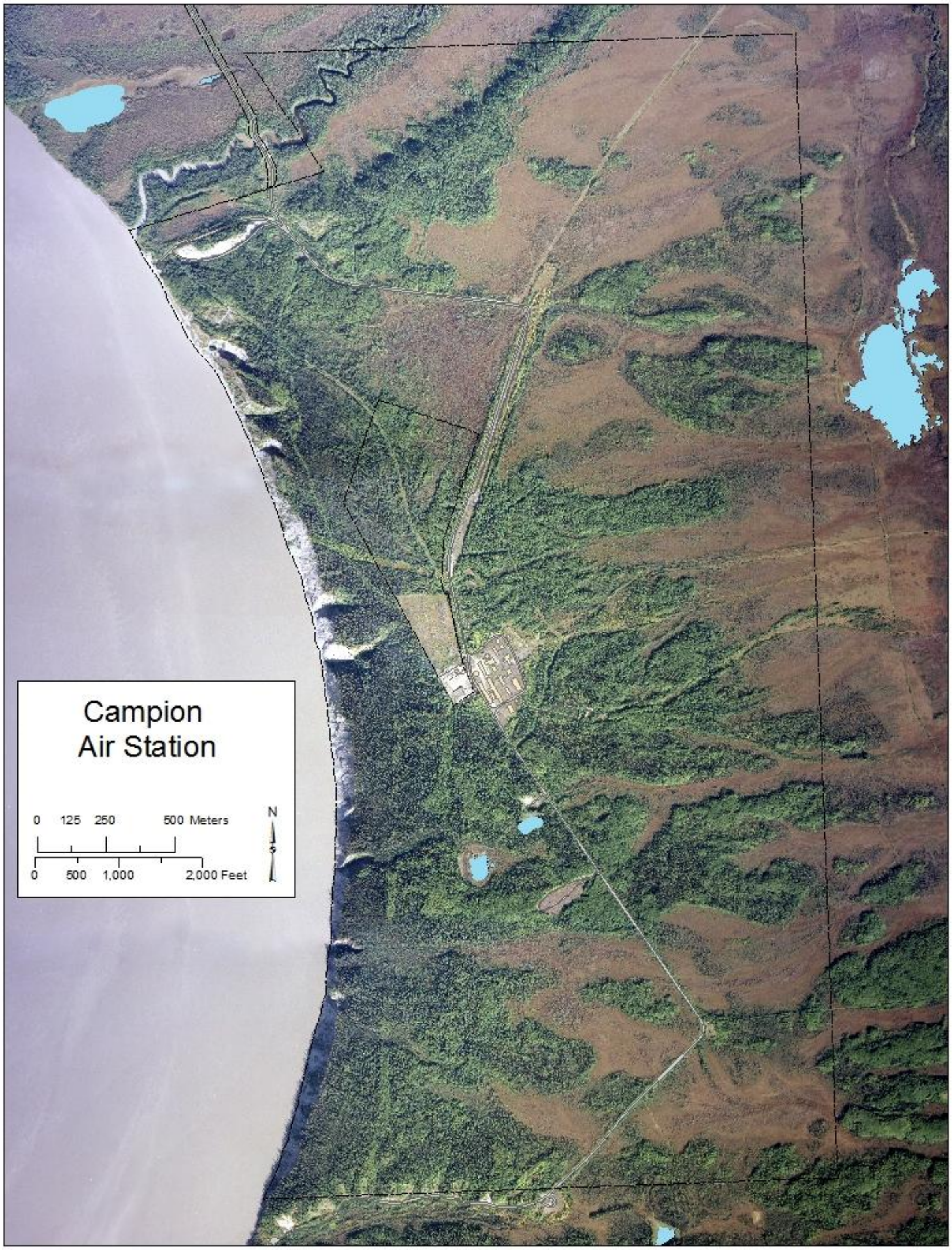
Galena is the nearest community to the Campion site. The site is accessible by road from Galena. Galena is located near an old fish camp site called Henry's Point and was established in 1918 as a supply and trans-shipment point for Galena area lead ore mines. Beginning in 1920 Koyukuk Athapaskans, who had traditionally lived at Louden, 14 miles upriver, began moving to Galena (EA Engineering Science and Technology 1993). A school was established at Galena in the mid-1920s, and a post office opened in 1932.

Galena remained small until World War II when construction began on an air base, which became operational in 1942. In 1945 the community suffered a major flood, and rapid community growth did not begin until the establishment of military facilities at Galena AFB in the 1950s. Airport and road developments were completed in 1950, and a health clinic has operated since 1965.

The original town site of Galena is outside of the dike and is susceptible to flooding each spring during breakup. A flood in 1971 destroyed much of the original town site, resulting in the relocation of many residents and facilities to New Galena, 2.5 miles east of town (HQ AAC/DEPV 1988).

New Galena includes mostly residential and service land uses, including a privately-owned store. The school, which includes elementary through high school facilities, is located in New Galena. A restaurant, bar, gas station, liquor store, and Galena Commercial Company store are found in Old Galena. The population of Galena is 470 (2010). Subsistence food sources include salmon, whitefish, moose, and berries. In 2010, 12 residents held commercial fishing permits (www.dced.state.ak.us 2012).

Figure 3.1 Campion Air Force Station



3.4 Regional Land Use

Galena is a trade and transportation center for the middle Yukon River area. Federal, state, city, school, and village government employment dominates, but Galena has other jobs in air transportation and retail businesses. In 2010, 12 residents held commercial fishing permits. Seasonal work, such as construction and BLM fire fighting, provides some income. The Illinois Creek gold mine, 50 miles southwest of Galena, has closed due to low market prices (www.dced.state.ak.us 2012).

Galena is also the transportation hub for surrounding communities, including Ruby and Koyukuk, which are 50 miles east and 30 miles west of Galena, respectively, and Hughes, Nulato, and Huslia, which are located further from Galena. There are no roads connecting Galena with these communities; and outlying travel is by air, boat (summer), or snow machine (winter).

3.5 Local and Regional Natural Areas

The Koyukuk NWR and the Innoko NWR are near the Campion site. Koyukuk NWR encompasses 3.5 million acres and lies within the floodplain of the Koyukuk River, in a basin that extends from the Yukon River to the Purcell Mountains and the foothills of the Brooks Range As many as 100,000 ducks are hatched and raised on Koyukuk NWR lands during a single nesting season. Waterfowl, migratory songbirds, and raptors depend on the rich resources of the refuge for breeding and raising young. Koyukuk Refuge’s Three-Day Slough area, part of the 400,000 acre Koyukuk Wilderness, has some of the most productive moose habitat in Alaska. This region has, at times, supported more than 10 moose per square mile. Some areas still contain densities of five moose or more per square mile. Caribou from the migratory Western Arctic Herd, which numbers more than 450,000, often move into the northernmost reaches of the refuge in winter months. The Koyukuk also supports a resident non-migratory caribou population, which numbers about 300 (USFWS 2007a).

Innoko NWR covers some 3,850,000 acres, with 1,240,000 acres designated as wilderness. The refuge is blessed with a wealth of avian life. It is estimated that 130 species of birds use these lands, and more than 300,000 waterfowl and shorebirds nest on the refuge every spring. The 750,000-acre Northern Innoko NWR, commonly known as Kaiyuh Flats, is managed as part of the Koyukuk/Nowitna Refuge Complex. Rich in wetlands, the Northern Innoko is an extremely productive breeding area for migratory waterfowl and fish. Streams and rivers of the refuge complex support three species of salmon, arctic grayling, sheefish, and many other fish species (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The Campion site has a cold, continental climate with large temperature differences between winter and summer. Mean annual temperatures are 20 to 30°F, and the warmest month averages 60°F (Universe Technologies, Inc. and Gene Stout and Associates 2001b).

The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10 to below 0 °F. Sustained temperatures of -40 °F are common during winter. Extreme temperatures have been measured from -64 to 92 °F. Annual precipitation averages 12.7 inches, with 60 inches of snowfall. The river is ice-free from mid-May through mid-October (www.dced.state.ak.us 2012).

Over half of rainfall occurs between July and September. Precipitation is comparatively low during winter. Thunderstorms and small hailstorms usually occur several days each year, primarily in June and July. However, due to cold temperatures, snow is persistent from October through April; by spring the accumulation may total several feet. Peak growing months in Galena are May through September, and the frost-free period is normally about 100 days.

Prevailing winds are from the north in winter and the southwest or east in summer. The average wind speed is 3.9 knots with calm winds about one-third of the time.

4.2 Landforms

The Campion site is within the Central Yukon Subregion of the Yukon physiographic region of Alaska. The site lies geographically within the drainage area of the Yukon River between the confluence of the Yukon and Tanana rivers and the confluence of the Koyukuk and Yukon rivers. About 20 percent of the area within the Yukon-Tanana river basins consists of swampy lowlands (Woodward-Clyde Consultants 1991c). Characteristic of the lowland are many large thaw lakes created by melting permafrost. Vegetation types are typical of the boreal forest or taiga of interior Alaska. White spruce occurs in large stands along rivers where soils are better drained. The incidence of fire in the Yukon-Koyukuk area is one of the highest in Alaska. Lowland areas burn about once every 108 years with a slightly longer fire cycle in upland areas. Fires have set vast areas back to earlier seral stages consisting of aspen, birch, and willow (Jones Technologies, Inc. and Gene Stout and Associates 1999d).

Elevations at the Campion site range from 100 to 350 feet above msl. The Cave Off Cliffs, along the Yukon River near the site, are 100-150 feet above msl. The area where the WACS once stood is set back from the cliffs at an elevation of 300 feet above msl (Woodward-Clyde Consultants 1991c).

4.3 Geology and Soils

The Campion site is located within the Yukon-Koyukuk Basin, an extensive structural trough, which extends from the Bering Sea to a point a few miles west of the Canadian border. Valleys of the Yukon-Koyukuk Basin occupy an extensive structural trough formed by subsidence during the Cenozoic period. The Yukon River system has developed in this area, depositing large quantities of sediments as it matures. The entire Yukon Region is characterized by meandering streams. The underlying alluvium includes lacustrine silt and silty sand of the late Tertiary period.

The geology of the site is dominated by Quaternary sediments deposited by the Yukon River to a depth greater than 400 feet below grade. The site is underlain by alluvial terrace deposits consisting of sand, silt, and clay.

Permafrost is discontinuous in the surrounding area. Permafrost has been encountered from immediately below the surface to about 380 feet below grade. Permafrost is thick and probably continuous at the site since the site is not affected by the Yukon River (Woodward-Clyde Consultants 1991c).

4.4 Hydrology

The dominant surface water feature in the region is the Yukon River, which drains about 204,000 square miles of Alaska. Freshwater streams in the Yukon Region are classified as high quality. Some streams in the Central Yukon Subregion, principally those that drain lowlands, may contain noticeable amounts of iron.

Nearly all streams and rivers in the vicinity of the site are characterized by low gradient, meandering courses, and spring flooding. The Campion site, situated on a high terrace, is not prone to flooding. Overland flow of surface water is directed radially from the site into unnamed drainages, Beaver Creek, or directly into the Yukon River. All drainages in the area eventually discharge into the Yukon River. Three unnamed streams lead to lakes and wetlands east of the site, and Beaver Creek drains wetlands east and north of the site. Unnamed tributaries of the Yukon River also start in steep drainages on cliffs on the western side of the Campion site.

Groundwater at the Campion site occurs below the permafrost zone in deep sand and gravel of unfrozen alluvium. Permafrost has been recorded as deep as 382 feet below grade. Two water supply wells that were drilled through permafrost into the river alluvium were used as the water supply for the site (Woodward-Clyde Consultants 1991c).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Campion Air Force Station (AFS). Much information included in INRMP Chapter 5.0 that includes Campion AFS is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Campion AFS site and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Campion AFS site. Threatened or Endangered Species that may occur at Campion AFS site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 130 Subarctic Division
Province: 131 Yukon Intermontane Plateaus Tayga Province
Description: The province is made up of a series of broad valleys, dissected uplands, and lowland basins covered with alluvial deposits. In this semiarid province winters are long and severe with temperatures dropping as low as -75°F ,and summers are short and hot with temperatures rising as high as 100°F. Dense white spruce-cottonwood-poplar forests are found on major river bottoms; evergreen and coniferous forests are on outer valley edges; and in upland areas are dense white spruce-birch-aspen-poplar forests. Near streams are pure stands of white spruce. The dominant soil is Inceptisols, which are found in the river bottoms, lower slopes, and uplands; bog soils are Histosols.

5.2 Vegetation

The vegetative cover of the Campion site can be broadly separated into taiga (birch and white spruce), birch stands, black spruce, muskeg, and open-grass and sedge bogs. Disturbed upland areas have a vegetative cover of grasses and willows. Vegetation at the site is characterized as bottom-land, spruce-poplar forest. Forests at the site are primarily white spruce locally mixed with balsam poplar. Generally, undergrowth consists of dense shrubs, including alder, rose, and dogwood species. The forest floor generally has ferns, fireweed, lichens, herbs, and mosses (CH2M Hill 1993a).

During a vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001b), it was observed that interior forest and bog vegetation were the dominant component of the site. Birch forests and birch/white spruce forests with a relatively dense understory of green alder and a moss-dominated forest floor were prevalent. Equally predominant were larch/black spruce bogs that were very open with scattered birch and diamond leaf willow shrubs and occasionally alder. Bog areas have thick moss hummocks with blueberry and Labrador tea, and cottongrass tussocks and dwarf Arctic birch.

Aspen stands were few and primarily located along the cliff area west of the site. Some riparian spruce dominated forest is present along Beaver Creek, north of the site. Previously cleared areas are revegetating to balsam poplar and feltleaf willow with lesser amounts of alder in well-drained areas. Previously cleared areas in bogs are revegetating to sedge-dominated meadow vegetation.

The 2000 site visit (Universe Technologies, Inc. and Gene Stout and Associates 2001b) identified 73 species of vegetation. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Campion site.

5.3 Fish and Wildlife

5.3.1 Fish

King, coho, and chum salmon annually migrate up the Yukon River to spawning and rearing grounds. Arctic grayling, northern pike, burbot, and several species of whitefish are found throughout the main drainage of the Yukon River and most of its tributaries. Other species occurring in the Yukon River system are longnosed sucker, lake chub, Alaska blackfish, slimy sculpin, and Arctic lamprey (ADFG 1990b).

5.3.2 Mammals

The area surrounding Campion site supports terrestrial wildlife species typical for interior Alaska. Caribou from the Western Arctic herd have been known to migrate through or close to the general area of the Campion site, which is far to the southeast of their pre-1985 range. Galena Mountain and Kokrines Hills also support resident herds of caribou. The marten is one of the most important furbearers to trappers in the Koyukuk area and is widely trapped by local residents. The Koyukuk and Innoko refuges support some of the densest beaver populations in the state (Jones Technologies, Inc., and Gene Stout and Associates 1999d).

5.3.3 Birds

Some of the more common waterfowl that nest or stop over in the area during their migratory flights include the American Widgeon, Mallard, Green-winged Teal, Loons, Horned and Red-necked Grebe, Northern Pintail, Surf and White-winged Scoter, and Canada and White-fronted Geese. Numerous waterfowl, on their way to and from nesting areas, stop to feed and rest on the Yukon River. Nearby Innoko and Koyukuk NWRs provide nesting habitat and migration resting areas for waterfowl and shorebirds. This area also provides habitat for a variety of shorebirds, such as the Common Snipe, Spotted Sandpiper, Solitary Sandpiper and Semi-palmated Plover and occasionally, Whimbrels, Godwits, and Lesser Yellowlegs can be sighted in the area.

Several raptors, notably Bald Eagles, Ospreys, Red-tailed Hawks, Great Grey Owls, Short-eared Owls, and Peregrine Falcons, are found in the area. Passerine species include the American Robin, Yellow Warbler, Yellow-rumped Warbler, Hermit Thrush, Cliff Swallow and White-crowned Sparrow. Aquatic birds include the Mew, Herring, and Glaucous Gull (Jones Technologies, Inc., and Gene Stout and Associates 1999d).

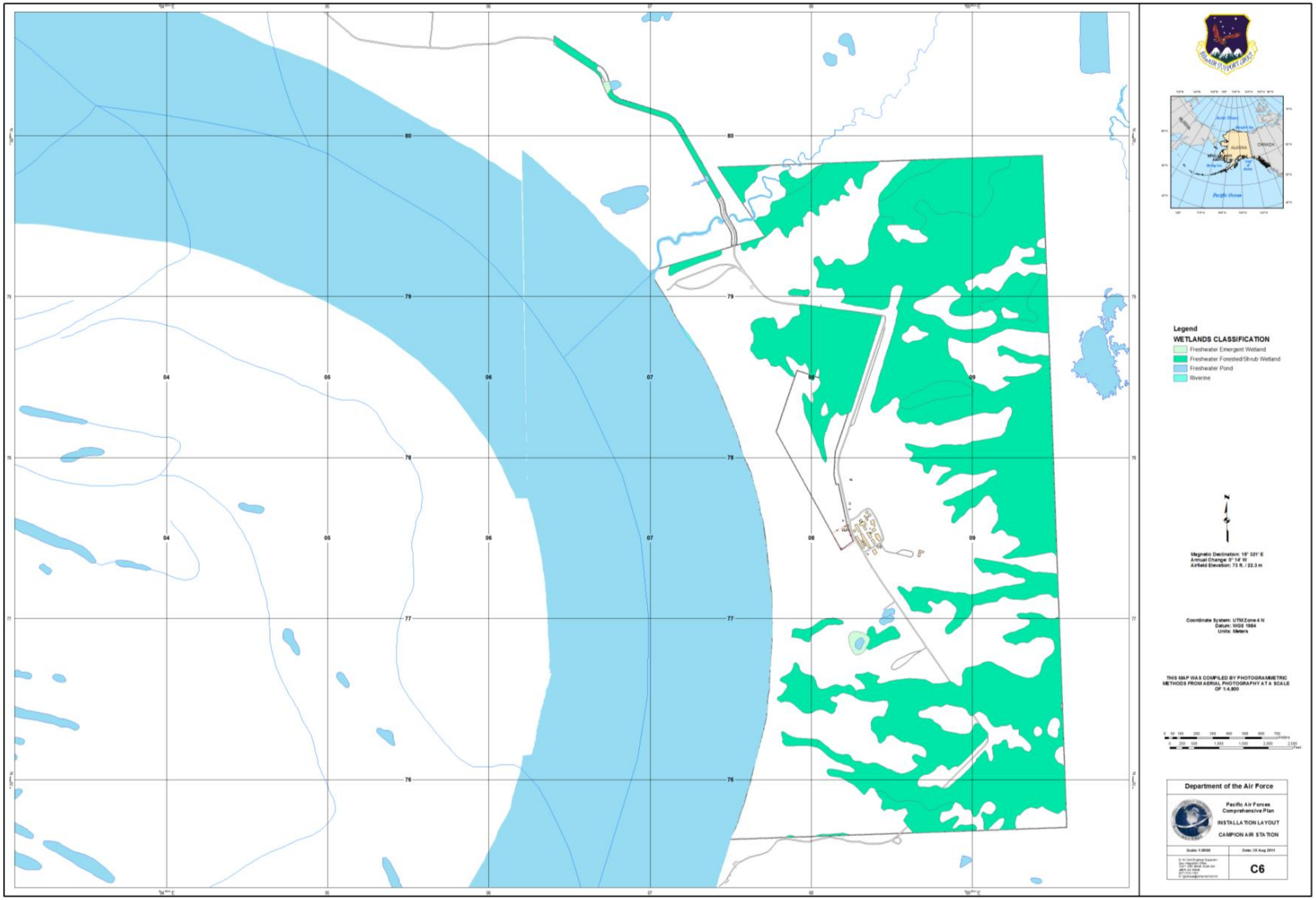
5.4 Threatened and Endangered Species

Several protected species potentially occur within the vicinity of the Campion site. The Steller’s Eider has been observed in the vicinity of the nearby former USAF Galena Airport installation (Jones Technologies, Inc., and Gene Stout and Associates 1999d), although this should be considered an exceptional sighting and not a regular potentially occurring species in this area. No known threatened or endangered species are known to occur on the Campion site.

5.5 Wetlands

A NWI map specific to the site completed during 2000-2005 provides wetlands information. Figure 5.5 shows NWI wetlands (909.32 acres) on Campion site from 2011 data.

Figure 5.5 Campion Site Wetlands, 2011



5.6 Other Natural Resource Information

5.6.1 Subsistence

The nearest community to the Campion site is Galena. The importance of subsistence to Galena residents is reflected in high participation rates of households that use (100%), harvest (93%), and share (95%) subsistence resources. Galena residents rely heavily on large mammals and fish. Specifically, chum salmon and moose account for about 78% of Galena's annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

The Koyukon Indians traditionally used seasonal camps to access resources. These camps are maintained and visited when time and money permit. Fish camps tend to be near Galena on the main channel of the Yukon River and on sloughs in the area. Hunting areas for moose and caribou extend downstream to Nulato and upstream almost 50 miles beyond Ruby, and in the Koyukuk River and its tributaries beyond Huslia. Some caribou are taken on the Selawik, Unalakleet and Tagagawik rivers, which are on the far sides of mountain ranges up to 110 miles away. Moose and waterfowl are taken to the northeast in an area bounded by the Koyukuk and Dalbi rivers (Braund and Associates 2004).

5.6.2 Outdoor Recreation

The Campion site and the surrounding area provide excellent fishing and hunting opportunities. The community of Galena serves as the gateway to fish and wildlife resources in surrounding areas. Outdoor recreation at the former USAF Galena Airport installation and at the Campion site was formerly organized for military personnel but now consists of unorganized activities (*e.g.*, hunting moose and bear; fishing for burbot, pike, whitefish, and salmon; and ATV riding). The road to Campion provides wildlife viewing opportunities and access to ATV trails to the old rock quarry.

APPENDIX A: Natural Resources of Various Inactive and Excess Sites

Table A1: Vascular Plant Species Potentially Occurring on or near Campion, Lake Louise, Bear Creek, Beaver Creek, and Kalakaket Creek Sites

Common Name	Scientific Name	Campion (C)	Kalakaket Creek (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Common yarrow	*Achillea millefolium*			X	X	X	BC, BRC, LL
Siberian yarrow	*Achillea sibirica*	X	X	X	X	X	C, BC, LL
Monkshood	*Aconitium delphinifolium*	X	X	X	X	X	C
Baneberry	*Acatea rubra*	X	X	X	X	X	
Musk root (Moschatel)	*Adoxa moschatellina*	X	X	X	X	X	C
Agrostis	*Agrostis scabra*					X	LL
Wild chives	*Allium schoenoprasum*	X	X	X	X	X	
American green alder	*Alnus crispa*	X	X	X	X	X	C, BC, BRC, LL
Sitka alder	*Alnus sinuata*				X	X	LL
Thinleaf alder	*Alnus tennuifolia*	X	X	X	X	X	C
Round leaf orchis	*Amerorchis rotundifolia*	X	X	X	X	X	
Bog rosemary	*Andromeda polifolia*	X	X	X	X	X	C
Pasque flower	*Anemone drummondii*	X	X	X	X	X	
Narcissus-flower anemone	*Anemone narcissiflora*	X	X	X	X	X	
Northern anemone	*Anemone parviflora*	X	X	X	X	X	
Yellow anemone	*Anemone richardsonii*	X	X	X	X	X	C, BC
Wild celery	*Angelica lucida*	X	X	X	X	X	
Pussytoes	*Antennaria friesiana*	X	X	X	X	X	
Pussytoes	*Antennaria isolespis*				X	X	BRC
Lyre-leaf rockcress	*Arabis lyrata*						
Pendent grass	*Arctophila fulva*	X	X	X	X	X	
Alpine bearberry	*Arctostaphylos alpina*	X	X	X	X	X	
Red-fruit bearberry	*Arctostaphylos rubra*	X	X	X	X	X	C, LL
Bearberry (kinikinik)	*Arctostaphylos uva-ursi*	X	X	X	X	X	BRC, LL
Frigid arnica	*Arnica fridgida*	X	X	X	X	X	
Lessing's arnica	*Arnica lessingii*	X	X	X	X	X	
Alaska sagebrush	*Artemisia alaskana*	X	X	X	X	X	
Northern wormwood	*Artemisia borealis*	X		X	X	X	
Common wormwood	*Artemisia tilesii*	X	X	X	X	X	C, BC
Arctic wormwood	*Artemisia arctica*	X		X	X	X	
Siberian aster	*Aster sibiricus*	X	X	X	X	X	C
Alpine milk vetch	*Astragalus alpinus*	X	X	X	X	X	C, BRC, LL
Wintercress	*Barbarea orthoceras*					X	LL
Beckmannia	*Beckmannia erucaeformis*	X	X	X	X	X	
Dwarf Arctic birch	*Betula nana*	X	X	X	X	X	C, BC, LL
Paper birch	*Betula papyrifera*	X	X	X	X	X	C, BC, BRC, LL
Broomrape	*Boschniakia rossica*	X	X	X	X	X	
Moonwort	*Botrychium lunaria*	X	X	X	X	X	
Alaska boykinia	*Boykinia richardsonii*	X	X	X	X	X	
Bluejoint grass	*Calamagrostis canadensis*	X	X	X	X	X	C, BC, BRC, LL
Calamagrostis grass	*Calamagrostis lapponica*					X	LL
Reed bentgrass	*Calamagrostia sp.*	X	X	X	X	X	
Wild calla lily	*Calla palustris*	X	X	X	X	X	
Marsh marigold	*Caltha palustris*	X	X	X	X	X	
Bluebell	*Campanula lasiocarpa*	X	X	X	X	X	
Bitter cress	*Cardamine purpurea*	X	X	X	X	X	
Cuckoo flower	*Cardamine pratensis*	X	X	X	X	X	C
Sedge	*Carex aquatilis*	X	X	X	X	X	C, LL
Sedge	*Carex atherodes*	X	X	X	X	X	

Common Name	Scientific Name	Campion (C)	Kalakaket Creek (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Sedge	*Carex bigelowii*	X	X	X	X	X	C, BC
Sedge	*Carex rotundifolia*	X	X	X	X	X	C
Four-angled cassiope	*Cassiope tetragona*	X	X	X	X	X	
Paintbrush	*Castilleja* sp.	X	X	X	X	X	BRC, LL
Bering Sea chickweed	*Cerastrium berringianum*	X	X	X	X	X	
Leatherleaf	*Chamaecyparis calyculata*	X	X	X	X	X	
Chamaedaphne	*Chamaedaphne calyculata*	X		X	X	X	C
Strawberry blight	*Chenopodium capitatum*	X	X	X	X	X	
Mackenzie water hemlock	*Cicuta mackenzienana*	X	X	X	X	X	
Alaska spring beauty	*Claytonia sarmentosa*	X	X	X	X	X	
Coral root	*Corallorrhiza trifida*	X	X	X	X	X	BC, LL
Bunchberry	*Cornus canadensis*	X	X	X	X	X	C, BC
Red-osier dogwood	*Cornus stolonifera*	X	X	X	X	X	
Northern lady's slipper	*Cypripedium passerinum*	X	X	X	X	X	
Arctic larkspur	*Delphinium glaucum*	X	X	X	X	X	
Deschampsia	*Deschampsia brevifolia*	X	X	X	X	X	
Diapensia	*Diapensia lapponica*	X		X	X	X	
Frigid shooting star	*Dodecatheon frigidum*	X	X	X	X	X	
Douglasia	*Douglasia gormanii*	X	X	X	X	X	
Smoothing whitlow-grass	*Draba hirta*	X		X	X	X	
Round-leaved sundew	*Drosera rotundifolia*	X		X	X	X	C
Mountain avens	*Dryas interifolia*	X		X	X	X	
Crowberry	*Empetrum nigrum*	X	X	X	X	X	BC, BRC, LL
Fireweed	*Epilobium angustifolium*	X	X	X	X	X	C, BC, BRC, LL
Dwarf fireweed	*Epilobium latifolium*	X	X	X	X	X	LL
Common horsetail	*Equisetum arvense*	X	X	X	X	X	C, BC, LL
Horestail	*Equisetum* sp.	X	X	X	X	X	
Horsetail	*Equisetum palustre*	X	X	X	X	X	C
Horsetail	*Equisetum fluviatile*	X	X	X	X	X	C
Horsetail	*Equisetum pratense*				X	X	BRC
Horsetail	*Equisetum silvaticum*			X			C, BC, LL
Blue fleabane	*Erigeron acris*	X	X	X	X	X	
Tall cotton grass	*Eriophorum angustifolium*	X	X	X	X	X	C
Arctic Cotton grass	*Eriophorum scheuchzeri*	X	X	X	X	X	
Sheathed cotton grass	*Eriophorum vaginatum*	X	X	X	X	X	C
Arctic forget-me-not	*Eritichum aretioides*	X	X	X	X	X	
Fescue grass	*Festuca altaica*		X	X		X	LL
Fescue grass	*Festuca* sp.	X	X	X	X	X	
Northern bedstraw	*Galium boreale*	X	X	X	X	X	C, BC
Bedstraw	*Galium trifidium*	X	X	X	X	X	
Glaucous gentian	*Gentiana glauca*	X	X	X	X	X	
Geocaulon	*Geocaulon lividum*	X		X	X	X	C, BRC, LL
Wild geranium	*Geranium erianthum*	X	X	X	X	X	
Eskimo potato	*Hedysarum* sp.	X		X	X	X	C
Squirreltail grass	*Hordeum jubatum*	X		X	X	X	C
Wild iris	*Iris setosa*	X	X	X	X	X	
Arctic rush	*Juncus arcticus*	X	X	X	X	X	
Common juniper	*Juniperus communis*	X	X	X	X	X	C
Tamarack	*Larix laricina*	X	X	X	X	X	C
Vetchling	*Lathyrus palustris*	X	X	X	X	X	
Narrowleaf Labrador tea	*Ledum decumbens*	X	X	X	X	X	
Labrador tea	*Ledum groenlandicum*	X	X	X	X	X	C, BRC, LL

Common Name	Scientific Name	Campion (C)	Kalakaket Creek (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Labrador tea	*Ledum palustre*	X	X	X	X	X	C, BC
Twin-flower	*Linnaea borealis*	X		X	X	X	C, BRC, LL
Alp lily	*Lloydia serotina*	X	X	X	X	X	
Alpine azalea	*Loiseleuria procumbens*	X	X	X	X	X	BC
Arctic lupine	*Lupinus arcticus*	X	X	X	X	X	
Lupine	*Lupinus polyphyllus*					X	LL
Wood rush	*Luzula parviflora*			X			BC
Wood rush	*Luzula rufescens*	X		X	X	X	C
Alpine club moss	*Lycopodium alpinum*	X	X	X	X	X	
Stiff clubmoss	*Lycopodium annotinum*			X	X	X	BC, BRC
Clubmoss	*Lycopodium clavatum*			X			BC
Clubmoss	*Lycopodium complanatum*						
Matricaria	*Matricaria matricarioides*	X		X	X	X	C
Bladder campion	*Melandrium apetalum*	X	X	X	X	X	
Bogbean (buckbean)	*Menyanthes trifoliata*	X	X	X	X	X	
Chiming bells	*Mertensia paniculata*	X	X	X	X	X	C, BRC
Wild snapdragon	*Mimulus guttatus*	X	X	X	X	X	
Arctic sandwort	*Minuartia arctica*	X	X	X	X	X	
Grove sandwort	*Moerhingia lateriflora*	X	X	X	X	X	C, BC, BRC, LL
Shy maiden	*Moneses uniflora*	X	X	X	X	X	BRC
Sweet gale	*Myrica gale*	X	X	X	X	X	
Yellow pond lily	*Nuphar polysepalum*	X	X	X	X	X	
Blackish oxytrope	*Oxytropis nigrescens*	X	X	X	X	X	
Grass of Parnassus	*Parnassia palustris*	X		X	X	X	C, LL
Parrya	*Parrya nudicaulis*	X	X	X	X	X	
Pedicularis	*Pedicularis labradorica*	X		X	X	X	C
Oeder’s lousewort	*Pedicularis oederi*	X	X	X	X	X	
Bumblebee flower	*Pedicularis verticillata*	X	X	X	X	X	
Frigid coltsfoot	*Petasites frigidus*	X	X	X	X	X	C, LL
White spruce	*Picea glauca*	X	X	X	X	X	C, BRC, LL
Black spruce	*Picea mariana*	X	X	X	X	X	C, BC, LL
Plantain	*Plantago major*	X		X	X	X	C, BC, BRC
Small northern bog orchid	*Platanthera obtusata*	X	X	X	X	X	
Blue grass	*Poa* sp.	X	X	X	X	X	BC, BRC
Kentucky blue grass	*Poa pratensis*	X	X	X	X	X	
Tall Jacob’s ladder	*Polemonium acutiflorum*	X	X	X	X	X	C, BC, BRC, LL
Bistort	*Polygonum bistorta*	X	X	X	X	X	
Alpine meadow bistort	*Polygonum viviparum*	X	X	X	X	X	
Balsam poplar	*Populus balsamifera*	X	X	X	X	X	C, BC, BRC, LL
Quaking aspen	*Populus tremuloides*	X	X	X	X	X	C, BC, BRC, LL
Silverweed	*Potentilla anserina*	X	X	X	X	X	C, BC
Silverweed	*Potentilla egedii*	X	X	X	X	X	
Shrubby cinquefoil	*Potentilla fruticosa*	X		X	X	X	
Marsh fivefinger	*Potentilla palustris*	X	X	X	X	X	C, LL
Potentilla	*Potentilla multifida*						
Potentilla	*Potentilla norvgeica*			X	X	X	BC, BRC, LL
Potentilla	*Potentilla virbulata*					X	LL
Pasqueflower	*Pulsatilla patens*	X	X	X	X	X	
Pink pyrola	*Pyrola asarifolia*	X	X	X	X	X	

Common Name	Scientific Name	Campion (C)	Kalakaket Creek (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Wintergreen	*Pyrola chlorantha*				X	X	BRC, LL
Large-flowering wintergreen	*Pyrola grandiflora*	X	X	X	X	X	C, LL
Wintergreen	*Pyrola secunda*				X	X	BRC, LL
Buttercup	*Rapunculus* sp.	X	X	X	X	X	
Rhinanthus	*Rhinanthus minor*					X	LL
Northern black currant	*Ribes hudsonianum*	X		X	X	X	
Currant	*Ribes laxiflora*	X		X	X	X	C, BRC
Currant	*Ribes* sp.	X	X	X	X	X	
American red currant	*Ribes triste*	X	X	X	X	X	LL
Prickly rose	*Rosa acicularis*	X	X	X	X	X	C, BRC, LL
Nagoonberry	*Rubus arcticus*	X	X	X	X	X	C
Cloudberry	*Rubus chamaemorus*	X	X	X	X	X	C, BC, LL
American red raspberry	*Rubus idaeus* var. *strigosus*	X	X	X	X	X	BRC
Arctic dock	*Rumex arcticus*	X	X	X	X	X	
Dock	*Rumex graminifolius*	X	X	X	X	X	
Feltleaf willow	*Salix alaxensis*	X	X	X	X	X	C, BC
Littletree willow	*Salix arbusculoides*	X	X	X	X	X	C, BRC
Bebb’s willow	*Salix bebbiana*	X	X	X	X	X	C, BC, BRC, LL
Alaska bog willow	*Salix fuscescens*	X	X	X	X	X	C
Grayleaf willow	*Salix glauca*	X	X	X	X	X	BRC, LL
Halberd willow	*Salix hastata*	X	X	X	X	X	
Sandbar willow	*Salix interior*	X	X	X	X	X	
Richardson willow	*Salix lanata richardsonii*	X	X	X	X	X	
Diamondleaf willow	*Salix planifolia pulchra*	X	X	X	X	X	C, BC
Scouler willow	*Salix scouleriana*					X	LL
Willow	*Salix sitchensis*			X			BC
Burnet	*Sanguisorba officianalis*	X	X	X	X	X	
Yellow marsh saxifrage	*Saxifraga hirculis*	X	X	X	X	X	
Spiked saxifrage	*Saxifraga spicata*	X	X	X	X	X	
Saxifrage	*Saxifraga tricuspidata*				X	X	BRC
Roseroot	*Sedum rosea*	X		X	X	X	
Ragwort	*Senecio* sp.	X	X	X	X	X	
Mastodon flower	*Senecio congestus*	X	X	X	X	X	C
Black-tipped groundsel	*Senecio lugens*	X	X	X	X	X	
Buffalo berry (soapberry)	*Shepherdia canadensis*	X		X	X	X	C, BRC, LL
Campion moss	*Silene acaulis*	X	X	X	X	X	
Goldenrod	*Solidago multiradiata*	X	X	X	X	X	BRC
Green Mountain ash	*Sorbus scopulina*	X	X	X	X	X	
Bur-reed	*Sparganium augustifolium*	X	X	X	X	X	
Beauverd spirea	*Spiraea beauverdiana*	X	X	X	X	X	C, BC
Ladies’ tresses	*Spiranthes romanzoffiana*	X	X	X	X	X	
Dandelion	*Taraxacum lucerum*	X		X	X	X	C
Dandelion	*Taraxacum offininale*	X		X	X	X	C, BC, BRC, LL
Dandelion	*Taraxacum* sp.	X	X	X	X	X	
False asphodel	*Tofieldia coccinea*			X			BC
Asphodel	*Tofieldia pusilla*					X	LL
Star flower	*Trientalis europea*	X	X	X	X	X	C
Trifolium	*Trifolium* sp.	X		X	X	X	C
Trisetum	*Trisetum spicatum*		X		X	X	BRC, LL
Bladderwort	*Utricularia intermedia*	X	X	X	X	X	
Bog cranberry	*Vaccinium oxycoccus*	X	X	X	X	X	
Bog blueberry	*Vaccinium uliginosum*	X	X	X	X	X	C, BC,

Common Name	Scientific Name	Campion (C)	Kalakaket Creek (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
							BRC, LL
Low-bush cranberry	*Vaccinium vitis-idaea*	X	X	X	X	X	C, BC, BRC, LL
Capitate Valerian	*Valeriana capitata*	X	X	X	X	X	C
Mountain heliotrope	*Valeriana sitchensis*	X	X	X	X	X	
Highland cranberry	*Viburnum edule*	X	X	X	X	X	C, BRC
Two-flowered violet	*Viola biflora*	X	X	X	X	X	
Marsh violet	*Viola epipsila*			X			BC
Camass, death	*Zygadenus elegans*	X	X	X	X	X	

Observation Codes:
C - Campion
K - Kalakaket Creek
BC - Bear Creek
BRC - Beaver Creek
LL - Lake Louise

Sources:
CH2M Hill, 1993(a and b)
Hulten, 1968
Jones Technologies, Inc., and Gene Stout and Associates, 1999d; 2000c
Pratt, 1991
Viereck and Little, 1972
White, 1974

Note:
No observations made at Kalakaket Creek during 2000 visits due to difficulties reaching the site.

Table A2: Fish Species Potentially Occurring on or near Campion, Lake Louise, Bear Creek, Beaver Creek, Driftwood Bay, Kalakaket Creek, Nikolski, and Port Heiden Sites

Common Name	Scientific Name	Campion	Kalakaket Creek	Bear Creek	Lake Louise	Beaver Creek	Port Heiden	Driftwood Bay	Nikolski
Sablefish	*Anoplopoma fimbria*							X	X
Longnose sucker	*Catostomus catostomus*	X		X	X	X			
Pacific herring	*Clupea pallasi*						X	X	X
Humpback whitefish	*Coregonus pidschian*	X		X	X	X			
Least cisco	*Coregonus sardinella*	X		X		X			
Bering cisco	*Coregonus laurettae*	X		X		X			
Slimy sculpin	*Cottus cognatus*	X		X		X			
Lake chub	*Couesius plumbeus*	X		X		X			
Alaska blackfish	*Dallia pectoralis*	X		X		X			
Safron cod	*Eleginus gracilis*						X		
Northern pike	*Esox lucius*	X		X		X			
Pacific cod	*Gadus macrocephalus*						X	X	X
Three-spine stickleback	*Gasterosteus aculeatus*						X		
Irish lord	*Hemilepiodotus* sp.						X		
Masked greenling	*Hexagrammos octagrammus*						X		
Whitespotted greenling	*Hexagrammos stelleri*						X		
Halibut	*Hippoglossus stenolepis*						X	X	X
Surf smelt	*Hypomesus pretiosus*						X		
Arctic lamprey	*Lampetra japonica*	X		X		X			
Burbot	*Lota lota*	X		X	X	X			
Pink salmon	*Oncorhynchus gorbuscha*	X	X	X		X	X	X	X
Sockeye (red) salmon	*Oncorhynchus nerka*	X	X	X		X	X	X	X
Chum salmon	*Oncorhynchus keta*	X	X	X		X	X	X	X
Coho (silver) salmon	*Oncorhynchus kisutch*	X	X	X		X	X	X	X
Chinook (king)	*Oncorhynchus*	X	X	X		X	X	X	X

Common Name	Scientific Name	Campion	Kalakaket Creek	Bear Creek	Lake Louise	Beaver Creek	Port Heiden	Driftwood Bay	Nikolski
salmon	*tshawytscha*								
Rainbow smelt	*Osmerus dentex*						X		
Yellow-fin sole	*Limanda aspera*						X	X	X
Round whitefish	*Prosopium cylindraceum*	X	X	X	X	X			
Nine-spine stickleback	*Pungitus pungitus*						X		
Rainbow trout	*Salmo gairdneri*						X		X
Arctic char	*Salvelinus alpinus*		X				X	X	X
Dolly Varden	*Salvelinus malma*	X		X		X	X	X	X
Lake trout	*Salvelinus namaycush*				X				
Pacific ocean perch	*Sebastes alutus*						X	X	X
Inconnu (sheefish)	*Stenodus leucichthys*	X		X		X			
Pollock	*Theragra chalcogramma* sp.						X		
Walleye pollock	*Theragra calcogrammus*						X	X	X
Arctic grayling	*Thymallus arcticus*	X	X	X	X	X			

Sources:
Cansler, 1993
CH2M Hill, 1993b; 1994 (b, c, and e)
Fison and Associates, 1987
Jones Technologies, Inc., and Gene Stout and Associates, 1999d, 2000 (b and c)
Morrow, 1980
Robbins *et al*., 1991
USAF; 1998a, 1997

Table A3: Mammal Species Potentially Occurring on or near Campion, Lake Louise, Bear Creek, Beaver Creek, Driftwood Bay, Kalakaket Creek, Nikolski, and Port Heiden Sites

Common Name	Scientific Name	Campion	Kalakaket Creek	Bear Creek	Lake Louise	Beaver Creek	Port Heiden	Driftwood Bay	Nikolski
Brown/grizzly bear	*Ursus arctos*	X	X	X	X	X	X**		
Black bear	*Ursus americanus*	X**	X	X	X	X			
Arctic fox	*Alopex lagopus*						X	X	X
Red fox	*Vulpes vulpes*	X*	X	X	X	X	X	X	X
Wolf	*Canis lupus*	X	X	X	X	X	X		
Coyote	*Canis latrans*				X				
North American lynx	*Felis lynx*	X	X	X	X	X	X		
Least weasel	*Mustela rixosa*	X	X				X		
Marten	*Martes americana*	X	X	X	X	X			
Short-tailed weasel (ermine)	*Mustela erminea*	X	X				X		
Wolverine	*Gulo gulo*	X	X	X	X	X	X		
Mink	*Mustela vison*	X	X	X	X	X	X		
River otter	*Lutra canadensis*	X	X	X		X	X		
Muskrat	*Ondantra zibethicus*	X	X			X	X		
Beaver	*Castor canadensis*	X**	X	X	X	X	X		
Hoary marmot	*Marmora caligata*			X					
Porcupine	*Erethizon dorsatum*	X*	X			X	X		
Tundra hare	*Lepus othus*								
Snowshoe hare	*Lepus americanus*	X*	X		X*	X*			
Arctic ground squirrel	*Spermophilus paryi*			X			X*	X	X
Red squirrel	*Tamiasciurus hudsonicus*	X*	X		X*	X*			
Jumping mouse	*Zapus hudsonius*	X	X	X	X	X	X		
Brown lemming	*Lemmus trimucronatus*						X		
Collared lemming	*Dicrostonyx groenlandicus*							X	X
Bog lemming	*Synaptomys borealis*	X	X				X		
Arctic shrew	*Sorex arcticus*	X	X						
Common shrew	*Sorex sp.*			X					
Pygmy shrew	*Microsore hoyi*	X	X	X	X	X			
Dusky shrew	*Sorex vagrans*	X	X	X	X	X	X		
Masked shrew	*Sorex cinereus*	X	X				X		

Common Name	Scientific Name	Campion	Kalakaket Creek	Bear Creek	Lake Louise	Beaver Creek	Port Heiden	Driftwood Bay	Nikolski
Red-backed vole	*Clethrionomys rutilus*	X	X	X	X	X	X		
Tundra vole	*Microtus oeconomus*	X	X	X	X	X		X	X
Meadow vole	*Microtus pennsylvanicus*	X	X						
Yellow-cheeked vole	*Microtus xanthognathus*	X	X	X	X	X			
Alaska vole	*Microtus miurus*			X	X	X			
Moose	*Alces alces*	X*	X	X**	X**	X**	X		
Caribou	*Rangifer taranus*	X	X			X	X**		
Reindeer	*Rangifer arcticus*								X
Blue whale	*Balaenoptera musculus*							X	X
Bowhead whale	*Balaena mysticetus*						X	X	X
Pilot whale	*Globicephala macrorhynchus*							X	
Fin whale	*Balaenoptera physalus*						X	X	X
Killer whale	*Orcinus orca*								X
Minke whale	*Balaenoptera acutorostrata*							X	X
Sperm whale	*Physeter macrocephalus*							X	X
North Pacific Right whale	*Balena glacialis*						X	X	X
Harbor porpoise	*Phocoena phocoena*							X	
Baird's beaked whale	*Berardius bairdii*							X	
Pacific dolphin	*Lagenorhynchus obliquidens*							X	
Northern fur seal	*Callorhinus ursinus*							X	X
Harbor seal	*Phoca vitulina*						X	X	X
Spotted seal	*Phoca larga*								
Steller's sea lion	*Eumetopias jubatus*						X	X	X
Sea otter	*Enhydra lutris*						X	X	X

Observation Codes:	**Sources:**	**Notes:**
* - Observed ** - Tracks, den site, bones, skull observed. Species observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during 1999 and 2000 site visits.	CH2M Hill, 1994 (b, c, and e) EMCON Alaska Inc., 1996b Fison and Associates, 1987 Jones Technologies, Inc., and Gene Stout and Associates, 1999d; 2000 (b and c) USAF, 1997 University of Alaska, 1998 USFWS 2007a	No observations made at Kalakaket Creek during 2000 visits due to difficulties reaching the site.

Table A4: Bird Species Potentially Occurring on or near Campion, Lake Louise, Bear Creek, Beaver Creek, and Kalakaket Creek Sites

Common Name	Scientific Name	Campion (C)	Kalakaket Creek* (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	X	X	LL
Pacific Loon	*Gavia pacifica*	X	X	X	X	X	
Common Loon	*Gavia immer*	X	X	X	X	X	
Horned Grebe	*Podiceps auritus*	X	X	X	X	X	
Red-necked Grebe	*Podiceps grisegena*	X	X	X	X	X	LL
Double-crested Cormorant	*Phalacrocorax auritus*					X	LL
Tundra Swan	*Cygnus columbianus*	X	X	X	X	X	
Trumpeter Swan	*Cygnus buccinator*	X	X	X	X	X	
Greater White-fronted Goose	*Anser albifrons*	X	X	X	X	X	
Snow Goose	*Chen caerulescens*	X	X	X	X	X	
Brant	*Branta bernicla*	X	X				
Canada Goose	*Branta canadensis*	X	X	X	X	X	
Green-winged Teal	*Anas crecca*	X	X	X	X	X	
Mallard	*Anas platyrhynchos*	X	X	X	X	X	
Northern Pintail	*Anas acuta*	X	X	X	X	X	
Blue-winged Teal	*Anas discors*				X	X	
Northern Shoveler	*Anas clypeata*	X	X	X	X	X	
Gadwall	*Anas strepera*					X	
American Wigeon	*Anas americana*	X	X	X	X	X	LL
Canvasback	*Aythya valisineria*	X	X	X	X	X	
Redhead	*Aythya americana*	X	X	X	X	X	
Ring-necked Duck	*Aythya collaris*	X	X	X	X	X	
Greater Scaup	*Aythya marila*	X	X	X	X	X	
Lesser Scaup	*Aythya affinis*	X	X	X	X	X	LL
Harlequin Duck	*Histrionicus histrionicus*	X	X	X	X	X	
Long-tailed Duck	*Clangula hyemalis*	X	X	X	X	X	
Black Scoter	*Melanitta nigra*	X	X	X		X	
Surf Scoter	*Melanitta persicillata*	X	X	X	X	X	LL
White-winged Scoter	*Melanitta fusca*	X	X	X	X	X	LL
Common Goldeneye	*Bucephala clangula*	X	X	X	X	X	
Barrow’s Goldeneye	*Bucephala islandica*	X	X	X	X	X	
Bufflehead	*Bucephala albeola*	X	X	X	X	X	
Common Merganser	*Mergus merganser*				X	X	
Red-breasted Merganser	*Mergus serrator*	X	X	X	X	X	
Osprey	*Pandion haliaetus*	X	X	X	X	X	
Bald Eagle	*Haleaeetus leucocephalus*	X	X	X	X	X	LL
Northern Harrier	*Circus cyaneus*	X	X	X	X	X	
Sharp-shinned Hawk	*Accipiter striatus*	X	X	X	X	X	LL
Northern Goshawk	*Accipiter gentiles*	X	X	X	X	X	
Red-tailed Hawk	*Buteo jamaicensis*	X	X	X	X	X	
Rough-legged Hawk	*Buteo lagopus*	X	X	X	X	X	

Common Name	Scientific Name	Campion (C)	Kalakaket Creek* (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Golden Eagle	*Aquila chrysaetos*	X	X	X	X	X	
American Kestrel	*Falco sparverius*	X	X	X	X	X	
Merlin	*Falco columbarius*	X	X	X	X	X	
Peregrine Falcon	*Falco peregrinus*	X	X	X	X	X	
Gyrfalcon	*Falco rusticolus*	X	X	X	X	X	
Spruce Grouse	*Falcipennis canadensis*	X	X	X	X	X	
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	X	X	
Rock Ptarmigan	*Lagopus mutus*	X	X	X	X	X	
Ruffed Grouse	*Bonasa umbellus*	X	X	X	X		
Sharp-tailed Grouse	*Tympanuchus phasianellus*			X	X	X	
Sandhill Crane	*Grus canadensis*	X	X	X	X	X	
Black-bellied Plover	*Pluvialis squatarola*	X	X				
American Golden-Plover	*Pluvialis dominica*	X	X	X	X	X	
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	X	X	
Killdeer	*Charadrius vociferus*				X	X	
Greater Yellowlegs	*Tringa melanoleuca*	X	X	X		X	
Lesser Yellowlegs	*Tringa flavipes*	X	X	X	X	X	LL
Solitary Sandpiper	*Tringa solitaria*	X	X	X	X	X	
Wandering Tattler	*Heteroscelus incanus*	X	X	X	X	X	
Spotted Sandpiper	*Actitis macularia*	X	X	X	X	X	LL
Upland Sandpiper	*Bartramia longicauda*	X	X	X	X	X	
Whimbrel	*Numerius phaeopus*	X	X	X	X	X	
Buff-breasted Sandpiper	*Tryngites subruficollis*	X	X				
Ruddy Turnstone	*Arenaria interpres*	X	X	X	X	X	
Surfbird	*Aphriza virgata*	X	X	X	X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	X	X	
Western Sandpiper	*Calidris mauri*					X	
Least Sandpiper	*Calidris minutilla*	X	X	X	X	X	
Baird's Sandpiper	*Calidris bairdii*	X	X	X	X	X	
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	X	X	
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	X	X	
Common Snipe	*Gallinago gallinago*	X	X	X	X	X	C, LL
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	X	X	
Parasitic Jaeger	*Stercorarius parasisiticus*	X	X				
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	X	X	
Bonaparte's Gull	*Larus Philadelphia*	X	X	X	X	X	LL
Mew Gull	*Larus canus*	X	X	X	X	X	C, LL
Herring Gull	*Larus argentatus*	X	X	X	X	X	LL
Glaucous-winged Gull	*Larus glaucescens*	X	X	X	X	X	LL
Glaucous Gull	*Larus hyperboreus*	X	X	X			
Sabine's Gull	*Zema sabini*	X					
Arctic Tern	*Sterna paradisaea*	X	X	X	X	X	LL

Common Name	Scientific Name	Campion (C)	Kalakaket Creek* (KC)	Bear Creek (BC)	Beaver Creek (BRC)	Lake Louise (LL)	Observed
Great-horned Owl	*Bubo virginianus*	X	X	X	X	X	C
Snowy Owl	*Nyctea scandiacascandian*	X	X	X		X	
Great Gray Owl	*Strix nebulosa*	X	X	X		X	
Northern Hawk Owl	*Surnia ulula*	X	X	X	X	X	
Short-eared Owl	*Asio flammeus*	X	X	X	X	X	
Boreal Owl	*Aegolius funereus*	X	X	X	X	X	
Belted Kingfisher	*Ceryle alcyon*	X	X	X	X	X	LL
Downy Woodpecker	*Picoides pubescens*	X	X	X	X	X	
Hairy Woodpecker	*Picoides villosus*	X	X	X	X	X	
Three-toed Woodpecker	*Picoides tridactylus*	X	X	X	X	X	
Olive-sided Flycatcher	*Contopus borealis cooperi*	X	X	X	X	X	C
Western Wood-pewee	*Contopus sordidulus*				X	X	
Northern Flicker	*Colaptes auratus*	X	X	X	X	X	LL
Alder Flycatcher	*Empidonax alnorum*	X	X	X	X	X	C, BC, LL
Hammond’s Flycatcher	*Empidonax hammondii*	X	X	X	X	X	
Say’s Phoebe	*Sayornis saya*			X	X	X	
Horned Lark	*Eremophila alpestris*	X	X	X	X	X	
Tree Swallow	*Tachycineta bicolor*	X	X	X	X	X	
Violet-green Swallow	*Tachycineta thalassina*	X	X	X	X	X	
Bank Swallow	*Riparia riparia*	X	X	X	X	X	C
Cliff Swallow	*Petrochelidon pyrrhonota*	X	X	X	X	X	
Gray Jay	*Perisoreus canadensis*	X	X	X	X	X	C, BRC
Black-billed Magpie	*Pica pica*				X	X	
Common Raven	*Corvus corax*	X	X	X	X	X	C, BRC, LL
Black-capped Chickadee	*Poecile atricapilla*	X	X	X	X	X	C
Boreal Chickadee	*Poecile hudsonica*	X	X	X	X	X	BRC, LL
American Dipper	*Cinclus mexicanus*	X	X	X	X	X	
Arctic Warbler	*Phylloscopus borealis*			X	X	X	
Ruby-crowned Kinglet	*Regulus calendula*	X	X	X		X	C, BC
Northern Wheatear	*Oenanthe oenanthe*	X	X	X	X	X	
Mountain Bluebird	*Sialia currucoides*	X	X	X	X	X	
Townsend’s Solitaire	*Myadestes townsendi*			X	X	X	
Gray-cheeked Thrush	*Catharus minimus*	X	X	X	X	X	
Swainson’s Thrush	*Catharus ustalatus*	X	X	X	X	X	C, BC, BRC, LL
Hermit Thrush	*Catharus guttatus*	X	X	X	X	X	
American Robin	*Turdus migratorius*	X	X	X	X	X	C, BC, BRC, LL
Varied Thrush	*Ixoreus naevius*	X	X	X	X	X	
Yellow Wagtail	*Motacella flava*	X	X	X			
American Pipit	*Anthus rubescens*	X	X	X	X	X	

Common Name	**Scientific Name**	**Campion (C)**	**Kalakaket Creek* (KC)**	**Bear Creek (BC)**	**Beaver Creek (BRC)**	**Lake Louise (LL)**	**Observed**
Bohemian Waxwing	*Bombycilla garrulous*	X	X	X	X	X	
Northern Shrike	*Lanius excubitor*	X	X	X	X	X	
Orange-crowned Warbler	*Vermivora celata*	X	X	X	X	X	C, BC,
Yellow Warbler	*Dendroica petechia*	X	X	X	X	X	BC, LL
Yellow-rumped Warbler (Myrtle)	*Dendroica coronata*	X	X	X	X	X	C, BC, BRC, LL
Townsend's Warbler	*Dendroica townsendi*				X		BRC
Blackpoll Warbler	*Dendroica striata*	X	X	X	X	X	LL
Northern Waterthrush	*Seiurus noveboracensis*	X	X	X	X	X	C
Wilson's Warbler	*Wilsonia pusilla*	X	X	X	X	X	C
American Tree Sparrow	*Spizella arborea*	X	X	X	X	X	
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	X	X	C, LL
Fox Sparrow	*Passerella iliaca*	X	X	X	X	X	BC, LL
Lincoln's Sparrow	*Melospiza lincolnii*	X	X	X	X	X	C
Golden-crowned Sparrow	*Zonotrichia atricapilla*	X	X	X	X	X	
White-crowned Sparrow	*Zonotrichia leuophrys*	X	X	X	X	X	C, BC, LL
Dark-eyed (Slate-colored) Junco	*Junco hyemalis*	X	X	X	X	X	C, BC, BRC, LL
Lapland Longspur	*Calcarius lapponicus*	X	X	X	X	X	
Snow Bunting	*Plectrophenax nivalis*	X	X	X	X	X	
Rusty Blackbird	*Euphagus carolinus*	X	X	X	X	X	
Gray-crowned Rosy-Finch	*Leucosticte ephrocotis*	X	X	X	X	X	
Pine Grosbeak	*Pinicola enucleator*	X	X	X	X	X	
White-winged Crossbill	*Loxia leucoptera*	X	X	X	X	X	
Common Redpoll	*Corduelis flammea*	X	X	X	X	X	
Hoary Redpoll	*Carduelis hornemanni*	X	X	X	X	X	

Observation Codes:
C - Campion
K - Kalakaket Creek
BC - Bear Creek
BRC - Beaver Creek
LL - Lake Louise

Sources:
Armstrong, 1998
Gibson, 1993
Igl, 1996 (Koyukuk/Nowitna Complex NWR, Tetlin NWR, Wrangell-St. Elias National Park and Preserve)
Johnson, 1998
Jones Technologies, Inc., and Gene Stout and Associates, 1999d; 2000c
USAF, 1998a

Notes:
* - No observations made at Kalakaket Creek during 2000 visits due to difficulties reaching the site.

Appendix 3.0 - Louise. Lake Louise Recreation Site

3.0 Installation Overview

3.1 Location and Area
Lake Louise Recreation Site (inactive site) is about 45 miles northwest of Glennallen, Alaska, which is about 189 miles east of Anchorage (INRMP Figure 3.1). The 25-acre site is on the west shore of Lake Louise at the juncture with Dinty Lake (Woodward-Clyde 1995g) (Figure 3.1). The site is not completely accessible by road; wading, boating, or a four-wheel drive vehicle is required to cross a 20-foot wide waterway.

3.2 Installation History
The Lake Louise site was purchased as two parcels in 1955 and 1957. Though use of the site began in 1949, according to real estate records it was first named Elmendorf/Lake Louise Recreation Annex in 1958 and then became the Lake Louise Recreation Annex. The site was developed as a recreation camp to provide a recreational fishing and boating location and facilities for Air Force personnel and their families. It was located midway between Eielson AFB and Elmendorf AFB. Facilities at the camp consisted of a lodge, dining hall, dormitory, boat shop and fueling point, generator building, water pump house, check-in building, shower house, several small cabins, and a picnic area. An earthquake in 1964 caused extensive damage to facilities, and use of the site was discontinued in 1965. Facilities at the site were demolished in 1971, and debris was either removed or buried (Cansler 1993). Clean Sweep occurred in 2010-2012.

3.3 Surrounding Communities
The population of Glennallen is 483 consisting of 12.1 percent Alaska Native or part Native. Glennallen is the supply hub of the Copper River region. Local businesses serve area communities and Glenn Highway traffic. State highway maintenance and federal offices, such as the BLM, and state government offices, such as Alaska State Troopers and ADFG are in Glennallen. In 2010 three residents held commercial fishing permits, and there are several small farms in the area (www.dced.state.ak.us 2012).

3.4 Regional Land Use
The Lake Louise site is accessed via a gravel road from the Glenn Highway. The community of Glennallen lies along the Glenn Highway at its juncture with the Richardson Highway, about 45 miles from the site. Glennallen was named for Maj. Edwin Glenn and Lt. Henry Allen, both leaders in early explorations of the Copper River region. Glennallen is one of the few communities in the region that was not built on the site of a Native village (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas
There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Lake Louise site.

4.0 Physical Environment

4.1 Climate
The Lake Louise site has a continental climate, with long, cold winters, and relatively warm summers. The mean temperature in January is -10°F and 56°F in July. Recorded temperature extremes range from -

74° to 96°F. Total annual precipitation is about nine inches, with snowfall averaging about 39 inches (www.dced.state.ak.us 2012).

Winter temperatures below - 40°F commonly occur, and summer temperatures may reach into the 90s°F. Mean annual temperatures are 20 to 30°F, and the warmest month averages 60°F (Universe Technologies, Inc. and Gene Stout and Associates. 2001b). Continuous sunlight and twilight occur from early June through mid-July. Day length at the winter solstice is less than 5 hours long.

4.2 Landforms

The Lake Louise site is in the Copper River Basin in southcentral Alaska, which is characterized as flat and poorly drained with numerous freshwater lakes. The region is physically delineated by the Alaska Range, the Wrangell Mountains, the Chugach Mountains, and the Talkeetna Mountains. Elevations range from about 2,000 to 3,000 feet above msl. The site is at an elevation of about 2,400 feet above msl and generally slopes east toward Lake Louise. The property rises steeply about 50 feet in elevation from the lake shore, then levels to gentle to undulating slopes. A low ridge extends through the site from north to south.

4.3 Geology and Soils

Rocks bordering the Copper River Basin consist of schist, greenstone, graywacke, shale, and sandstone. During one or more early Pleistocene glaciations, glaciers from surrounding mountains covered the entire basin floor. The central basin was covered with a large proglacial lake, and lacustrine sediments deposited in the lake partially buried older glacial features. Broad level terraces are the most extensive geologic features in the area. Terraces consist of clayey lacustrine sediments from the proglacial lake. Wind-blown sediments of varying thicknesses mantle stream and lacustrine terraces in the area (Clark and Kautz 1999).

Permafrost underlies the entire basin at varying depths, except on floodplains and under lakes. Where a thick organic mat overlies the mineral soil, permafrost and a perched water table can occur within the soil profile (Clark and Kautz 1999).

4.4 Hydrology

The area surrounding the site is dotted with numerous fresh water lakes. The Copper, Tazlina, Maclaren, and Susitna rivers are the major surface water drainage features in the area. The site is on the shore of Lake Louise, one of the largest lakes in the area. The Lake Louise site has no flowing surface water on the site. Surface water runoff flows directly into Lake Louise or percolates directly into the ground. Groundwater resources in the area are unknown (Woodward-Clyde 1995g). However, subsurface water throughout much of the Copper River Basin is under artesian pressure beneath fine-grained material and/or permafrost. Wells drilled in Glennallen have produced water that is somewhat saline (Clark and Kautz 1999).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Lake Louise Recreation site. Much information included in INRMP Chapter 5.0 that includes Lake Louise Recreation site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Lake Louise Recreation site and the surrounding area. ***Appendix 3.0-Campion***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Lake Louise

Figure 3.1 Lake Louise Recreation Site

Recreation site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Lake Louise Recreation site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division - Mountain Provinces
Province: M135 Alaska Range Humid Tayga-Tundra-Meadow Province
Description: This province's landscape is a continuation of the Pacific Coast Mountains, the Wrangell Mountains, and the Alaska Range, which typify the ruggedness of the area. The Susitna and upper Copper Rivers are the only major waterways. Winters are severe, and summers hot and dry. Temperatures range from 90°F to -70°F; average precipitation is 16 inches. Vegetation is characterized by vertical zonation. On flood plains and low terraces are stands of white spruce and cottonwood; above these stands are black spruce stands; from the black spruce stands to timberline (2,500-3,500 feet) are upland spruce-hardwood forests with undergrowth of moss, ferns, and grass; and from timberline up to the ice caps on the highest peaks are tundra systems of low shrubs and herbaceous plants. Well-drained Entisol soils are found in the bottom-land and terrace areas of the Copper and Susitna Rivers; in upland hardwood forests are Inceptisols; and in moister tundra areas soils range from wet Inceptisols to Histosols. On north-facing slopes permafrost is continuous; on south-facing slopes permafrost is discontinuous.

5.2 Vegetation

The Copper River Basin supports a mixture of black and white spruce, aspen, birch, and cottonwood. However, higher slopes are often treeless and support alpine tundra (Woodward-Clyde 1995g).

The Lake Louise site is primarily a mixed white and black spruce forest. Few large birch or aspen occur. The understory has scattered shrub/small tree-sized Bebb's willow, grayleaf willow, and a few Scouler willow. Disturbed areas around old foundations and other cleared areas are regenerating to a thick cover of American green alder, Bebb's willow, grayleaf willow, and some white spruce. Some willows are small tree-sized. Patches of wet sedge meadow occur along the lakeshore.

A vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001b) identified 53 species during a 2000 site visit. A general vegetation map of the Lake Louise site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Lake Louise Recreation site.

5.3 Fish and Wildlife

5.3.1 Fish

Lake Louise supports lake trout, burbot, Arctic grayling, whitefish, and suckers (Woodward-Clyde 1995g).

5.3.2 Mammals

The area is inhabited by black and brown bears, moose, caribou, wolves, ground squirrels, hares, red foxes, mink, martens, beavers, muskrats, weasels, etc.

5.3.3 Birds

Concentrations of nesting waterfowl and two colonies of seabirds occur on Lake Louise. Lake Louise is also used by Trumpeter Swans for nesting and brood-rearing. Species commonly observed at the site include the American Robin, Swainson's Thrush, Yellow Warbler, Yellow-rumped Warbler, Alder Flycatcher, Dark-eyed Junco, White-crowned Sparrow, Fox Sparrow, Savannah Sparrow, Common

Flicker, Mew Gull, Arctic Tern, Double-crested Cormorant, and Red-throated Loon. A Bald Eagle nest exists in the middle of the Lake Lousie site. Appropriate protection measures will be put in place prior to restoration cleanup.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur on the Lake Louise Recreation site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Lake Louise site. Restoration work at Lake Louise will need to be surveyed prior to implementation and appropriate permits obtained if necessary.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The nearest communities to the Lake Louise site include Lake Louise and Glennallen. The community of Lake Louise is adjacent to the Lake Louise site. Glennallen is about 36 miles southeast of the site. There is significant use of subsistence resources by people in the Lake Louise community. In particular, fish and large land mammals are sought, and products are exchanged by local residents. In addition, many species not locally available, such as halibut, are harvested and brought back to the community. Residents at Lake Louise utilize a subsistence use area that includes Lake Louise; the Tyone River; West Fork, Fish, Ewan, and Crosswind lakes; and the Gulkana River (Braund and Associates 2004).

5.6.2 Outdoor Recreation

There are several commercial lodges near the site, and Lake Louise is very popular year-round with sportsmen. There is a public boat launch and parking area at the end of the road, directly across the narrow waterway that must be crossed to access the site. Several permanent residences are in the immediate area, and these residents, as well as others from more distant areas, practice subsistence harvest of fish, wildlife, and berries. Other recreation activities include camping, hiking, and wildlife viewing.

Appendix 3.0 - Lay. Point Lay Former Long Range Radar Site

3.0 Installation Overview

Figure 3.0 View of Former Point Lay LRRS

3.1 Location and Area

The Point Lay inactive site occupies 1,442 acres on the eastern side of Kasegaluk Lagoon (Figure 3.1). Located near the mouth of the Kokolik River, Point Lay is about 180 miles southwest of Barrow (INRMP Figure 3.1).

3.2 Installation History

The Point Lay site is withdrawn from public domain by public land order for military purposes. Point Lay, a former LLRS, was built in 1955 as an auxiliary DEW Line station. In 1957 the site was turned over to a civilian contractor for operation and maintenance and was operated in that fashion until 1999. In the mid-1980s Point Lay was upgraded into a North Warning LLRS. The radar was removed in 1998; contract personnel were removed, and the site was deactivated in 1999.

Clean Sweep building demolition and debris removal occurred in 2005. All structures were removed except for an aircraft hanger and a small storage building. Remedial action at a landfill site is scheduled for 2012 (personal communication, L. Roy 2008).

Though 611 ASG has maintained an Automated Weather Observing System (AWOS) at the inactive site, in 2003 a 5-year lease was granted to the FAA for a temporary AWOS and shelter on 0.0689 acres and a permanent AWOS and shelter on 0.349 acres, and 19.66 acres were granted to FAA for a maintenance shelter and Non Directional Beacon with associated tower and radials. The North Slope Borough maintains the runway in exchange for leasing certain buildings and the runway.

3.3 Surrounding Communities

Due to a resurgence in the early 1970s, Point Lay's population has remained fairly stable, mainly from immigration from Barrow and Wainwright. The native village of Point Lay is one mile north of the Point Lay site. Point Lay has a population of 189 (2010) consisting of 88.4 percent Alaska Native or part Native. The one school in Point Lay is attended by 87 students (www.dced.state.ak.us 2012).

Point Lay is relatively isolated and is the smallest village in the region, which affects economic opportunities. Most year-round employment opportunities are with the borough government. Other jobs are provided by a store, the school, a clinic, and various construction projects for community facilities and housing. Local crafts provide some income and include the manufacture of ivory carvings and Eskimo clothing. Electricity is provided by the North Slope Borough. Households have water delivered to home tanks, which allows running water for kitchens.

Some villagers hunt and trap furbearers, particularly in winter. Traditional subsistence activities in the Point Lay area have revolved principally around caribou and marine mammals, especially beluga whales. Fish, waterfowl, and furbearers are also important subsistence resources (Braund & Associates 2004). Productive lagoons and barrier beaches and islands in the Point Lay vicinity attract sea mammals and migrating and nesting birds.

3.4 Regional Land Use

Point Lay is one of the more recently established Inupiat (northern Eskimo) villages on the Arctic coast, which was historically occupied year-round by a small group of one or two families who were joined in 1929-1930 by several families from Point Hope. The village was formerly located on a barrier beach close to the location of the present village. The village was relocated to the banks of the Kokolik River in 1974.

The population of Point Lay fluctuates with the seasons. The population in 1939 was 117, but after 1940 Point Lay began to decline. By 1958 Point Lay was essentially a ghost town, and the local school closed (Minerals Management Services 1989).

The era of the DEW Line Station at Point Lay was from 1958-1971. Construction of the DEW line, along with the closing of the school, contributed to the depopulation of Point Lay. DEW Line construction provided employment at Point Lay but was also a major source of disruption in the community, particularly through the supplying of alcohol to the village. A substantial emigration from Point Lay occurred coincident with the completion of the DEW Line Station as wage opportunities diminished and subsistence resources in the area could not support a large permanent population (Minerals Management Services 1989).

Figure 3.1 Point Lay Former LRRS

The deeply indented shoreline prevents effective bowhead whaling, but the village participates in beluga whaling. Seals, walrus, beluga whale, caribou, and fish are staples of the diet (www.dced.state.ak.us 2007).

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Point Lay site.

4.0 Physical Environment

4.1 Climate

Point Lay's climate is arctic. Temperatures range from -55 to 78°F. Precipitation is light, averaging seven inches annually, with 21 inches of snow. The Chukchi Sea is ice-free from late June until September (www.dced.state.ak.us 2012).

Temperatures at Point Lay remain below the freezing point much of the year, with the maximum daily temperature being higher than the freezing point only 138 days annually. The daily minimum temperature drops below freezing 263 days of the year, and freezing temperatures have been observed every month of the year. February is the coldest month, and July is the warmest. Average summer temperatures range from 32° to 53°F, while winter temperatures range from -5° to -27°F (Selkregg 1975; CH2M Hill 1981).

Prevailing winds are northeasterly year-round with a mean speed of 12 mph. November winds are slightly stronger than those of other months, but there is very little variation in wind speed from one month to the next. Winds of 35 mph or more are not uncommon, and gusts can occasionally attain much greater speeds (CH2M Hill 1981).

4.2 Landforms

Point Lay is within the Arctic Coastal Plain physiographic region. Point Lay village and the site are located south of the Kokolik River on the tundra near the shore of Kasegaluk Lagoon on a low coastal bluff. The site is generally flat with local topographic features that include high- and low-centered polygons and small thaw lakes and ponds. The old village site, also known as the summer village, is on an offshore gravel barrier island in the Chukchi Sea. The island is part of a lengthy barrier island-spit complex bounding Kasegaluk Lagoon, which rises to approximately 15 feet above msl (University of Alaska 1978).

4.3 Geology and Soils

The Point Lay site is underlain by permanently frozen sediments of the Quaternary Gubik Formation - mixtures and lenses of marine and alluvial clay, silt, sand, and gravel. This formation is more silty at Point Lay than at other 611 ASG North Slope sites. It is the characteristic formation that is deposited throughout the shallow, near-shore shelf marine environment. Frequent sea level changes have alternately exposed and inundated the Coastal Plain, depositing, reworking, and mixing sediments. Erosion potential in the Point Lay area is moderate overall, although streambank and shoreline erosion on ponds, coastal lakes, and along coastal shorelines is extensive, particularly in early summer.

The soil that predominates at the Point Lay site is a poorly drained peat with a silty loam texture. The permafrost table is near the surface, generally thawing to not more than 18 inches in summer.

4.4 Hydrology

Point Lay village and Point Lay site are near the Kokolik River and Kasegaluk Lagoon, dominant surface water features in the area. Rivers west of the Colville River exhibit drowned coastal features, indicating subsidence of the Coastal Plain. Due to the low elevation of Point Lay, it is moderately susceptible to coastal flooding. The village has been relocated twice due to continual erosion of the riverbank and seasonal flooding during spring thaw and breakup of river ice.

Surface drainage on the Arctic Coastal Plain occurs as sheetflow and shallow creek runoff from near the coast. Runoff may also follow natural depressions and improved ditches. Infiltration may occur to a limited extent down to the permafrost table during summer.

Permafrost throughout the area precludes the development of groundwater as a drinking water source. A large freshwater lake, south of Point Lay, provides drinking water for the village.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Point Lay site. Much information included in INRMP Chapter 5.0 that includes Point Lay site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Point Lay site and the surrounding area. Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4). Threatened or Endangered Species that may occur at Point Lay site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 124 Arctic Tundra Province
Description: This province is a broad, level plain with rolling foothills near the Colville River; in summer there are lakes and marshes dotting the landscape. Winter temperatures can go as low as -60°F and due to the area's northern location receives differing amounts of sunlight throughout the year. Precipitation is low throughout the year, averaging only seven inches. Due to permafrost there are extensive marshes and lakes in the province. The most widespread vegetation system, cottongrass-tussock, grows along with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. Dominant soils are wet, cold Inceptisols. Upland soils are poorly drained clayey soils. Soils on south slopes and low moraines are well drained and loamy; lowland soils are deep, wet, and silty. Permafrost is continuous throughout the province, reaching depths of 2,000 feet in some areas.

5.2 Vegetation

A general vegetation map of the Point Lay site was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995c). Further improvements in vegetation mapping at active radar sites, including Point Lonely, occurred in 2002 (Ritchie *et al*. 2003) when flora and fauna surveys were conducted and a wildlife habitat map was prepared for the Point Law site.

Schick *et al*. (2004) made significant improvements in vegetation mapping at Point Lay site (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys. The habitat assessment map and data were updated following 2006 Eider surveys (Frost *et al*. 2007). Details and specific results of this survey are in Table 5.2 and Figure 5.2, for which data include USAF property and a 150-meter buffer outside the property boundary.

Table 5.2 Total Area and Percent Cover of Wildlife Habitat Types (in bold) and Landcover Types Mapped within each Habitat Type at Point Lay Site, 2000

Wildlife Habitats and Landcover Types	Hectares	Acres	%
Marine Nearshore Water (Estuarine)	**28.58**	**70.62**	**3.74**
Coastal Barrens	**20.26**	**50.06**	**2.66**
Coastal Barren Mud	17.84	44.07	2.34
Coastal Barren Sand Beach	1.95	4.82	0.26
Coastal Partially Vegetated Sand Beach	0.47	1.17	0.06
Coastal Brackish Water	**0.57**	**1.41**	**0.08**
Coastal Shallow Brackish Water	0.57	1.41	0.08
Deep Water	**52.75**	**130.34**	**6.91**
Deep Water w/ Islands or Polygonized Margins	**16.28**	**40.23**	**2.13**
Deep Lacustrine Water w/ Islands	16.28	40.23	2.13
Shallow Water	**2.24**	**5.54**	**0.29**
Shallow Water w/ Islands or Polygonized Margins	**0.29**	**0.71**	**0.04**
Shallow Lacustrine Water w/ Islands	0.29	0.71	0.04
Lowland Lacustrine Barrens	**0.22**	**0.54**	**0.03**
Lowland Barren Lacustrine Bottoms	0.09	0.22	0.01
Lowland Partially Vegetated Lacustrine Bottoms	0.13	0.32	0.02
Lowland Aquatic Grass Marsh	**9.67**	**23.89**	**1.27**
Lowland Aquatic Grass Marsh	4.65	11.49	0.61
Lowland Aquatic Grass Marsh w/ Islands	5.02	12.40	0.66
Lowland Aquatic Sedge Marsh	**1.43**	**3.53**	**0.18**
Lowland Aquatic Sedge Marsh	1.33	3.28	0.17
Coastal Aquatic Sedge–Grass Marsh	0.10	0.25	0.01
Lowland Patterned Aquatic Marsh	**1.81**	**4.48**	**0.24**
Lowland Aquatic Sedge Marsh (on patterned ground)	1.81	4.48	0.24
Lowland Nonpatterned Wet Tundra	**4.95**	**12.22**	**0.65**
Lowland Wet Sedge Tundra	4.40	10.87	0.58
Coastal Wet Sedge–Grass Tundra	0.55	1.35	0.07
Lowland Patterned Wet Tundra	**188.51**	**465.80**	**24.69**
Lowland Wet Sedge–Willow Tundra (on patterned ground)	122.39	302.42	16.03
Lowland Aquatic–Wet Sedge–Willow Tundra (on patterned ground)	66.12	163.38	8.66
Lowland Wet–Moist Patterned Tundra Complex	**108.82**	**268.90**	**14.26**
Lowland Wet–Moist Sedge–Willow Tundra (on patterned ground)	108.82	268.90	14.26
Lowland Moist Sedge–Shrub Tundra	**105.07**	**259.64**	**13.77**
Lowland Moist Sedge–Shrub Tundra	104.92	259.26	13.75
Lowland Moist Sedge–Grass Tundra	0.15	0.38	0.02
Lowland Moist Tussock Tundra	**34.74**	**85.85**	**4.55**
Old Basin Wetland Complex (Ice-rich)	**137.62**	**340.07**	**18.03**
Lowland Dwarf Scrub	**1.26**	**3.11**	**0.16**
Lowland Dwarf Ericaceous Scrub	1.26	3.11	0.16
Upland Low Shrub–Tussock Scrub	**22.31**	**55.14**	**2.92**
Artificial	**25.89**	**63.97**	**3.39**
Drainage Impoundment	0.16	0.39	0.02
Maintained Gravel Fill	25.01	61.80	3.28
Partially Revegetated Gravel Fill	0.72	1.78	0.09
Totals	**763.27**	**1886.05**	**100.00**

Wildlife habitats at the Point Lay site are primarily lacustrine, lowland tundra types, and wetland complexes with no riverine and little upland habitat types present. Nearshore (estuarine) marine and coastal waterbodies comprise 3.82% of the site, and lacustrine waters cover 9.37% of the area. Of the waterbodies, Marine Nearshore Water and Deep Water are predominant types (70.6 acres and 130.3 acres, respectively). Deep and shallow waterbodies are scattered throughout the site, but occur primarily within the Old Basin Wetland Complex in the center of the site; one large lake occurs at the eastern end of the property. Freshwater lakes and ponds with islands and/or polygonized margins occur at Point Lay, but they are not common (2.17% of the land area). The Old Basin Wetland Complex in the center of the property comprises 18.03% of the land area of the site. Coastal Salt Marsh, often used by brood-rearing waterfowl, does not occur on the site (Schick *et al*. 2004).

Of remaining habitats, freshwater marsh and lowland tundra are primary wildlife habitats at the site and cover 59.61% of the land area. Of the tundra habitats, Lowland Patterned Wet Tundra (465.8 acres), Lowland Wet–Moist Patterned Tundra Complex (268.9 acres), and Lowland Moist Sedge–Shrub Tundra (259.6 acres) are the most common. Artificial habitats, including gravel roads and pads and drainage impoundments, occupy 64.0 acres (3.39% of the area) (Ritchie *et al*. 2003).

Most wetlands of Point Lay are classified as palustrine, persistent emergent/broad-leaved deciduous shrub. Some lower, wetter, and seasonally flooded areas lack the shrub component. Deep and shallow open water habitats are also common, including lakes and ponds, sometimes with emergent vegetation (*e.g*., *Arctophila fulva* and *Carex aquatilis*) growing in permanently flooded shallow margins (Ritchie *et al*. 2003).

Schick *et al*. (2004) identified 20 distinct wildlife habitat types (Figure 5.2) using ground-truthing surveys at the site. The habitat map was updated following 2006 surveys (Frost *et al*. 2007). At the Point Lay site, 10 habitats were limited in areal extent (<2%). Five habitats combined covered >75% of the site: Marine Nearshore Water (11.8%), Lowland Patterned Wet Tundra (22.6%), Lowland Wet-Moist Patterned Tundra Complex (13.0%), Lowland Moist Sedge-Shrub Tundra (12.7%), and Old basin Wetland Complex (16.5%).

5.3 Fish and Wildlife

5.3.1 Fish

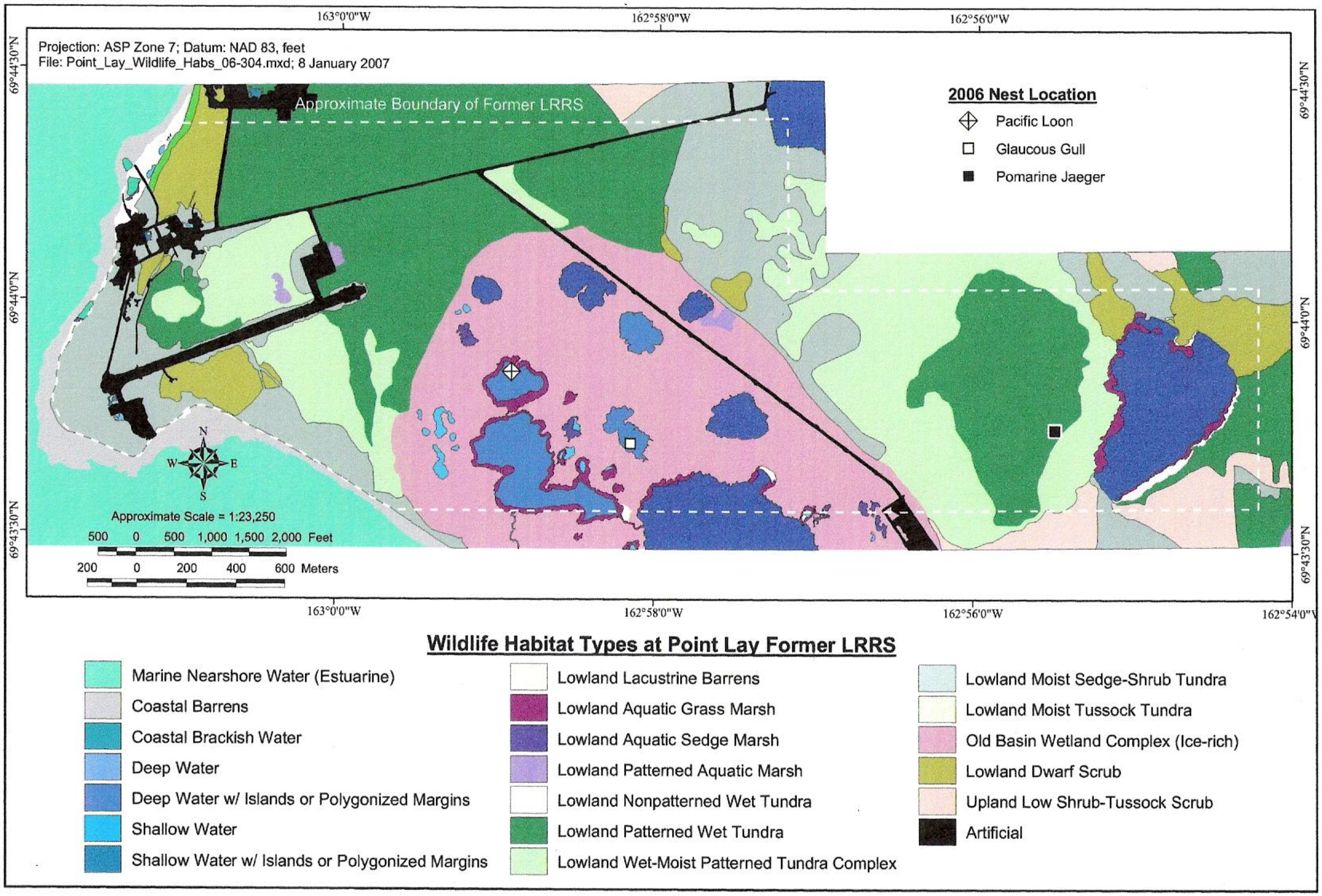
Species commonly found in Kasegaluk Lagoon include Arctic char, Arctic flounder, Pacific herring, Arctic grayling, and rainbow smelt (U.S. Department of Interior 1987a). The most common fish species caught in the Kokluk River is the Arctic char.

5.3.2 Mammals

The dominant herbivore around the site is the Arctic ground squirrel, although collared lemmings and brown lemmings are also common. Other herbivorous mammals include the caribou. Carnivorous mammals include the Arctic fox, brown/grizzly bear, wolf, and wolverine (Woodward-Clyde 1995c, Gusey 1988). Brown/grizzly bears are uncommon in the Point Lay area but are occasionally harvested by hunters.

Marine mammals occurring in nearshore waters of Point Lay during summer include the endangered bowhead whale (USFWS 2011). Other marine mammal species that occur during summer include the gray whale, beluga whale, minke whale, killer whale, harbor porpoise, spotted seal, and Pacific walrus (Candidate species). Winter residents to the Point Lay area include the polar bear and bearded seal. Year-round residents include only the ringed seal (Wynne 1993).

Figure 5.2 Point Lay Wildlife Habitat Map, 2000



5.3.3 Birds

The wet tundra environment within and adjacent to the site provides nesting and foraging habitat for a wide variety of bird species. Common Eiders were the most common nesting species observed at the site during 2003 and Common Raven was the only species identified nesting in artificial habitat at the site (Schick *et al*. 2004).

The Point Lay area is frequented by large numbers of waterfowl during the post-breeding molt and fall migration. Waterfowl are hunted by local natives at Point Lay throughout the summer. Waterfowl species commonly using the area include White-fronted Goose, Snow Goose, Tundra Swan, Brant, Mallard, Northern Pintail, Green-winged Teal, Greater Scaup, Common Eider, King Eider, Longtail Duck, Red-breasted Merganser, and Red-throated and Pacific Loons.

Passerine species that use tundra in the area include Snow Buntings, Lapland Longspurs, and Redpolls. Yellow Wagtails, Savannah Sparrows, Lapland Longspurs, Western Kingbirds, Snow Buntings, and Common Redpolls are also common.

Shorebirds using the area include Semipalmated Sandpiper, Western Sandpiper, Pectoral Sandpiper, American Golden Plover, Dunlin, Long-billed Dowitcher, Red-necked Phalarope, and Red Phalarope. Pomarine, Parasitic, and Long-tailed Jaegers; Glaucous Gulls; Glaucous-winged Gulls; Arctic Terns; Sandhill Cranes; Snowy Owls; Common Ravens; and Willow Ptarmigan are common.

Barrier islands west of Point Lay provide resting substrate for several sea bird colonies. These barrier islands are probably of long-term importance for nesting birds, including Common Eiders, Arctic Terns, and Glaucous Gulls (Sowls *et al*. 1978). During post-breeding molt and the fall migration, shores of these islands and salt water lagoons are used by large numbers of Longtail Duck, Brant, Phalarope, and other shorebirds and waterfowl.

5.4 Threatened and Endangered Species

Several federally-protected species (USFWS 2011) are known to occur in the Point Lay area, including the endangered bowhead whale, threatened Spectacled Eider, Steller’s Eider, and polar bear, candidate Yellow-billed Loon, Kittlitz’s Murrelet, and Pacific walrus, and threatened ringed and bearded seals. The Harlequin Duck and North American lynx, former Category 2 candidate species occur in the Point Lay area.

A 1994 survey (Day *et al*. 1995) confirmed the Spectacled Eider at the Point Lay site, and the site was also confirmed as a brood-rearing location. Nesting potential at the site for Spectacled Eiders was rated as moderate. The site was one of four remote USAF sites in Alaska (Bullen Point, Oliktok, and Point Lonely are the others) with the greatest potential for Steller’s Eider nesting. No Spectacled Eider nests have been recorded during any of the five survey years at Point Lay former LRRS in 1994, 2000, 2002, 2003, 2006 (Day *et al*. 1995, Day and Rose 2000, Ritchie *et al*. 2003, Schick *et al*. 2004, Frost *et al*. 2007). However, Oasis Environmental, Inc. (2008) found a failed Spectacled Eider nest at Point Lay former LRRS. The 611 ASG Natural Resources Manager conducted a visual bird survey, emphasizing eiders, in June 2012 and visual Pacific walrus surveys in June and September 2012 at the site.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Point Lay site, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller’s Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004).

5.5 Wetlands

The vegetation discussion in Section 5.2, Vegetation is particularly pertinent to wetlands at Point Lay site.Most wetlands of Point Lay are classified as palustrine, persistent emergent/broad-leaved deciduous shrub. These areas are typically moist and wet tundra and are either saturated or seasonally flooded, depending on microtopography and landscape position. Some lower, wetter, and seasonally flooded areas lack the shrub component. Deep and shallow open water habitats are also common, including lakes and ponds (Ritchie *et al*. 2003).

The general Point Lay site vegetation map's wetland features (Woodward-Clyde 1995c) were significantly updated by a NWI map (completed during 2000-2005) and mapping done by Schick *et al*. (2004). Table 5.2 shows wetland acreages at Point Lay site. Figure 5.5 shows NWI wetlands (1,373.11 acres) on Point Lay site from 2011 data.

5.6 Other Natural Resources Information

5.6.1 Subsistence

The Point Lay area has an abundant diversity of marine mammals, terrestrial mammals, fish, birds, and other resources. Traditional subsistence activities in the Point Lay area have revolved principally around caribou and marine mammals, especially beluga whales. Fish, waterfowl, and furbearers are also important subsistence resources. Residents of Point Lay utilize a large subsistence area that extends along the coast from Wainwright to Cape Sabine and inland along the Utukok and Kokolik rivers and their associated tributaries. Beluga whale, caribou, migratory birds, and walrus account for about 87 percent of Point Lay's annual subsistence harvest in terms of edible pounds (Braund & Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at or near the Point Lay site include game and waterfowl hunting, ATV riding along gravel roads, boating in Kasegaluk Lagoon, and limited fishing opportunities in the Kokolik River north of Point Lay Village. The limited hunting that occurs near the site primarily consists of subsistence harvest and egg collecting by local residents.

Figure 5.4 Spectacled Eider Habitat Assessment at the Point Lay Site

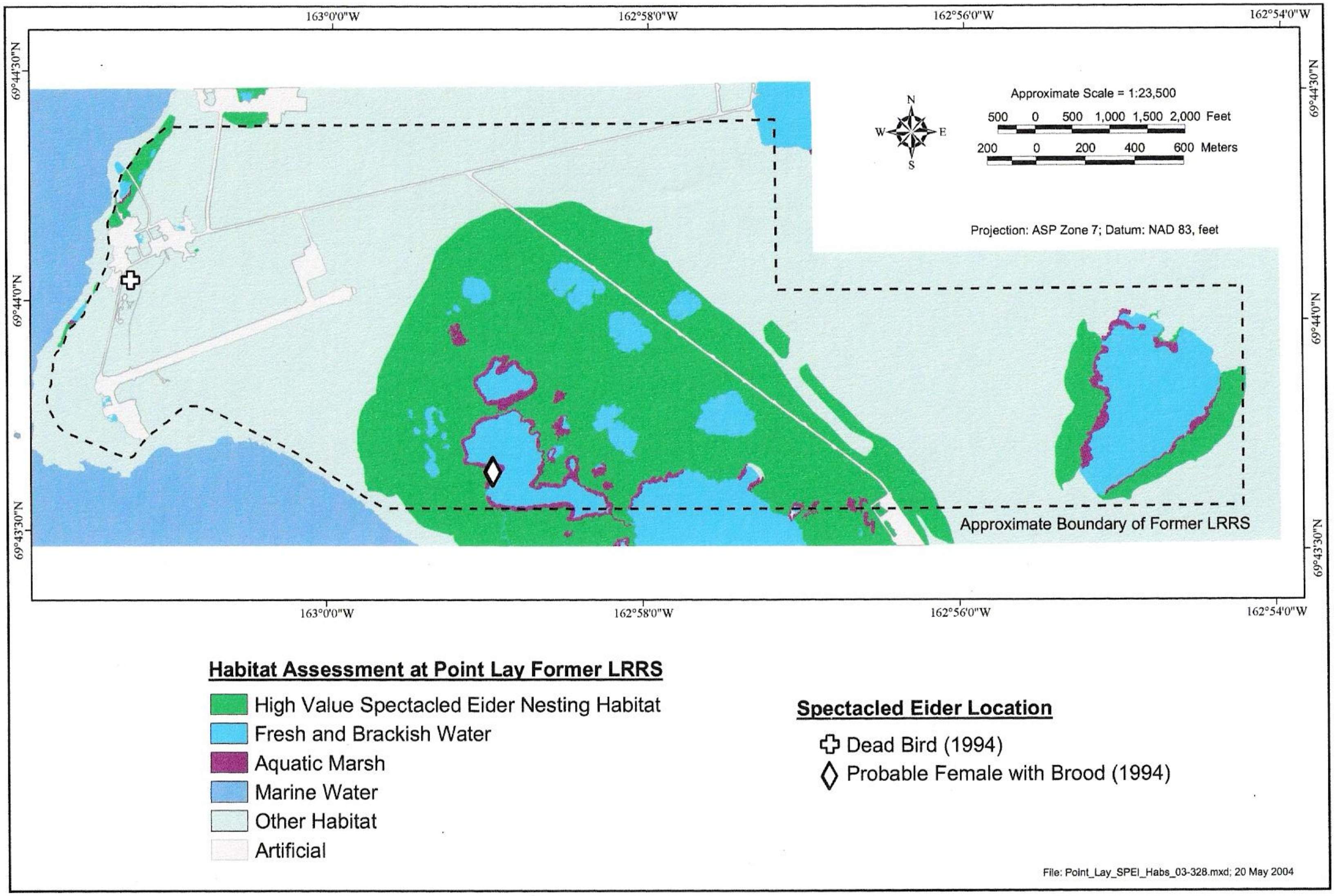
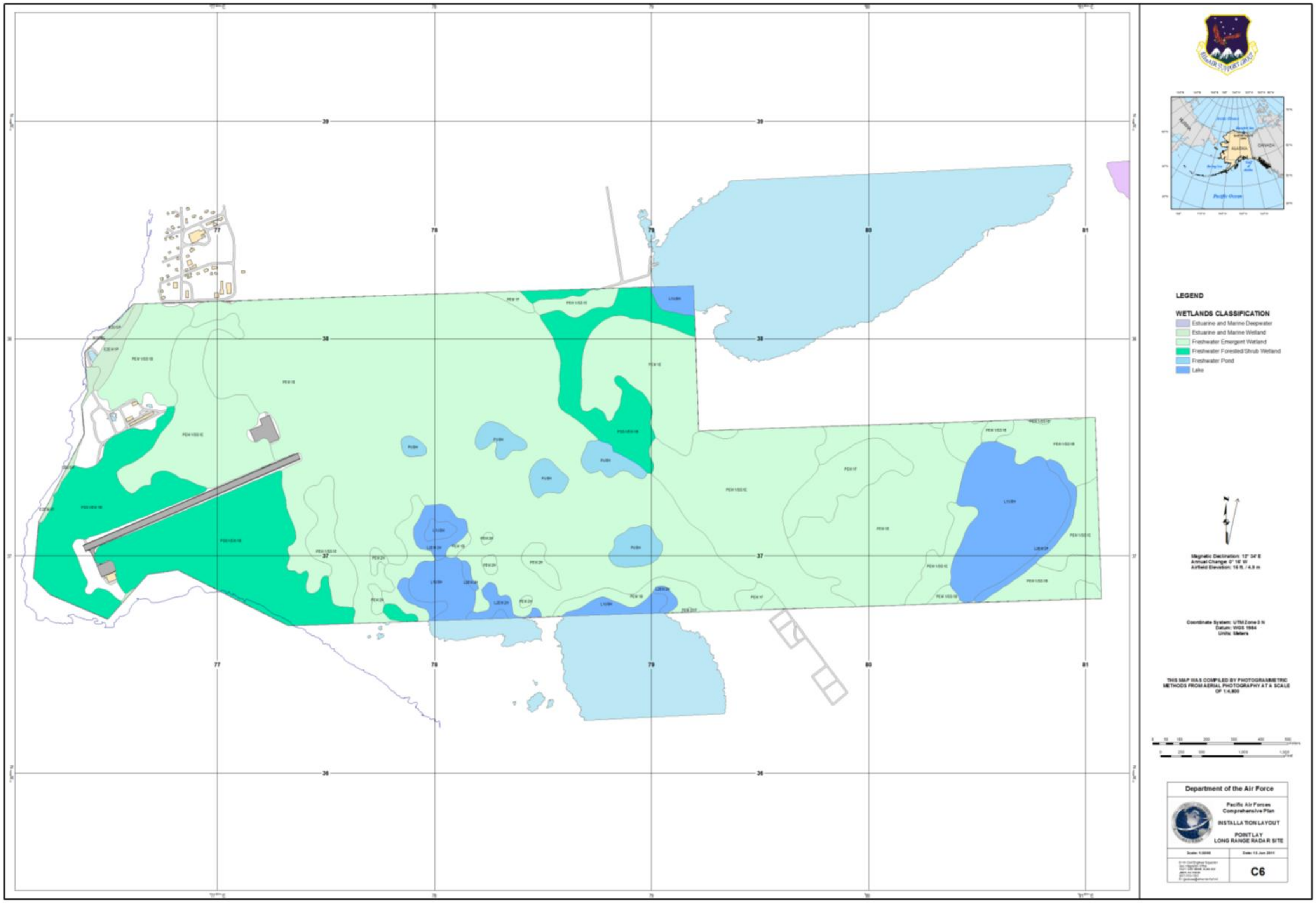


Figure 5.5 Point Lay Site Wetlands, 2011



APPENDIX A: Natural Resources of Various Inactive and Excess Sites

Table A1: Vascular Plant Species Potentially Occurring on or near Point Lay and Point Lonely Sites

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Shrubs				
Alpine bearberry	*Arctostaphylos alpine*		X	
Red-fruit bearberry	*Arctostaphylos rubra*	X	X	
Lapland cassiope	*Cassiope tetragona*	X	X	PL, LAY
Bunchberry	*Cornus canadensis*	X		
Diapensia	*Diapensia lapponica*		X	
White mountain avens	*Dryas octopetala*		X	
Crowberry	*Empetrum nigrum*		X	LAY
Narrowleaf Labrador tea	*Ledum palustre* ssp. *decumbens*	X	X	
Lapland rosebay	*Rhodedendron lapponicum*		X	
Cloudberry	*Rubus chamaemorus*	X	X	
Feltleaf willow	*Salix alaxensis*	X	X	
Arctic willow	*Salix arctica*	X	X	LAY
Barren-ground willow	*Salix brachycarpa*	X	X	
Alaska bog willow	*Salix fuscescens*	X	X	
Grayleaf (northern) willow	*Salix glauca*	X	X	
Richardson willow	*Salix lanata* ssp. *richardsonii*	X	X	
Oval-leafed willow	*Salix ovalifolia*	X	X	
Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X	X	
Diamond-leaf willow	*Salix planifolia ssp. pulchra*	X	X	PL
Polar willow	*Salix polaris*	X	X	PL
Netleaf (net-veined) willow	*Salix reticulata*	X	X	PL
Least (round-leaf) willow	*Salix rotundifolia*	X	X	PL
Bog blueberry	*Vaccinium uliginosum*		X	
Low-bush cranberry	*Vaccinium vitis-idaea*	X	X	PL
Herbaceous Plants				
Alpine foxtail	*Alopecurus alpinus*	X		PL
Rock jasmine	*Androsace chamaejasme*	X	X	
Northern jasmine	*Androsace septentrionalis*	X	X	
Pasque flower	*Anemone drummondii*		X	
Narcissus-flower anemone	*Anemone narcissiflora*		X	
Northern anemone	*Anemone parviflora*	X	X	
Yellow anemone	*Anemone richardsonii*	X	X	
Pussytoes	*Antennaria friesiana*	X	X	
Cats paws	*Antennaria monocephala*	X	X	
Polar grass	*Arctagrostis latifolia*			PL
Pendent grass	*Arctophila fulva*	X	X	PL
Tall sandwort	*Arenaria capillaries*		X	
Alpine arnica	*Arnica alpine*	X		
Frigid arnica	*Arnica frigida*	X	X	
Lessing’s arnica	*Arnica lessingii*		X	

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Arctic wormwood	*Artemisia arctica*	X	X	
Northern wormwood	*Artemisia borealis*	X	X	
Purple wormwood	*Artemisia globularia*		X	
Siberian aster	*Aster sibiricus*	X	X	
Alpine milkvetch	*Astragalus alpinus*	X	X	
Hairy Arctic milkvetch	*Astragalus umbellatus*	X	X	
Moonwort	*Botrychium lunaria*		X	
Bluejoint grass	*Calamagrostis canadensis*		X	LAY
Reed bent grass	*Calamagrostis* sp.	X	X	
Marsh marigold	*Caltha palustris*	X	X	
Bluebell	*Campanula lasiocarpa*	X	X	
Bittercress	*Cardamine digitata*		X	
Cuckoo flower	*Cardamine pratensis*	X	X	
Sedge	*Carex aquatilis*	X	X	PL, LAY
Sedge	*Carex bigelowii*	X		PL
Sedge	*Carex* sp.	X		PL
Elegant paintbrush	*Castilleja elegans*		X	
Paintbrush	*Castilleja* sp.		X	
Chickweed	*Cerastium beeringianum*	X	X	PL
Cushion hawk's beard	*Cerpis nana*		X	
Arctic daisy	*Chrysanthemum arcticum*		X	
Entire-leaved chrysanthemum	*Chrysanthemum integrifolium*	X	X	
Alaska spring beauty	*Claytonia sarmentosa*		X	
Scurvy grass	*Cochlearia officinalis*			PL
Coral root	*Corallorrhiza trifida*	X		
Frigid shooting star	*Dodecatheon frigidum*	X	X	
Ochotsk douglasia	*Douglasia ochotensis*	X	X	
Draba	*Draba alpina*			PL
Smoothing whitlow-grass	*Draba hirta*		X	
Draba	*Draba pseudopilosa*	X		PL
Arctic (mountain) avens	*Dryas integrifolia*	X	X	PL
Eight petaled dryas	*Dryas octopetala*		X	
Tundra grass	*Dupontia fisheri*	X		PL
River beauty (dwarf fireweed)	*Epilobium latifolium*	X	X	
Cutleaf fleabane	*Erigeron compositus*		X	
Fleabane	*Erigeron humilis*		X	
Arctic fleabane	*Erigeron hyperboreus*		X	
Narrow-leafed cotton grass	*Eriophorum angustifolium*			PL
Arctic cotton grass	*Eriophorum scheuchzeri*	X	X	LAY
Sheated cotton grass	*Eriophorum vaginatum*			PL
Arctic forget-me-not	*Eritichum aretioides*	X	X	
Fescue grass	*Festuca sp.*		X	LAY
Alpine fescue	*Festuca brachyphylla*	X		PL
Glaucous gentian	*Gentiana glauca*		X	

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Glacier avens	*Geum glaciale*		X	PL
Alpine eskimo potato	*Hedysarum hedysaroides*		X	
Alpine holy grass	*Hierochloe alpina*			PL
Glaucous weaselsnout (lagotis)	*Lagotis glauca*		X	
Bladder pod	*Lesquerella arctica*	X	X	
Alp lily	*Lloydia serotina*	X	X	
Alpine azalea	*Loiseleuria procumbens*		X	
Arctic lupine	*Lupinus arctica*	X	X	PL
Bladder campion	*Melandrium apetalum*	X	X	
Arctic sandwort	*Minuartia arctica*		X	
Alpine forget-me-not	*Myosotis alpestris*		X	
Mountain sorrel	*Oxyria digyna*			PL
Blackish oxytrope	*Oxytropis nigrescens*	X	X	
Lapland poppy	*Papaver lapponicum*	X	X	PL
Macoun's poppy	*Papaver macounii*	X		
Northern Grass of Parnassus	*Parnassia palustris*	X	X	
Lousewort	*Pedicularis albolabiata*		X	
Capitate lousewort	*Pedicularis capitata*	X		
Wooly lousewort	*Pedicularis kanei*			PL
Oeder's lousewort	*Pedicularis oederi*		X	
Lousewort	*Pedicularis sudetica*	X	X	PL, LAY
Whorled leaf lousewort	*Pedicularis verticillata*	X	X	LAY
Snowgrass	*Phippsia algida*			PL
Siberian phlox	*Phlox sibirica*		X	
Alpine bluegrass	*Poa alpina*		X	
Arctic bluegrass	*Poa arctica*			PL
Blue grass	*Poa glauca*	X	X	LAY
Blue grass	*Poa* sp.	X	X	PL
Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	
Bistort	*Polygonum bistorta*	X	X	
Alpine meadow bistort	*Polygonum viviparum*	X	X	
Two-flowered cinquefoil	*Potentilla biflora*		X	
Arctic cinquefoil	*Potentilla hyparctica*			PL
Marsh fivefinger	*Potentilla palustris*	X	X	
One-flowered cinquefoil	*Potentilla uniflora*	X	X	
Northern primrose	*Primula borealis*	X	X	PL
Large-flowered wintergreen	*Pyrola grandiflora*	X	X	PL
Alkali grass	*Puccinellia andersonii*			PL
Creeping alkali grass	*Puccinellia phryganodes*			PL
Buttercup	*Ranunculus pedatifidus*		X	
Snow buttercup	*Ranunculus nivalis*			PL
Pallas's buttercup	*Ranunculus pallasii*			PL
Buttercup	*Ranunculus* sp.	X		

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Arctic dock	*Rumex arcticus*	X	X	
Dock	*Rumex graminifolius*		X	LAY
Narrow-leafed saussurea	*Saussurea angustifolia*		X	
Spotted saxifrage	*Saxifraga bronchialis*	X	X	
Tufted saxifrage	*Saxifraga caespitosa*			PL
Bulblet saxifrage	*Saxifraga cernua*	X	X	PL
Spiderplant	*Saxifraga flagellaris*	X	X	
Hawkweed-leafed saxifrage	*Saxifraga hieracifolia*	X	X	PL
Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	PL
Cordate-leaved saxifage	*Saxifraga punctata*	X	X	PL
Brook saxifrage	*Saxifraga nelsoniana*		X	
Purple mountain saxifrage	*Saxifraga oppositifolia*	X	X	PL
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*		X	
Marsh fleawort (mastodon flower)	*Senecio congestus*	X	X	
Black-tipped groundsel	*Senecio lugens*	X	X	
Seabeach scenecio	*Senecio pseudo-arnica*	X		
Moss campion	*Silene acaulis*		X	
Smelowskia	*Smelowskia calycina*		X	
Goldenrod	*Solidago multiradiata*	X	X	
Low chickweed	*Stellaria humifusa*			PL
Dandelion	*Taraxacum* sp.	X	X	PL
Capitate valerian	*Valeriana capitata*	X	X	

Observation Codes:
PL - Point Lonely
LAY – Point Lay

Sources:

Elias *et al*., 1996

Hulten, 1968

Jones Technolgies Inc. and Gene Stout and Associates, 1999c

Pratt, 1991

Universe Technologies, Inc. and Gene Stout and Associates, 2001a

Viereck and Little, 1972

White, 1974

Woodward-Clyde, 1995c

Notes:
Species listed alphabetically by scientific name.
Observed species identified during June-July 1999 site visits by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates).

Plant species collected and field identified at Point Lay during 1993 site visit (Woodward-Clyde 1995c) or during 1993-94 site visit by Elias *et al*. (1996).

Table A2: Fish Species Potentially Occurring on or near Point Lay, Point Lonely, Anvil Mountain, Bethel, Big Mountain, Granite Mountain, Naknek Recreation Camps, Nome Field POL, and North River Sites

Common Name	Scientific Name	Point Lonely	Point Lay	Nome Field POL	Anvil Mountain	Granite Mountain	North River	Bethel	Naknek Recreation Camps	Big Mountain
Green sturgeon	*Acipenser medirostris*							X	X	
Arctic cod	*Boreogadus saida*	X	X	X	X					
Longnose sucker	*Catostomus catostomus*						X		X	X
Pacific herring	*Clupea pallasi*	X	X	X	X		X			
Broad whitefish	*Coregonus nasus*	X	X							
Whitefish	*Coregonus sp.*			X	X		X	X		
Humpback whitefish	*Coregonus pidschian*	X	X					X	X	
Least cisco	*Coregonus sardinella*	X	X					X	X	
Bering cisco	*Coregonus laurettae*	X	X							
Arctic cisco	*Coregonus autumnalis*	X	X							
Coast-range sculpin	*Cottus aleuticus*							X	X	X
Slimy sculpin	*Cottus cognatus*							X	X	X
Alaska blackfish	*Dallia pectoralis*						X	X	X	X
Safron cod	*Eleginus gracilis*		X							
Pacific lamprey	*Entosphenus tridentatus*									X
Northern pike	*Esox lucius*		X	X	X	X	X	X	X	X
Three-spine stickleback	*Gasterosteus aculeatus*							X	X	X
Pond smelt	*Hypomesus olidus*							X	X	X
Arctic lamprey	*Lampetra japonica*							X	X	X
Arctic flounder	*Liopsetta glacialis*	X	X	X	X					
Burbot	*Lota lota*	X	X	X	X		X	X	X	X
Eelpout	*Lycodes sp.*		X							
Capelin	*Mallotus villosus*		X							
Pacific tomcod	*Microgadus proximus*			X	X		X			
Fourhorn sculpin	*Myoxocephalus quadricor*	X	X							
Pink salmon	*Oncorhynchus gorbuscha*	X	X	X	X		X	X	X	X

Common Name	Scientific Name	Point Lonely	Point Lay	Nome Field POL	Anvil Mountain	Granite Mountain	North River	Bethel	Naknek Recreation Camps	Big Mountain
Sockeye (red) salmon	*Oncorhynchus nerka*			X	X		X	X	X	X
Chum salmon	*Oncorhynchus keta*	X	X	X	X		X	X	X	X
Coho (silver) salmon	*Oncorhynchus kisutch*			X	X		X	X	X	X
Chinook (king) salmon	*Oncorhynchus tshawytscha*			X	X		X	X	X	X
Rainbow smelt	*Osmerus mordax*	X	X	X	X		X	X	X	
Starry flounder	*Platichthys stellatus*		X					X	X	
Pygmy whitefish	*Prosopium coulteri*							X	X	
Round whitefish	*Prosopium cylindraceum*	X	X					X	X	X
Nine-spine stickleback	*Pungitus pungitus*			X	X			X	X	X
Rainbow trout	*Salmo gairdneri*							X	X	X
Arctic char	*Salvelinus alpinus*	X	X	X	X		X	X	X	X
Dolly Varden	*Salvelinus malma*			X	X		X	X	X	X
Lake trout	*Salvelinus namaycush*							X	X	X
Inconnu (sheefish)	*Stenodus leucichtys*	X				X	X			
Arctic grayling	*Thymallus arcticus*	X	X	X	X	X	X	X	X	X

Sources:
ADFG, 1992
CH2M Hill 1994 (c and d)
Craig, 1984
Flock and Hubbard, 1979
ICF Technology, Inc., 1996e
John Craighead-George, 1993
Jones Technology, Inc., and Gene Stout and Associates; 1999 (b and c), 2000 (and and b)
Morrow, 1980
Robbins *et al.*, 1991
U.S. Army Corps of Engineers 1991
U. S. Department of the Interior, 1987a
USFWS, 1988
Walker, 1993, personal comm.
Woodward-Clyde, 1995b

Table A3: Mammal Species Potentially Occurring on or near Point Lay, Point Lonely, Anvil Mountain, Bethel, Big Mountain, Granite Mountain, Naknek Recreation Camps, Nome Field POL, and North River Sites

Common Name	Scientific Name	Point Lonely	Point Lay	Nome Field POL	Anvil Mountain	Granite Mountain	North River	Bethel	Naknek Recreation Camps	Big Mountain
Brown/grizzly bear	*Ursus arctos*	X	X	X	X	X**	X	X	X	X**
Black bear	*Ursus americanus*							X		
Arctic fox	*Alopex lagopus*	X*	X*	X	X	X	X	X	X	X
Red fox	*Vulpes vulpes*		X*	X	X	X	X	X**	X*	X*
Wolf	*Canis lupus*	X	X	X	X	X**	X	X	X	X**
Coyote	*Canis latrans*								X	
North American lynx	*Felis lynx*			X	X	X	X	X	X	
Least weasel	*Mustela rixosa*	X	X	X	X	X	X	X	X	X
American marten	*Martes americana*									X
Short-tailed weasel (ermine)	*Mustela erminea*	X	X	X	X	X	X	X	X	X
Wolverine	*Gulo gulo*	X	X	X	X	X	X	X	X	X
Mink	*Mustela vison*			X	X	X	X	X	X	X
River otter	*Lutra canadensis*			X	X	X	X	X	X	X
Muskrat	*Ondantra zibethicus*			X	X	X	X	X**	X	X
Beaver	*Castor canadensis*							X	X	X**
Hoary marmot	*Marmora caligata*		X							X
Porcupine	*Erethizon dorsatum*							X	X	X
Tundra hare	*Lepus othus*			X	X	X	X	X	X	
Snowshoe hare	*Lepus americanus*			X	X	X	X	X**	X	X*
Arctic hare	*Lepus arcticus*									X
Arctic ground squirrel	*Spermophilus paryi*	X*	X*	X	X*	X*	X	X	X	X*
Red squirrel	*Tamiasciurus hudsonicus*								X	X
Northern flying squirrel	*Glaucomys sabrinus*									X
Jumping mouse	*Zapus hudsonius*							X	X	X
Brown lemming	*Lemmus trimucronatus*	X**	X	X	X	X	X	X	X	X
Collared lemming	*Dicrostonyx groenlandicus*	X**	X	X	X	X	X			
Bog lemming	*Synaptomys*							X	X	X

Common Name	Scientific Name	Point Lonely	Point Lay	Nome Field POL	Anvil Mountain	Granite Mountain	North River	Bethel	Naknek Recreation Camps	Big Mountain
	borealis									
Varying lemming	*Dicristonyx torquatus*							X	X	X
Little brown bat	*Myotis lucifugus*								X	X
Arctic shrew	*Sorex arcticus*							X		X
Pygmy shrew	*Microsore hoyi*									X
Dusky shrew	*Sorex vagrans*							X	X	X
Masked shrew	*Sorex cinereus*	X				X	X	X	X	X
Tundra shrew	*Sorex tundrensis*					X	X			
Red-backed vole	*Clethrionmys rutilus*			X	X	X	X	X	X	X
Tundra vole	*Microtus oeconomus*	X		X	X	X	X	X	X	X
Meadow vole	*Microtus pennsylvanicus*			X	X	X	X	X	X	X
Alaska vole	*Microtus miurus*			X	X	X	X			X
Moose	*Alces alces*		X*	X	X	X	X	X	X	X**
Musk ox	*Ovibos moschaturs*							X		
Caribou	*Rangifer taranus*	X*	X*	X	X	X*	X	X	X	X**
Reindeer	*Rangifer arcticus*			X	X					
Bowhead whale	*Balaena mysticetus*	X*	X	X						
Beluga whale	*Delphinapterus leucas*	X	X	X					X	
Gray whale	*Eschrichtius robustus*	X	X	X						
Fin whale	*Balaenoptera physalus*	X		X						
Killer whale	*Orcinus orca*	X	X	X						
Minke whale	*Balaenoptera acutorostrata*	X	X	X						
Humpback whale	*Megaptera novaeangliae*	X		X						
North Pacific Right whale	*Balena glacialis*			X						
Harbor porpoise	*Phocoena phocoena*	X	X	X						
Narwhal	*Monodon monoceros*	X								

Common Name	Scientific Name	Point Lonely	Point Lay	Nome Field POL	Anvil Mountain	Granite Mountain	North River	Bethel	Naknek Recreation Camps	Big Mountain
Ringed seal	*Phoca hispida*	X	X	X						
Ribbon seal	*Phoca fasciata*			X						
Bearded seal	*Erignathus barbatus*	X	X	X						
Harbor seal	*Phoca vitulina*								X	
Spotted seal	*Phoca larga*	X	X	X						
Steller sea lion	*Eumetopias jubatus*			X						
Walrus	*Odobenus rosmarus*	X	X	X						
Polar bear	*Ursus maritimus*	X*	X*	X*						

Observation Codes:
* - Observed
** - Tracks, den site, bones, skull observed.
Species observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during 1999 site visits, and as reported by Frost *et al*. (2007).

Sources:
Day *et al*., 1995
DOWL/Ogden Joint Venture, 1998a
EMCON Alaska, Inc., 1996a
Frost *et al*., 2007
Hart Crowser, 1987
ICF Technology, Inc., 1996a
Jones Technology, Inc., and Gene Stout and Associates, 1999 (b and c); 2000 (a, b, and c)
U.S. Dept. Interior, 1987b
USFWS undated (b)
Woodward-Clyde, 1995c
Wynne, 1993

Table A4: Bird Species Potentially Occurring on or near Point Lay and Point Lonely Sites

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Red-throated Loon	*Gavia stellata*	X	X	PL, LAY
Pacific Loon	*Gavia pacifica*	X	X	PL, LAY
Yellow-billed Loon	*Gavia adamsii*	X	X	PL, LAY
Tundra Swan	*Cygnus columbianus*	X	X	PL, LAY
Greater White-fronted Goose	*Anser albifrons*	X	X	PL, LAY
Snow Goose	*Chen caerulescens*	X	X	PL, LAY
Brant	*Branta bernicla*	X	X	PL, LAY
Canada Goose	*Branta canadensis*	X		PL
Green-winged Teal	*Anas crecca*	X	X	PL, LAY
Mallard	*Anas platyrhynchos*		X	LAY
Northern Pintail	*Anas acuta*	X	X	PL, LAY
Northern Shoveler	*Anas clypeata*		X	LAY
Greater Scaup	*Aythya marila*	X	X	PL, LAY
Common Eider	*Somateria mollissima*	X	X	LAY
King Eider	*Somateria spectabilis*	X	X	PL, LAY
Spectacled Eider	*Somateria fischeri*	X	X	PL, LAY
Steller's Eider	*Polysticta stelleri*	X	X	PL, LAY
Long-tailed Duck	*Clangula hyemalis*	X	X	PL, LAY
Surf Scoter	*Melanitta perspicillata*	X	X	LAY
White-winged Scoter	*Melanitta fusca*	X		
Red-breasted Merganser	*Mergus serrator*	X	X	LAY
Rough-legged Hawk	*Buteo lagopus*	X	X	PL*
Peregrine Falcon	*Falco peregrinus*	X	X	PL
Gyrfalcon	*Falco rusticolus*		X	LAY
Willow Ptarmigan	*Lagopus lagopus*	X	X	LAY
Sandhill Crane	*Grus canadensis*		X	LAY
Black-bellied Plover	*Pluvialis squatarola*	X	X	LAY

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
American Golden Plover	*Pluvialis dominica*	X	X	PL*, LAY
Semipalmated Plover	*Charadrius semipalmatus*	X	X	PL, LAY
Killdeer	*Charadriusvociferus*	X		
Bar-tailed Godwit	*Limosa lapponica*	X	X	LAY
Sanderling	*Calidris alba*		X	
Ruddy Turnstone	*Arenaria interpres*	X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	PL*, LAY
Western Sandpiper	*Calidris mauri*	X	X	LAY
Least Sandpiper	*Calidris minutilla*		X	
White-rumped Sandpiper	*Calidris fisciollis*	X	X	
Baird's Sandpiper	*Calidris bairdii*	X	X	PL*, LAY
Pectoral Sandpiper	*Calidris melanotos*	X	X	PL*, LAY
Sharp-tailed Sandpiper	*Calidris acuminata*	X	X	
Dunlin	*Calidris alpina*	X	X	PL*, LAY
Buff-breasted Ssandpiper	*Tryngites subruficollis*	X	X	PL
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	PL*, LAY
Common Snipe	*Gallinago gallinago*	X	X	LAY
Wilson's Snipe	*Gallinago delicata*	X	X	PL, LAY
Red-necked Phalarope	*Phalaropus lobatus*	X	X	PL*, LAY
Red Phalarope	*Phalaropus fulicaria*	X	X	PL*, LAY
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	PL, LAY
Parasitic Jaeger	*Stercorarius parasisticus*	X	X	PL, LAY
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	PL, LAY
Glaucous-winged Gull	*Larus glaucescens*		X	LAY
Glaucous Gull	*Larus hyperboreus*	X	X	PL, LAY
Black-legged Kittiwake	*Rissa tridactyla*		X	
Red-legged Kittiwake	*Rissa brevirostris*		X	LAY
Sabine's Gull	*Xema sabini*	X	X	PL, LAY
Arctic Tern	*Sterna paradisaea*	X	X	PL, LAY

Common Name	Scientific Name	Point Lonely (PL)	Point Lay (LAY)	Observed
Aleutian Tern	*Sterna aleutica*	X		
Black Guillemot	*Cepphus grille*	X		
Kittlitz's Murrelet	*Brachyramphus brevirostris*	X	X	LAY
Snowy Owl	*Nyctea scandiacascandian*	X	X	PL, LAY
Eastern Kingbird	*Tyrannus tyrannus*		X	LAY
Western Kingbird	*Tyrannus verticalis*		X	LAY
Barn Swallow	*Hirundo rustica*	X	X	PL, LAY
Common Raven	*Corvus corax*	X	X	PL, LAY
American Robin	*Turdus migratorius*	X		
Hermit Thrush	*Catharus guttatus*	X		PL
Varied Thrush	*Ixoreus naevius*			PL
Eastern Yellow Wagtail	*Motacella flava*	X	X	PL, LAY
White Wagtail	*Motacella alba*		X	
Red-throated Pipit	*Anthus cervinus*		X	
Yellow-rumped Warbler	*Dendroica coronata*	X		
Savannah Sparrow	*Passerculus sandwichensis*	X	X	PL, LAY
White-crowned Sparrow	*Zonotrichia leucophrys*	X		
Dark-eyed Junco	*Junco hyemalis*	X		PL
Lapland Longspur	*Calcarius lapponicus*	X	X	PL*, LAY
Snow Bunting	*Plectrophenax nivalis*	X	X	PL*, LAY
Common Redpoll	*Carduelis flammea*	X	X	PL, LAY
Hoary Redpoll	*Carduelis hornemanni*	X	X	PL, LAY

Observation Codes:
PL - Point Lonely
LAY - Point Lay
* - Breeding behavior and/or nests observed.

Sources:
Armstrong, 1998
Day *et al*., 1995
Frost *et al*., 2007
Garner and Reynolds, 1987
Gusey, 1988
King, 1977
Murray, 1978
Norton *et al*., 1993
Oasis Environmental, Inc.,

Notes:
Species listed by phylogenic order.
Observed includes species observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during June-July 1999 site visits, species observed by Woodward-Clyde and USAF biologists during a 1993 site visit and USFWS (Andres and Brann, 1997), observations reported by Frost *et al*. (2007), and observed by Oasis Environmental, Inc. (2008).

2008
Pitelka, 1974
Robbins *et al*., 1983
Spindler, 1978, 1979
Woodward-Clyde, 1995c

Appendix 3.0 - Lonely. Point Lonely Former Short Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Point Lonely Former SRRS

3.1 Location and Area

Point Lonely SRRS (inactive site) is located on the Beaufort Sea coast (INRMP Figure 3.1) near Pitt Point and between Smith and Harrison bays. There are no nearby villages. Point Lonely SRRS occupies 1,802 acres (Figure 3.1).

3.2 Installation History

The Point Lonely site was activated in 1953 as an auxiliary radar station in the DEW Line. The DEW radar was removed in 1987, and the DEW site was closed in 1989. The Point Lonely SRRS was built in 1992 and activated in 1993 as an unattended radar. The unattended radar site includes a radar structure, support building, fuel tanks, and a helicopter landing area. The inactive DEW Line facilities include a 5,000-foot gravel airstrip, one 25-module train, a hangar, a warehouse, a garage, a fixed POL tank and four communications antennas. The land comprising the Point Lonely site is managed by the BLM.

Point Lonely SRRS became inactive in 2005. Clean Sweep began at Point Lonely in 2006 and is scheduled to continue till 2015, when the site will become clear of all structures. A contract will be let in 2013. Because the Bureau of Land Management (BLM) manages the land, the Air Force is using a right of entry permit to gain access to buildings, structures and to conduct environmental cleanup and demolition activities.

Figure 3.1 Point Lonely Former SRRS

3.3 Surrounding Communities

No inhabited villages or sites are located near Pitt Point or the Point Lonely site. USAF occupation of the Point Lonely site began in 1953 with construction of an auxiliary DEW line station. The closest community is Nuiqsut, about 75 miles southeast. Nuiqsut has a population of 402 consisting of 87.1 percent Alaska Native or part Native. Most of the population are Inupiat Eskimos practicing a traditional lifestyle. North Slope Borough provides all utilities in Nuiqsut, and most homes have running water to the kitchen. There is one school in the community, which is attended by 91students. Unemployment is high in Nuiqsut. The Kuukpik Native Corporation, school, borough services, and the store provide most year-round employment in the village. Trapping and craft-making provide some income. Year-round access to Nuiqsut is by air transportation, but during ice-out the site can be accessed by sea. Barrow is about 85 miles northwest of the Point Lonely site (www.dced.state.ak.us 2012).

3.4 Regional Land Use

The nearest settlement is the village of Kokruagarok (abandoned), located about four miles east of the site. Kolovik (abandoned) is a historic trapping and trading site about two miles southwest of the site. Other traditional land use and prehistoric sites are known in the vicinity of Point Lonely about 17-20 miles away.

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Point Lonely site.

4.0 Physical Environment

4.1 Climate

The climate is arctic. Temperatures range from -56 to 78 °F. On average, the daily minimum temperature is below freezing 297 days each year. Annual precipitation is light, averaging five inches, with 20 inches of snowfall (www.dced.state.ak.us 2012).

The northern Arctic coast, including the Point Lonely site, has the Arctic Ocean to the west, north, and east and flat tundra stretching 200 miles to the south. There are no natural barriers to the persistent cold easterly winds that blow around the edge of the high pressure area over the North Pole. (CH2M Hill 1981).

Prevailing winds are easterly and average nearly 12 miles per hour with very little annual variation; however, October and November winds are the strongest. Maximum steady wind speeds of 35 mph have been reported every month of the year, and an extreme steady wind of 58 mph was reported in March 1960. Gusts have had much greater speeds, but no record of extreme gusts exists (CH2M Hill 1981).

4.2 Landforms

The Point Lonely site is located in the northern portion of the Arctic Coastal Plain physiographic region on the coast of the Beaufort Sea. The site is on Pitt Point, a broad point of land extending northward toward the Beaufort Sea with elevations ranging from about 6 to 24 feet above msl. The site is on a low, broad, east-west trending slope, about 1.4 miles long and up to about 0.5 miles wide. A large salt-water lagoon is situated between the site and the Beaufort Sea with bluffs on the southern side of the lagoon up to 20 feet high. Swampy, ponded areas occur south and west of the site, and the Smith River is about 1.8 miles east of the site.

4.3 Geology and Soils

The Arctic Coastal Plain is one of the principal areas that was not glaciated (Wahrhaftig 1965). Thus, periglacial features, such as polygonal ground, sorted circles, pingos, and ice wedges, can be observed. At the Point Lonely site tundra mat overlies organic-rich peaty horizons that contain silt, with the Barrow unit of the Gubik Formation underlying the organic mats. Incorporation of organics into lower soil layers is often facilitated by frost churning and/or burial through processes involved with the thaw lake cycle. Soils of the Point Lonely area are moderately frost susceptible due to the high percentage of fine-grained material (Selkregg 1975). Coal, oil, and gas deposits may be present beneath the facility.

The Arctic Slope is underlain by thick continuous permafrost. The interval between permafrost and ground surface is the active zone due to freeze/thaw activity associated with seasonal weather changes. The thickness of the active zone at Point Lonely varies from one to six feet.

The area of the Point Lonely site tends to be relatively free of historic earthquakes. However, faults or folds that displaced Pleistocene deposits were detected at the continental shelf margin about 42 miles north of the site (Grantz *et al*. 1980, 1982).

4.4 Hydrology

The Point Lonely site lies about 0.6 miles from the Beaufort Sea. Surface drainage occurs radially away from the site as sheetflow and ephemeral streams that drain into larger streams or directly into the sea.

Point Lonely's terrain is swampy with low-centered polygons and several small ponds. A large (over 1.2 miles long and 0.5 miles wide) salt-water lagoon lies between the site and the Beaufort Sea. The Smith River is about 1.8 miles east of the site and flows northward to the Beaufort Sea.

When Point Lonely was active, potable water was obtained from a lake about 0.7 miles south of the facilities. During the winter potable water was taken from a larger, deeper lake about six miles from the facilities (ICF Technology, Inc. 1996e).

The Point Lonely groundwater regime is controlled by an extensive permafrost layer underlying the entire region. Groundwater use is limited due to the ephemeral nature of the active zone, and because much of the groundwater is brackish. Suprapermafrost groundwater, groundwater occurring above the permafrost zone, occurs only in summer thaw months. With saturated conditions exist during portions of the summer thaw period, it is difficult to delineate between surface water and this groundwater.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Point Lonely site. Much information included in INRMP Chapter 5.0 that includes Point Lonely site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Point Lonely site and the surrounding area. ***Appendix 3.0-Lay***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Point Lonely site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Point Lonely site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 124 Arctic Tundra Province

Description: This province is a broad, level plain with rolling foothills near the Colville River; in summer there are lakes and marshes dotting the landscape. Winter temperatures can go as low as -60°F and due to the area's northern location receives differing amounts of sunlight throughout the year. Precipitation is low throughout the year, averaging only seven inches. Due to permafrost there are extensive marshes and lakes in the province. The most widespread vegetation system, cottongrass-tussock, grows along with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and cinquefoil. Dominant soils are wet and cold. Upland soils are poorly drained clayey soils. Soils on south slopes and low moraines are well drained and loamy; lowland soils are deep, wet, and silty. Permafrost is continuous throughout the province, reaching depths of 2,000 feet in some areas.

5.2 Vegetation

The Point Lonely site is characterized by coastal tundra typical of the central Beaufort Sea area. Much of the site is covered with high-centered polygons with little topographic relief (< 0.5 m, sometimes referred to as "flat-topped polygons"). Vegetative cover in these areas typically is almost 100% and is dominated by vascular plants, such as *Carex aquatilis*, *Carex bigelowii*, *Salix planifolia*, and *Dryas integrifolia*, and various moss and lichen species. Shallow low-centered polygons (< 0.5 m relief), dominated by moist tundra vegetation, are also present. These areas provide suitable nesting habitat for several species of *Calidris* sandpipers and Lapland Longspur. Lake and pond complexes with moist strangmoor ridges, peninsulas, and islands are also present, and provide goose and duck nesting habitat. Large drained lake basins, which are covered with wet, non-patterned tundra dominated by *Carex aquatilis* and *Eriophorum angustifolium*, provide good nesting habitat for *Calidris* sandpipers and phalaropes (Ritchie *et al*. 2003).

The Smith River is nearby and has extensive areas of arctic saltmarsh with islands that are dominated by *Carex subspathacea* and *Puccinellia phryganodes*. These saltmarsh areas provide good brood rearing habitat for waterfowl, especially geese. A small sandy/cobbly spit forms a large lake between the coast and the site. Some areas of flat tundra along the immediate coast are saline-influenced from storm surges and have patches of driftwood and bare peat and mud. These areas support a mixture of typical moist tundra plants and more halophytic species, such as *Stellaria humifusa* and *Cochlearia officinalis* (Ritchie *et al*. 2003).

A general vegetation map of the Point Lonely site was presented in the draft 1995 Natural Resources Plan (Woodward-Clyde 1995c). Further improvements in vegetation mapping at active radar sites, including Point Lonely, occurred in 2002 (Ritchie *et al*. 2003) when flora and fauna surveys were conducted and a wildlife habitat map was prepared for the Point Lonely site. Results of the 2002 survey are discussed above.

Schick *et al*. (2004) made significant improvements in vegetation mapping at Point Lonely site (using 2000 digital aerial photos) with the preparation of a wildlife habitat map (detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a) and flora and fauna surveys. The habitat assessment map and data were updated following 2006 Eider surveys (Frost *et al*. 2007). Details and specific results of this survey are in Figure 5.2and Table 5.2, for which data include USAF property and a 150-meter buffer outside the property boundary.

Surveys have identified 21 distinct wildlife habitat types (Figure 5.2) using ground-truthing surveys at the site. The habitat map was updated following 2006 Eider surveys (Frost *et al*. 2007). At the Point Lonely site, four habitats combined covered >75% of the site: Lowland Moist-Sedge Shrub Tundra (29.4%), Lowland Wet-Moist Patterned Tundra Complex (22.2%), Marine Nearshore Water (13.0%), and Lowland Wet-Moist Nonpatterned Tundra Complex (11.9%) and 12 habitats were limited in areal extent (<2%) (Schick *et al*. 2004).

Figure 5.2 Point Lonely Wildlife Habitat Map, 2000

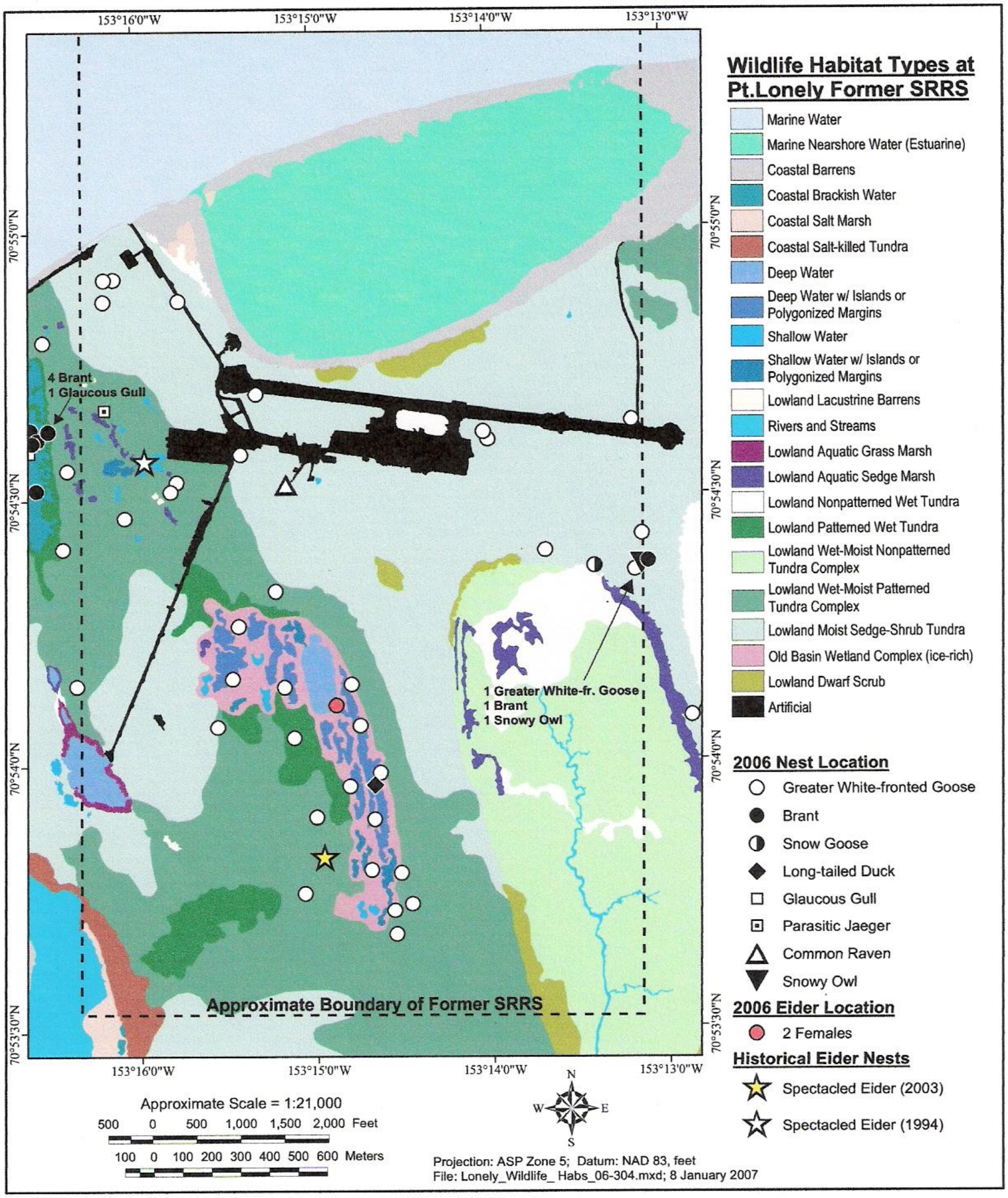


Table 5.2 Total Area and Percent Cover of Wildlife Habitat Types and Landcover Types Mapped within each Habitat Type at Point Lonely Site, 2000

Wildlife Habitats and Landcover Types	Hectares	Acres	%
Marine Nearshore Water (Estuarine)	97.5	240.9	13.0
Coastal Barrens	30.5	75.4	4.1
Coastal Brackish Water	3.8	9.4	0.5
Coastal Salt Marsh	3.7	9.1	0.5
Coastal Salt-killed Tundra	6.5	16.1	0.9
Deep Water	5.8	14.3	0.8
Deep Water w/ Islands or Polygonized Margins	7.5	18.5	1.0
Shallow Water	1.8	4.4	0.2
Shallow Water w/ Islands or Polygonized Margins	2.1	5.2	0.3
Lowland Lacustrine Barrens	0.2	0.5	<0.1
Rivers and Streams	14.8	36.6	2.0
Lowland Aquatic Grass Marsh	1.4	3.5	0.2
Lowland Aquatic Sedge Marsh	8.0	19.8	1.1
Lowland Nonpatterned Wet Tundra	20.8	51.4	2.8
Lowland Patterned Wet Tundra	18.8	46.5	2.5
Lowland Wet–Moist Nonpatterned Tundra Complex	89.0	219.9	11.9
Lowland Wet–Moist Patterned Tundra Complex	166.6	411.7	22.2
Lowland Moist Sedge–Shrub Tundra	220.5	544.9	29.4
Young Basin Wetland Complex (Ice-rich)	16.5	40.8	2.2
Lowland Dwarf Scrub	9.8	24.2	1.3
Artificial	24.5	60.5	3.3
Totals	**750**	**1,853**	**100**

5.3 Fish and Wildlife

5.3.1 Fish

Freshwater and anadromous fish likely use the interconnected lakes and ponds of the Smith River system for spawning, rearing, migration, and feeding. Species common to the area of Point Lonely include Arctic cisco, Arctic char, Arctic grayling, nine-spined stickleback, and Alaska blackfish (National Petroleum Reserve in Alaska Task Force 1978). Teshekpuk Lake (15 miles southwest of the site) provides recreational opportunities for fishing but only during limited portions of the year. Fish from the area are used for subsistence.

5.3.2 Mammals

Brown lemmings are probably the most obvious terrestrial mammal in the immediate vicinity of the site. This rodent, a staple food for Arctic foxes and avian predators, shows extreme population fluctuations in 3- to 5-year cycles. Arctic fox, collared lemmings, masked shrew, microtene rodents, and weasels occur at Point Lonely (Hart Crowser 1987). Barren-ground caribou of the Teshekpuk Lake herd range throughout the area with principal calving grounds southwest of the site along the western edge of Teshekpuk Lake. Caribou are the primary subsistence use species in the area of Point Lonely.

Marine mammals occurring in offshore waters near Point Lonely include the endangered bowhead whale (USFWS 2011), gray whales, beluga whales, and ringed seals. The whales pass the area on their annual migrations, and ringed seals are associated with the shear zone between the pack ice and shorefast ice during the winter. Polar bears, a protected species under the provisions of the Marine Mammal Protection Act, may visit the area during winter but are present less often during summer.

5.3.3 Birds

The wet tundra environment within and adjacent to the site provides nesting and foraging habitat for a wide variety of bird species. The Teshekpuk Lake area, 15 miles southwest of the site, contains some of the best waterbird breeding, molting, and premigratory staging habitat in arctic Alaska (Derksen *et al*. 1981). Several million migratory birds of at least 150 species use the area during their migratory cycle. The primary breeding passerine is the Lapland Longspur, which some are thought to overwinter in the area (ICF Technology, Inc. 1996b). Year-round residents include the Snow Bunting, Snowy Owl, Common Raven, and Willow Ptarmigan (Hart Crowser 1987, USFWS 1982a).

Surveys at the Point Lonely site have documented nesting by the threatened Spectacled Eider and confirmed observations of the Spectacled Eider and the threatened Steller's Eider (Schick *et al*. 2004).

Greater White-fronted Goose was the most common nesting species observed at the site in 2003, and Common Raven was the only species identified nesting in artificial habitat at the site (Schick *et a*l. 2004). Several species of Sandpipers, Red and Red-necked Phalarope, and Plovers have been observed nesting on the site. Loons, Northern Pintail, Scaup, and Eiders are some of the more commonly occurring waterfowl species in the area. Sea ducks that frequent nearshore areas include Long-tailed Ducks, Scoters, and Red-breasted Merganser. Predatory species, such as the Snowy Owl and Jaegers, are common in the area, particularly when lemming and ground squirrel populations are high.

5.4 Threatened and Endangered Species

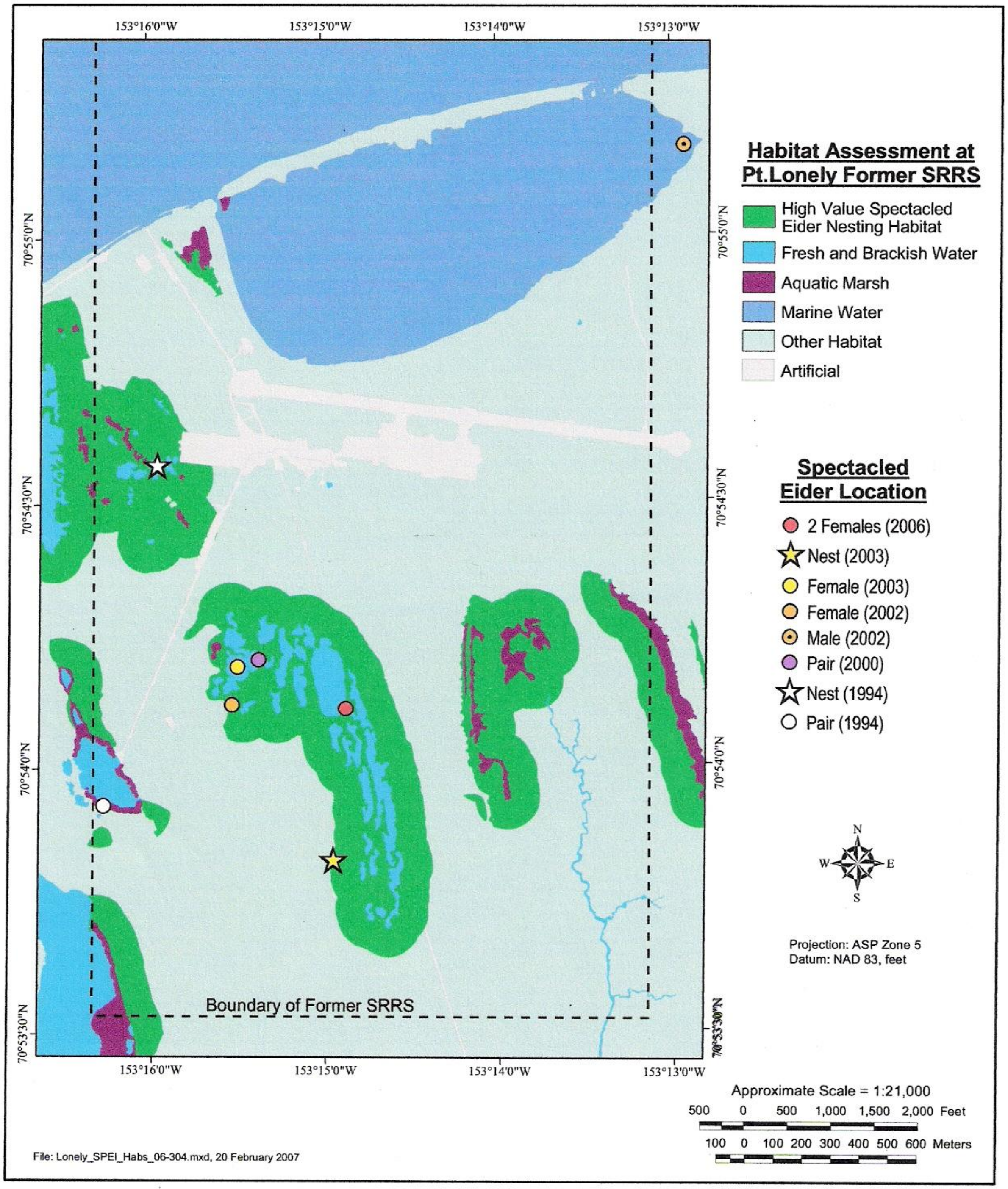
Several federally-protected species (USFWS 2011) potentially occur in the Point Lonely area, including the endangered bowhead whale, threatened Spectacled Eider, Steller's Eider, and polar bear, candidate Yellow-billed Loon, and threatened ringed seal. Polar bears are also protected under the provision of the Marine Mammal Protection Act. Potentially occurring in the area are endangered humpback and fin whales, candidate Pacific walrus, and threatened bearded seal.

Day *et al*. (1995) surveyed for Spectacled Eider and Steller's Eider at remote USAF sites. During the 1994 study, a pair of Spectacled Eiders were observed and one Spectacled Eider nest was found at the Point Lonely site. At least two eggs hatched from this nest. During brood-rearing surveys two female-plumaged Steller's Eider were observed at the site. Point Lonely is one of five remote USAF sites with the greatest potential for having nesting Spectacled Eider and Steller's Eider and one of four sites with the greatest potential for nesting or brood-rearing based on habitat suitability (Day *et al*. 1995).

During Eider surveys in 2002 two Spectacled Eiders were observed at the Point Lonely site (Ritchie *et al*. 2003). During Eiders surveys in 2003 Spectacled Eiders were recorded at two locations; one female on a deep open water lake and one successful Spectacled Eider nest at the Point Lonely site. Nest remains indicated that at least two eggs had successfully hatched (Schick *et al*. 2004). Oasis Environmental, Inc.'s (2008) 2007 monitoring effort did not locate any active nests or observe Spectacled or Steller's Eiders at Point Lonely site.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Point Lonely site, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller's Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004). The candidate Yellow-billed Loon is known for Point Lonely site.

Figure 5.4 Spectacled Eider Habitat Assessment at Point Lonely Site



5.5 Wetlands

Wetlands of the Point Lonely site consist of moist tussock tundra (*i.e.*, low-relief wet meadow) and extensive patches of wetlands (especially low-centered permafrost polygons with low-relief wet meadows) occurring within drained-lake basin complexes. The northern edge of the site borders a large, brackish lagoon (Ritchie *et al*. 2003).

The general Point Lonely site vegetation map's wetland features (Woodward-Clyde 1995c) were significantly updated by a NWI map (completed during 2000-2005) and mapping done by Schick *et al*. (2004). Table 5.2 shows wetland acreages at Point Lonely site. Figure 5.5 shows NWI wetlands (1,808.63 acres) on Point Lonely site from 2011 data.

5.6 Other Natural Resources Information

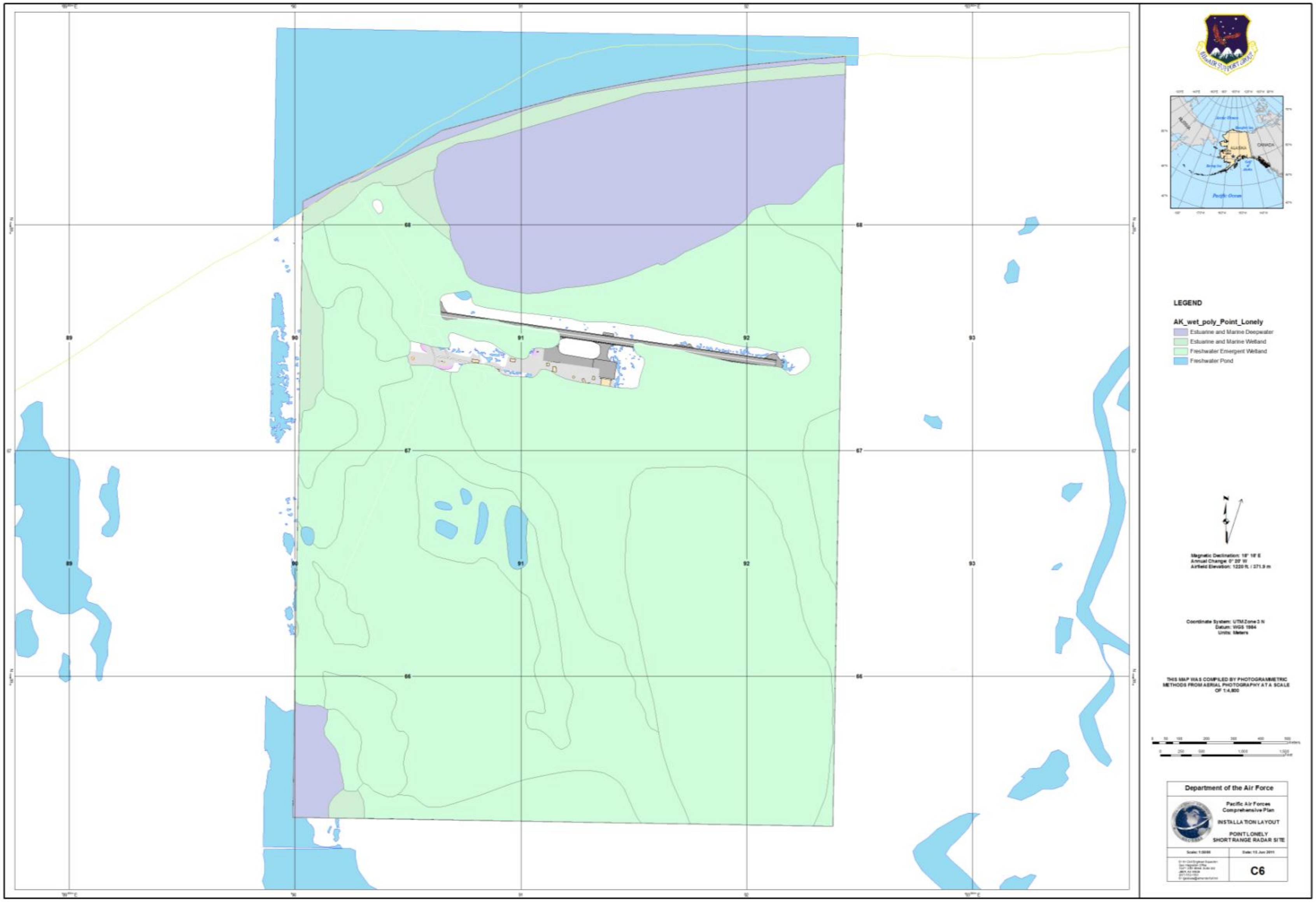
5.6.1 Subsistence

Barrow is located about 85 miles northwest of the Point Lonely site. Barrow is one of 10 Alaska Eskimo Whaling Commission communities. Hunting bowhead whales is a key activity in the organization of social relations in the community. Of all subsistence activities, bowhead whaling represents one of the greatest concentrations of effort, time, money, group symbolism, and significance. The Barrow subsistence use area includes a large geographic area extending from Wainwright to Nuiqsut. Barrow residents rely heavily on large land and marine mammals and fish. Bowhead whale, caribou, walrus, and whitefish account for about 85 percent of Barrow's annual subsistence harvest in terms of edible pounds (Braund & Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation at the Point Lonely site is very limited due primarily to the remote location. The only year-round access is by charter aircraft. Teshekpuk Lake, 15 miles southwest of Point Lonely, provides opportunities for sport fishing during limited times of the year.

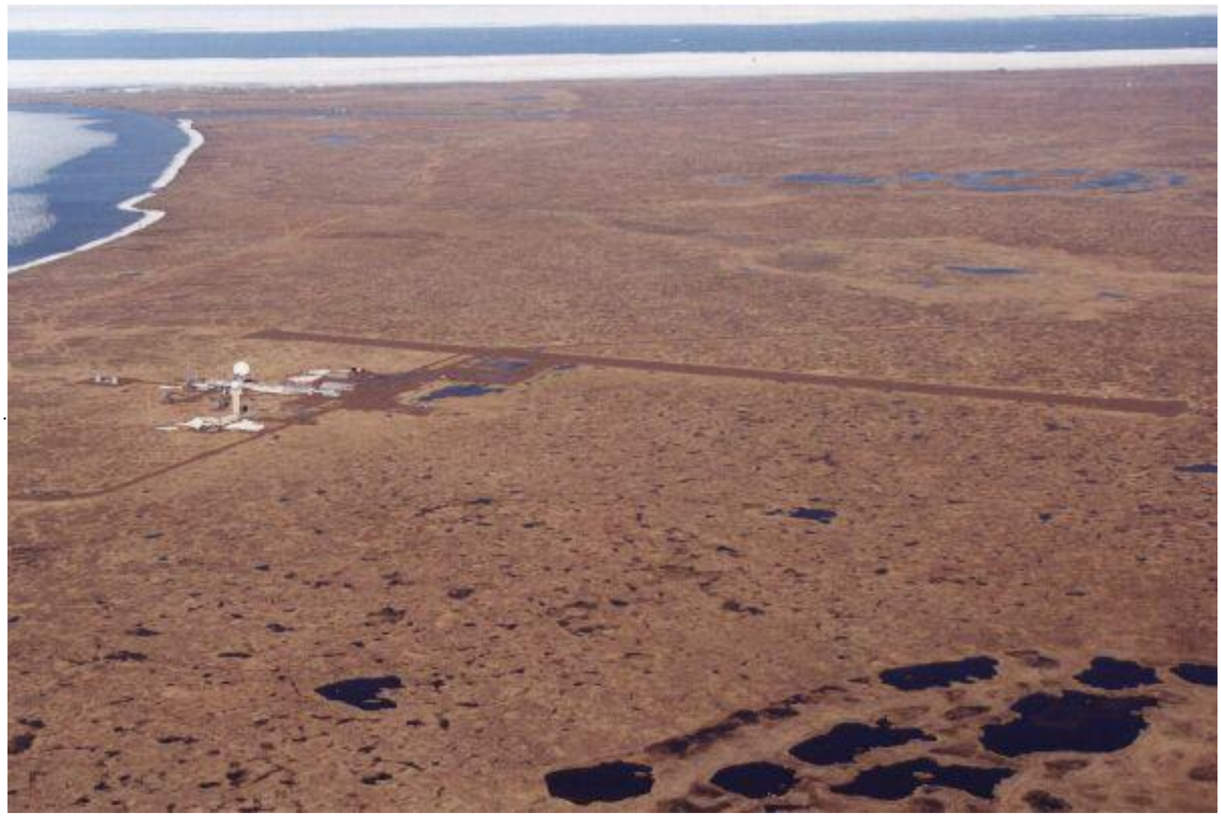
Figure 5.5 Point Lonely Site Wetlands, 2011



Appendix 3.0 – Wainwright. Wainwright Former Short Range Radar Site

3.0 Installation Overview

Figure 3.0 Aerial View of Former Wainwright SRRS



3.1 Location and Area

Wainwright SRRS (inactive site) occupies about 1,519 acres at the mouth of the Kuk River on the Chukchi Sea (Figure 3.1). Located about 4.5 miles southeast from Wainwright, Alaska, Wainwright SRRS is about 90 miles southwest of Barrow (INRMP Figure 3.1).

3.2 Installation History

The land occupied by the Wainwright SRRS is managed by the BLM. The property is solely used by the USAF. The SRRS was built in 1953 as an auxiliary DEW Line station. The installation was active until 1989. In 1995 construction was completed on the UAR radome tower, electrical power station, primary distribution line, diesel storage tank, pipeline, satellite communication ground terminal, beacon light, and helicopter pad with airfield special lighting. More recently, the site operated as an unmanned site, with exception of periodic maintenance of the active radar system. Wainwright SRRS has been deactivated and is now an Inactive Site.

Figure 3.1 Wainwright Former SRRS

Clean Sweep building demolition and clean up occurred in 2009-12 at Wainwright site and included about 80 different items, such as water and fuel tanks and pipelines, buildings, etc. Demolition and removal of contaminated soils are scheduled for 2013.

3.3 Surrounding Communities

The native village of Wainwright is about 4.5 miles northwest of the USAF site. The region around Wainwright was traditionally well-populated, though the present village was not established until 1904 when the Alaska Native Services built a school and clinic. The site was reportedly chosen by the captain of the ship delivering school construction materials because sea-ice conditions were favorable for landing. Coal was mined at several sites near the village and used for fuel (www.dced.state.ak.us 2012).

Wainwright became a city in 1972. Wainwright has a population of 556 (2010 estimate) with 90.1 percent being Alaska Native or part Native. Most of the population is Inupiat Eskimos who practice a subsistence lifestyle. Their ancestors were the Utukamiut (people of the Utukok River) and the Kukmiut (people of the Kuk River) (www.dced.state.ak.us 2012).

Wainwright is relatively isolated in the region, which affects economic opportunities. Jobs are provided primarily by the local and federal government. These include North Slope Borough (NSB) Capitol Improvement Projects (construction) and NSB police department, fire department, schools, health clinics, water treatment plant, and social service office. Other jobs include a store and movie theater (www.dced.state.ak.us 2012).

Subsistence-oriented hunting, fishing, and camping are common activities for Wainwright residents. Caribou, bowhead and beluga whales, seals, walrus, polar bears, birds, and fish are important natural resources to the community.

3.4 Regional Land Use

Wainwright is a small Inupiat (Northern Eskimo) village on the Arctic coast. Several cultural resources sites of traditional importance have been documented in the Wainwright area. Most of these are traditional use areas. The nearest site is in the immediate vicinity of the SRRS and has mythological significance. The other sites range from 1.5 to 11 miles from the SRRS and include trapping, hunting, fishing, and camping areas; sod house ruins; a coal reserve that was exploited until 1965; a gravel site; and the site of the old village of Wainwright, which was last occupied from 1902 through 1906. These sites have not been evaluated for listing in the National Register of Historic Places.

3.5 Local and Regional Natural Areas

Portions of the Alaska Maritime NWR are near Wainwright SRRS. The NWR is spread along most of the 47,300 miles of Alaska’s coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada’s Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime’s seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska’s nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The climate is arctic. Temperatures range from -56 to 80 °F. Precipitation is light, averaging five inches annually, with 12 inches of snow. The Chukchi Sea is ice-free from mid-July through September (www.dced.state.ak.us 2012). The record high temperature of 80°F occurred in July 1955, while the record low temperature of -56°F occurred in February 1964 (Hart Crowser, Inc. 1987).

Storms are primarily from the west during summer when a high pressure system centered over the northern Pacific forces storms northward through the Bering Strait, where they turn easterly toward the former SRRS. Prevailing winds are easterly and average nearly 10 mph. November winds are strongest, but there is very little monthly variation. Maximum steady winds of 35 mph can occur in any month, and gusts can occasionally attain much greater speeds (ICF Technology, Inc. 1996f).

4.2 Landforms

The Wainwright site is within the Arctic Coastal Plain physiographic region. The site is located on a bluff east of the Wainwright Inlet and the Kuk River. The site is generally flat with local topographic features that include high- and low-centered polygons and small thaw lakes and ponds. The slope from the site to Wainwright Inlet is about one-half mile long. The Wainwright site lies at an elevation of about 55 feet above msl (ICF Technology, Inc. 1996f).

4.3 Geology and Soils

The geology of the Wainwright site is characteristic of regional geology. The upper 12-18 inches of material consists of Holocene-age silty loam and an organic layer, tundra mat, which provides an insulating barrier between air and underlying perennially frozen ground (permafrost). The presence of numerous small lakes, ponds, and areas of standing water indicates that the silty loam is generally poorly drained. The active zone (the area above the permafrost that freezes and thaws seasonally) at Wainwright is estimated to range from one to six feet in thickness. Undifferentiated bedrock and coal-bearing rocks are exposed in the Kuk River and along sea cliffs northeast of Wainwright. Thick coal deposits are present under the installation.

4.4 Hydrology

The village of Wainwright and the Wainwright site are near the Kuk River and Wainwright Inlet, the dominant surface water features in the area. The Kuk River is 7-12 feet deep and 1.7 miles wide near the site, flowing north into Wainwright Inlet. Wainwright Inlet is a brackish to saline water body up to 16 feet deep, 6.4 miles long, and 3.5 miles wide. The area surrounding the site is drained by the Sinaruruk River (five miles north), Omikak Creek (two miles south), and their tributaries. Surface water flow in non-patterned ground areas is largely suprapermafrost sheet flow that channels into numerous small creeks.

Permafrost throughout the area precludes the development of groundwater as a drinking water source. When the SRRS was active, two unnamed lakes supplied potable water. A small freshwater lake supplied water during summer; a larger freshwater lake supplied water during winter.

Water for the village of Wainwright is obtained from Merekruak Lake, three miles northeast of the community and is stored in tanks. Honey buckets are commonly used for sewage disposal, and the majority of homes have running water for kitchen use. The village continues to develop a flush haul system.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to the Wainwright site. Much information included in INRMP Chapter 5.0 that includes Wainwright site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Wainwright site and the surrounding area. ***Appendix 3.0-Bullen***, Appendix A contains lists of vascular plants (Table A1), mammals (Table A2), and birds (Table A3). Fish species on Wainwright site and the surrounding area are in ***Appendix 3.0-Barter***, Appendix A, Table A2. These species lists have been combined in the two other site-specific appendices for brevity purposes. Threatened or Endangered Species that may occur at Wainwright site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 124 Arctic Tundra Province
Description: This province is a broad, level plain with rolling foothills near the Colville River; in summer there are lakes and marshes dotting the landscape. Winter temperatures can go as low as -60°F and due to the area's northern location receives differing amounts of sunlight throughout the year. Precipitation is low throughout the year, averaging only seven inches. Due to permafrost there are extensive marshes and lakes in the province. The most widespread vegetation system, cotton grass-tussock, grows along with sedges, dwarf shrubs, lichens, mosses, dwarf birch, Labrador-tea, and

cinquefoil. Dominant soils are wet and cold. Upland soils are poorly drained clayey soils. Soils on south slopes and low moraines are well drained and loamy; lowland soils are deep, wet, and silty. Permafrost is continuous throughout the province, reaching depths of 2,000 feet in some areas.

5.2 Vegetation

The wet sedge meadow environment of Wainwright site is characteristic of about three-quarters of the Arctic Coastal Plain. A vegetation survey performed in 1999 (Universe Technologies, Inc. and Gene Stout and Associates 2001a) identified 54 species.

Schick *et al*. (2004) mapped habitat at Wainwright site using 2000 digital aerial photography and conducted flora and fauna surveys (map and detailed methodology shown in Gene Stout and Associates and Blythe & Trousil 2007a). Wells *et al*. (2010) updated this mapping and data analysis for Wainwright site using 2006 pan-sharpened QuickBird aerial photos. Table 5.2 shows changes in acreage between 2000 and 2006. Figure 5.2a shows these habitat classes for 2006. Figure 5.2b shows habitat changes between 2000 and 2006. Figure and table data include USAF property and a 150-meter buffer outside the property boundary.

Wainwright site is dominated by well-drained, high-centered polygons with deep troughs (> 0.5 m relief), some with standing water. The high-centered polygons are largely covered by small tussocks of *Eriophorum vaginatum* (<= 20 cm high) and other acidic tundra plants such as *Rubus Chamaemorus*, *Cassiope tetragona*, *Ledum palustre*, *Vaccinium vitis-idea*, and various moss and lichen species. These areas provide suitable habitat for Lapland Longspur, Golden Plover, and Black-bellied Plover. The high-centered polygons alternate with large thaw lakes with elevated banks, and drained lake basins covered with wet tundra (dominated by *Carex aquatilis* and *Eriophorum angustifolium*). Drained lake basins often have partially-vegetated standing water and irregularly-shaped open water bodies. These drained lake basins provide good nesting habitat for *Calidris* sandpipers, phalaropes, and loons.

There are some clearly defined creek drainages in the vicinity of the site, and the site is noticeably elevated above the Kuk River, perhaps by as much as 8-10 m. Small bluffs along the Kuk River exhibit a thin band of saline-influenced tundra directly below and along the sandy/cobbly shore. These areas are characterized by a mixture of halophytic plant species, such as *Stellaria humifusa*, *Puccinellia phryganodes*, *Cochlearia officinalis*, and more typical moist tundra plants. A small sandy/cobbly spit forms a large lake along the shore of the Kuk River. Numerous Yellow-billed Loons were observed using this lake and waters of the Kuk River during the 1999 survey.

Wainwright site includes 18 different wildlife habitat types. Three habitats combined cover ~80% of the site: Lowland Moist Tussock Tundra (46.2%), Lowland Moist Sedge-Shrub Tundra (22.2%), and Lowland Aquatic/Wet/Moist Pond Complexes (11.0%). Other habitats with cover >2% include habitats dominated by lakes and ponds: Coastal Brackish Water, Deep Water, and Lowland Aquatic/Wet Pond Complexes (Schick *et al*. 2004).

Table 5.2 Area of Habitat Classes and Differences between Years in Habitat Classes Mapped from 2000 and 2006 Imagery, Wainwright Site

Habitat Class	Acres 2000	Acres 2006	Acreage Change
Artificial (including Artificial Partially Revegetated, Artificial Barrens, and Artificial Waterbody for 2006)	33.8	33.8	0.0
Coastal Barrens	9.5	21.7	+12.2
Coastal Brackish Water	69.6	58.7	-4.5
Deep Water	153.8	150.8	-3.0

Habitat Class	Acres 2000	Acres 2006	Acreage Change
Deep Water w/Islands or Polygonized Margins	23.3	23.1	-0.2
Lowland Aquatic Grass Marsh	42.6	44.4	+1.8
Lowland Aquatic Sedge Marsh	24.0	24.0	0.0
Lowland Dwarf Scrub	6.8	6.8	0.0
Lowland Lacustrine Barrens	0.1	0.0	-0.1
Lowland Moist Sedge–Shrub Tundra	1,402.3	1,400.8	-1.5
Lowland Moist Tussock Tundra	28.8	32.2	+3.4
Lowland Nonpatterned Wet Tundra	99.4	90.7	-8.7
Lowland Patterned Wet Tundra	58.6	66.1	+7.5
Marine Nearshore Water (Estuarine)	326.1	324.9	-1.2
Old Basin Wetland Complex (Ice-rich)	155.7	155.9	+0.2
Rivers and Streams	4.5	5.2	+0.7
Shallow Water	6.3	6.3	0.0
Shallow Water w/Islands or Polygonized Margins	3.6	3.5	-0.1
Totals	**2,448.6**	**2,448.6**	**0.0**

* Some changes are associated with imagery changes between years and/or altered disturbance regimes or recovery of vegetation. See Wells *et al*. (2010) for data adjustments.

Habitat ground-truthing surveys conducted in 2003 identified 18 wildlife habitat types at Wainwright site. Twelve habitat types were limited in areal extent (<2%). Over half of the site is covered by Lowland Moist Sedge-Shrub Tundra (57.3%). The next most abundant habitat types are associated with waterbodies: Marine Nearshore Water (13.3%), Old Basin Wetland Complex (6.4%), and deep Water (6.3%) (Schick *et al*. 2004).

5.3 Fish and Wildlife

5.3.1 Fish and Aquatic Invertebrates

Common anadromous fish species found in the Kuk River include salmon, Arctic cisco, whitefish, and smelt. Nine-spined stickleback and Alaska blackfish are likely present in wetlands, ponds, and thaw lakes (Hart Crowser 1987). Such waters also have seasonal significance for spawning, rearing, and feeding activities of other fish species.

Invertebrates that may be present in the waters and wet habitats of the Arctic Coastal Plain are well represented by the crustaceans (*i.e*., copepods, isopods, amphipods, and decapods) (ICF Technology, Inc. 1996g).

5.3.2 Mammals

The dominant herbivore around the site is the brown lemming. Other small mammals include the masked shrew, tundra vole, and weasels. Other herbivorous mammals include the caribou. Carnivorous mammals include the Arctic fox, red fox, and brown/grizzly bear (Hart Crowser 1987, Woodward-Clyde 1995c). Site observations during 2000 found arctic ground squirrels present and numerous burrows excavated in portions of the airfield, helipad, and other fill areas.

Calving activity of the Barren-ground caribou appears to be concentrated along the Utukok River, south of the former SRRS (Cuccarese *et al*. 1984). The site and the adjacent area are used during post-calving movements and dispersal. The area south of the Kuk River is reportedly used for over-wintering (ICF Technology, Inc. 1996f).

Figure 5.2a Wainwright Site Wildlife Habitat Map, 2006

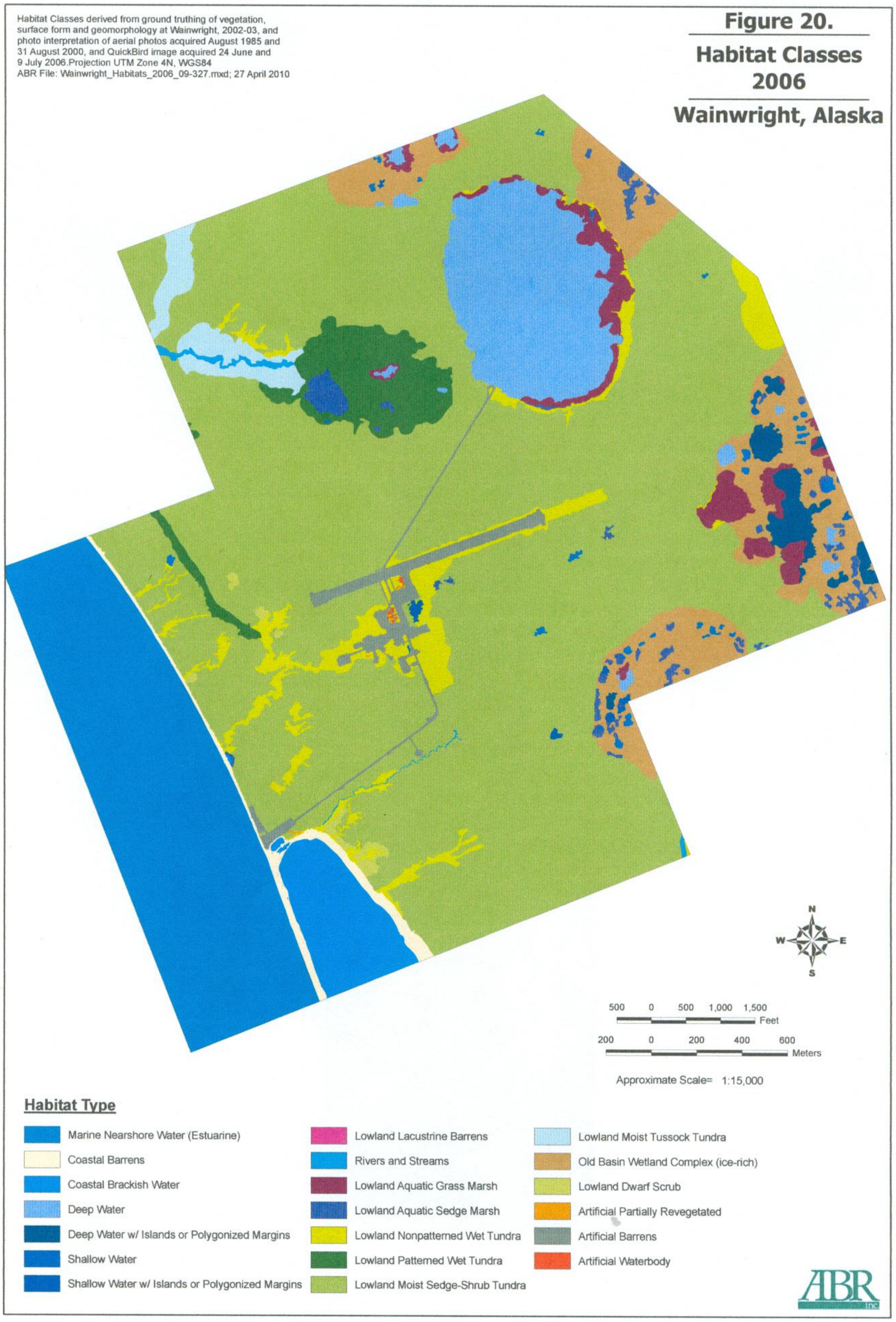


Figure 5.2b Wainwright Site Habitat Class Changes, 2000-2006

Marine mammals occurring in the nearshore waters of Wainwright include the gray whale, beluga whale, bearded seal (threatened), ringed seal (threatened), Pacific walrus, and the endangered bowhead whale. In addition, the fin whale (endangered), the sei whale (endangered), and the hump-backed whale (endangered) occur in the Arctic Coastal Plain and nearby waters (ICF Technology, Inc. 1996f). Polar bears range throughout the area during winter (National Petroleum Reserve in Alaska Task Force 1978), but there is no evidence of local denning activities.

Most marine mammals are under the jurisdiction of the NMFS. However, walruses and polar bears are under the jurisdiction of the USFWS. Wainwright is within the range of the threatened polar bear, a protected species under the provision of the MMPA (Bridges 2001).

5.3.3 Birds

The wet tundra environment within and adjacent to the former SRRS provides nesting and foraging habitat for a wide variety of bird species. The site is located along the migratory corridor for shorebirds and waterfowl. Some of the most common shorebird species occurring in the area of the Wainwright site include Dunlin and Phalaropes, Sandpipers, and Plovers. Glaucous Gulls and all species of Jaegers prey on small mammals of the wet tundra. During a 1999 survey, the Semi-palmated and Pectoral Sandpiper, Red and Red-necked Phalarope, and Plovers were commonly observed.

Passerine species that use the tundra in the area include the Snow Bunting, Lapland Longspur, Savannah Sparrow, and Common Redpoll. Long-tailed, Parasitic, and Pomarine Jaeger were observed, and Willow Ptarmigan were observed and heard vocalizing during 1999 site visits.

The Wainwright area is frequented by large numbers of waterfowl during the post-breeding molt and fall migration. Waterfowl are hunted by local natives at Wainwright throughout the summer. Representative waterfowl species include the Common Eider, King Eider, several Loon species, Brant, Northern Pintail, Green-winged Teal, White-fronted Goose, and Scaup.

The USFWS breeding bird survey (Andres and Brann 1997) on an Army National Guard training area at Barrow is an applicable addition to the database for the Arctic Coastal Plain. This four-day study confirmed 45 species.

5.4 Threatened and Endangered Species

Several federally-protected species are known to occur in the Wainwright area, including the endangered bowhead, fin and humpback whale, threatened Spectacled Eider and polar bear, candidate Yellow-billed Loon, and Pacific walrus, and threatened ringed and bearded seals. The threatened Steller's Eider may also occur in the area.

A 1994 survey (Day *et al*. 1995) did not observe or find evidence (nests) of the Spectacled or Steller's Eider at Wainwright site, but based on general geographic distribution, Wainwright has potential for having both nesting Spectacled and Steller's Eider. Wainwright's suitable habitats cover little of the site, which results in low overall potential for nesting eiders. During 2003 ground-based surveys, the first Spectacled Eider nest was identified at the site since surveys were initiated in 1994. Three adult Spectacled Eiders also were observed within the former SRRS near the eastern boundary (Schick *et al.* 2004). An active Spectacled Eider nest was found in the same wetland complex at Wainwright site in 2006 (Frost *et al*. 2007). Oasis Environmental, Inc. (2008) flushed four hens at Wainwright site.

Figure 5.4 provides a habitat assessment for the Spectacled Eider at Wainwright site, per recommendation by Day *et al*. (1995). This figure was taken from the *Spectacled and Steller's Eiders Surveys and Habitat Mapping at U.S. Air Force Radar Sites in Northern Alaska* (Schick *et al*. 2004).

5.5 Wetlands

Wainwright site includes a number of wetland types (Table 5.2, above), including Marine Nearshore Water (Estuarine) (324.9 acres, 13.3%), Coastal Brackish Water (58.7 acres, 2.4%), Deep Water (150.8 acres, 6.2%), Lowland Aquatic Grass Marsh (44.4 acres, 1.8 %), and Old Basin Wetland Complex (155.9 acres, 6.4%) (Wells *et al*. 2010). General Wainwright site's wetland features were significantly updated by a NWI map (completed during 2000-2005) and mapping done by Schick *et al*. (2004) and Wells *et al.* (2010). Table 5.2 shows wetland acreages at Wainwright site. Figure 5.5 shows NWI wetlands (1,112.93 acres) on Wainwright site from 2011 data.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Wainwright is one of the eight North Slope Borough communities. The Kuk River extends 50 miles inland from Wainwright, and it provides a travel corridor for inland hunting and fishing throughout the year by boat and by snowmachine. The Wainwright setting provides residents with harvest opportunities on the Chukchi Sea, access to the unique lagoon habitat, and the riparian habitat of the Kuk River and its tributaries. Wainwright is one of the 10 Alaska Eskimo Whaling Commission communities. Hunting bowhead whales is a communal activity that supplies important meat and maktak for the entire community, feasts and ceremonies. Bowhead whaling represents a significant concentration of effort, time, money, and group symbolism. Residents of Wainwright utilize a generalized subsistence use area along the coast from Cape Sabine in the south to Nulivak in the north and inland along the Meade and Colville rivers and their associated tributaries. Wainwright residents rely heavily on large terrestrial and marine mammals. Bowhead whales, caribou, walrus, and bearded seals account for about 90 percent of Wainwright's annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

5.6.2 Outdoor Recreation

611 ASG personnel and contractors who periodically visit Wainwright for environmental restoration or demolition of inactive facilities would have little to no opportunity for recreational use of natural resources in the area. Some outdoor recreation opportunities available in the Wainwright site area include game and waterfowl hunting, ATV riding along gravel roads, and boating and limited fishing in the Kuk River and Wainwright Inlet.

Figure 5.4 Spectacled Eider Habitat Assessment at Wainwright Site

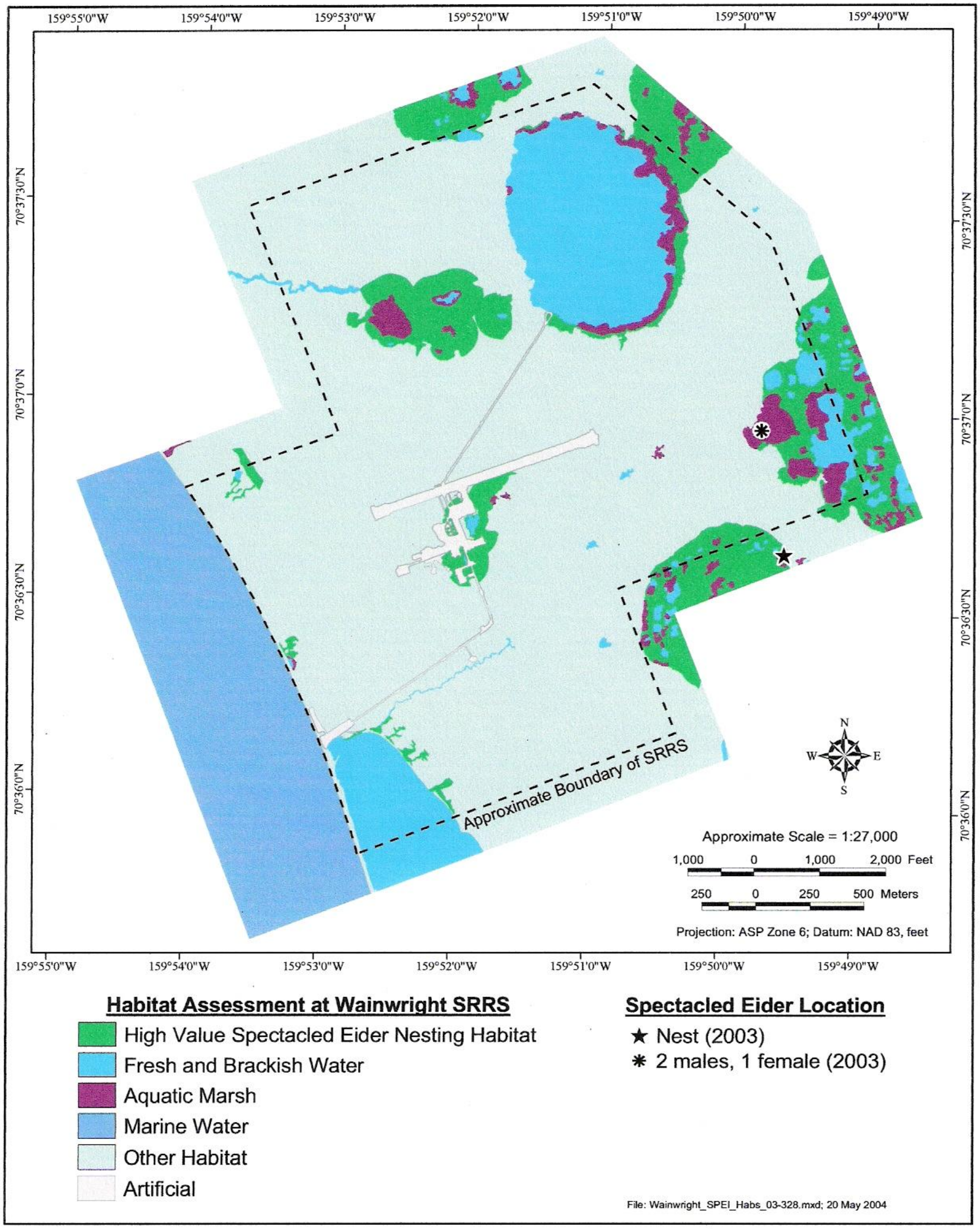
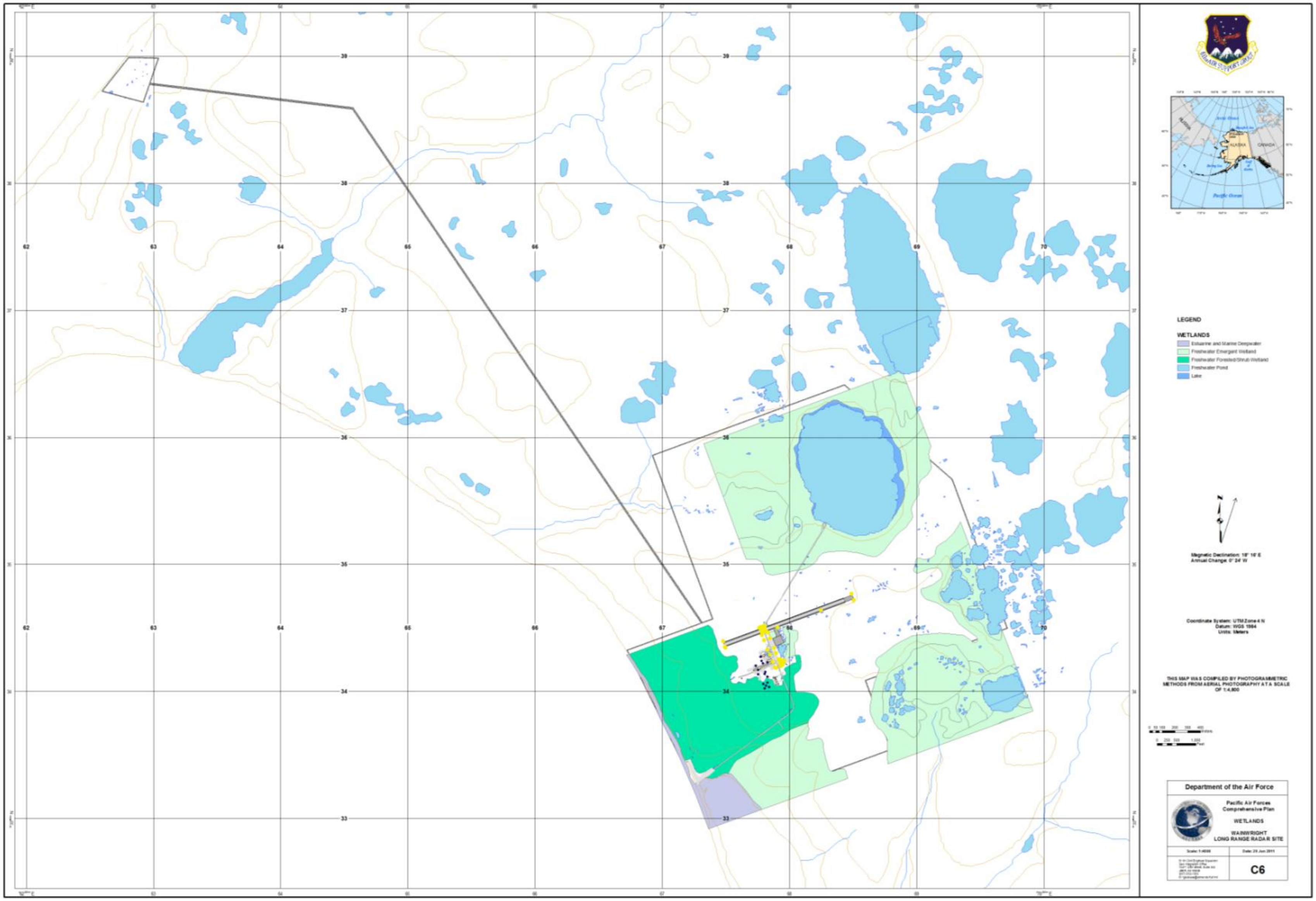


Figure 5.5 Wainwright Site Wetlands, 2011



Appendix 3.0 - Anvil. Anvil Mountain Radio Relay Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Former Anvil Mountain RRS

3.1 Location and Area

The Anvil Mountain excess site is on the Seward Peninsula about three miles north of the City of Nome, Alaska (INRMP Figure 3.1). Nome is about 539 miles northwest of Anchorage, Alaska. The site occupies 12 acres on the summit of Anvil Mountain (Figure 3.1).

3.2 Installation History

According to AF Form 1192 (28 Mar 1958), the installation was established in 1944. Though not documented, Anvil Mountain may have been the location or associated with the Nome location, one of six temporary radar sites of Alaskan Interim Aircraft Control and Warning System or the Lashup system that operated from 1949 to 1952. The Anvil Mountain site was developed in 1956 as a Radio Relay Site (RRS) to support the air defense system constructed in Alaska during the early 1950s. In 1957 a WACS was constructed on the site. The installation consisted of a composite building, a vehicle operations building (temporary garage), a vehicle maintenance building, four WACS antennas, two 70,000-gallon fuel storage tanks, several above-ground tanks for antenna heating systems, and associated fuel distribution piping. The WACS site was active until 1979 when it was replaced with a commercial satellite earth terminal. The site was declared excess in 1981. From 1956 to 1983 the United Smelting, Refining, and Mining Company and the city of Nome had rights-of-way for underground communications cables. Portions of the Anvil Mountain site were leased to various tenants during 1979 to 1993. In 1989 the two 70,000-gallon fuel tanks, five 1,000-gallon above-ground fuel tanks, and the vehicle maintenance building were transferred to the Nome Public School District. Demolition of remaining facilities, except the four WACS tropospheric antennas and the concrete slab where the temporary garage had been, occurred in 1999 and 2000. In 2010-11 PCB contamination was remediated at Anvil Mountain site. In 2011 some structures were demolished and removed.

Figure 3.1 Anvil Mountain Former RRS

3.3 Surrounding Communities

Nome has a population of 3,598 (2010) consisting of 54.8 percent Alaska Native or American Indian. Nome is the supply, service, and transportation center of the Bering Strait region. Government services provide most employment. In 2010, 43 residents held commercial fishing permits. Retail services, transportation, mining, medical and other businesses provide year-round employment. Nome has facilities common to most contemporary communities, such as a library, museum, visitor’s center, recreation center, two radio stations, a fire department, two meeting/conference facilities, a hospital, and about 200 businesses. Several small gold mines continue to provide some employment. Subsistence activities contribute to the local diet (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Gold first brought people, in large numbers, to the Nome area. Gold was discovered in Anvil Creek in 1898. Almost overnight an isolated stretch of tundra fronting the beach was transformed into a tent-and-log cabin city of 20,000 (www.dced.state.ak.us 2012). Nome suffered major fires in 1905 and 1934 and violent storms in 1900, 1913, 1945, and 1974, which left little of Nome’s gold rush architecture. Nome was the last stop on the ferry system for planes flying to the U.S.S.R. for the Lend/Lease program during World War II. The current airstrip was built, and many troops were stationed in Nome (www.dced.state.ak.us 2000).

3. 5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Anvil Mountain site.

4.0 Physical Environment

4.1 Climate

January temperatures range from -3 to 11 °F; July temperatures are typically 44 to 65° F. Average annual precipitation is 18 inches, with 56 inches of snowfall (www.dced.state.ak.us 2012). Mean summer temperatures range from 39° to 56°F, while mean winter temperatures range from -3° to 14°F. Maximum and minimum temperatures of 86°F and -46°F have been recorded (Arctic Environmental Information and Data Center [AEIDC] 1989).

The Anvil Mountain site has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. The area receives relatively little precipitation compared to other parts of Alaska. Annual precipitation averages 15.6 inches, with 10.5 inches of rain falling during summer and 54.8 inches of snow falling during winter (AEIDC 1989). Prevailing winds are from the north and average nearly 11 miles per hour.

4.2 Landforms

The Anvil Mountain site is located near the southwestern tip of the Seward Peninsula in western Alaska. Topography in the vicinity of Nome is relatively flat, becoming steeper to the north. The Anvil Mountain site is on a topographic high point at an elevation of about 1,100 feet above msl (U.S. Army Corp of Engineers 1997). Anvil Mountain is part of a series of hills and ridges oriented predominantly north-south and located north of the south coastal plain of the Seward Peninsula. Anvil Mountain’s WACS antennas are the prominent feature of the area’s skyline.

4.3 Geology and Soils

The Anvil Mountain area was subject to alpine glaciation during the Pleistocene Epoch. Paleozoic to Tertiary metamorphic and igneous rocks are folded into broad anticlines and synclines. Most rocks of the

Seward Peninsula are of sedimentary origin and are highly metamorphosed, consisting primarily of limestone overlain by schistose rocks. The Anvil Mountain site is within the Norton Sound Highlands.

The area is generally characterized by soils of the Histic Pergelic Cryaquepts-Pergelic Cryorthents association (Soil Conservation Service 1979). These soils consist of silt loam to very gravelly silt loam covered by a thin layer of organic soil. The site is underlain by a thin layer of silty topsoil covering schist rock, limestone, or broken and loose metamorphic mica-quartz. Slopes at the site vary from flat to 25 percent with some rock outcrops occurring.

4.4 Hydrology

Anvil Mountain site does not exhibit well defined drainage patterns; however, potential drainages from Anvil Mountain lead to tributary systems of two rivers, the Snake River and Nome River. Major named drainages of Anvil Mountain are Little Specimen Gulch and Cooper Gulch, which lead to the Snake River drainage, and Grass Gulch and Wet Gulch, which lead to the Nome River drainage. Anvil Creek is about 1½ miles west, and Bear Creek is about ¾ of a mile east of the Anvil Mountain site. Anvil and Bear creeks are tributaries of the Snake River. Dexter Creek is about one mile northeast of the summit of Anvil Mountain and discharges into the Nome River.

Moderately thick (90-120 feet deep) to relatively thin permafrost occurs in the area (Hart Crowser, Inc. 1997a), and the site is underlain with a 3-5 foot thick layer of permafrost. When Anvil Mountain was active, potable water was trucked to the site. There is no evidence of a groundwater table at the site (U.S. Army Corps of Engineers 1997). The primary drinking water supply for the city of Nome and Perkinsville is Moonlight Springs, an artesian spring about 1½ miles southwest of the summit of Anvil Mountain.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Anvil Mountain site. Much information included in INRMP Chapter 5.0 that includes Anvil Mountain site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Anvil Mountain site and the surrounding area. Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Anvil Mountain site. Fish and mammal species on Anvil Mountain site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively, combined for brevity purposes. Threatened or Endangered Species that may occur at Anvil Mountain site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M125 Seward Peninsula Tundra-Meadow Province
Description: The landscape of this province contains broad convex hills and flat divides cut by sharp V-shaped valleys. Rising above coastal lowlands and interior basins are isolated groups of rugged glaciated mountains with elevations of 2,500-4,700 feet. Winters are long and cold followed by short, cool summers. Average precipitation is 18 inches with heavy snowfall in winter and heavier concentrations of rain in summer. At lower elevations are moist and wet tundra communities; alpine tundra communities are found in high mountains. The vegetation is mostly sedge tussocks with scatterings of willows and birches; isolated spruce-hardwood forests also exist. Dominant soils for the province are Inceptisols; permafrost can be found throughout the province.

5.2 Vegetation

Vegetation within and around the Anvil Mountain site is characterized as moist tundra and high brush. Moist tundra usually completely covers the ground and can be productive during the growing season. The tundra varies from an almost continuous and uniformly developed cotton grass tussock growth to stands devoid of tussocks where dwarf shrubs dominate. The soil is commonly saturated, and mosses and lichens grow in channels between tussocks. High brush often occurs as a type that may be interspersed with reindeer lichens, low heath-type shrubs, or patches of tundra. Alders tend to occupy wetter sites; birch prefer more mesic areas; and tundra patches occur within the driest, most wind-exposed locations (Selkregg 1984).

A vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001c) identified 59 species during a 1999 site visit. The Anvil Mountain site is characterized by moist sedge/willow tundra. The site is dominated by arctic/alpine species such as *Carex microchaeta*, *Empetrum nigrum*, *Dryas octopetala*, *Salix reticulata*, and *S. planifolia* ssp. p*ulchra*. Gravel pads and roadsides are naturally revegetating to shrubby willows, dominated by *S. alexensis* and *S. planifolia* ssp. *pulchra*.

A general vegetation map of the Anvil Mountain site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Anvil Mountain site.

5.3 Fish and Wildlife

5.3.1 Fish and Aquatic Invertebrates

A variety of fish inhabit coastal waters near the Anvil Mountain site, including all five species of Pacific salmon (king, sockeye, coho, chum, and pink), Pacific cod, Arctic char, and halibut. Freshwater fish habitat in the area near the site includes primarily the Nome and Snake rivers and their tributaries. Freshwater fish include Arctic grayling, rainbow trout, whitefish, and northern pike. Marine invertebrates are abundant in Norton Sound and clams and crabs, particularly king crabs, are commonly harvested by subsistence and commercial users (CH2M Hill 1994a).

5.3.2 Mammals

Terrestrial mammals inhabiting the Seward Peninsula area are found in or around Anvil Mountain site (Bee and Hall 1956). A commercial reindeer herd is managed in the Anvil Mountain area, and their range surrounds the site. The site also is near to coastal waters of Norton Sound with its marine mammals.

5.3.3 Birds

The moist tundra and brush environment within and adjacent to the site provides nesting and foraging habitat for a wide variety of bird species. Breeding birds in the Anvil Mountain area are characteristic of arctic/alpine sites in Alaska and include American Pipit, Fox Sparrow, Golden-crowned Sparrow, Savannah Sparrow, and Lapland Longspur (USFWS 2004b).

The USFWS breeding bird survey (Andres and Brann 1997) on Army National Guard training areas at Teller, White Mountain, and Elim, Alaska is an applicable addition to the database for southern Seward Peninsula. The 1997 survey occurred over three to four days at each site, confirming 12, 25, and 26 species, respectively.

5.4 Threatened and Endangered Species

The threatened polar bear is known in the Anvil Mountain site area. However, the potential exists for several federally-protected species to occur in the Nome area, including the endangered bowhead, fin, and humpback whales and Steller's sea lion, threatened Spectacled Eider and Steller's Eider, and candidate Yellow-billed Loon and Kittlitz's Murrelet (USFWS 2011). There is low potential for either the Spectacled or Steller's Eider to nest or visit the Anvil Mountain site since there is no suitable habitat.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Anvil Mountain site.

5.6 Other Natural Resources Information

5.6.1 Subsistence

The City of Nome is associated with the Anvil Mountain and site. Regardless of the ethnic background or employment status, subsistence plays an important role in Nome. Ninety-five% of residents in 1995 used at least one subsistence resource, and 65% used at least six different wild resources. Harvest estimates are exclusively for birds and eggs. A large portion of the bird and egg harvest in 1995 consisted primarily of migratory birds, upland birds, and sea bird and loon eggs. Fish harvest includes salmon, Dolly Varden, grayling, and whitefish. Nome residents harvest such marine mammals as bearded, ringed, and spotted seals. In general, Nome residents use an area that consists of Norton Sound, west to Bering Strait, and all watersheds draining the southern portion of the Seward Peninsula between Golovin Bay and Port Clarence (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at the Anvil Mountain site include small and big game hunting and nonconsumptive activities, such as ATV riding along gravel roads and bird watching. The limited hunting that occurs on the site primarily consists of subsistence harvest of animals and the collection of vegetation for greens and berries by local residents.

APPENDIX A: Natural Resources of Anvil Mountain, Granite Mountain, Nome Field POL, and North River Sites

Table A1: Vascular Plant Species Potentially Occurring on or near Anvil Mountain, Granite Mountain, Nome Field POL, and North River Sites

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Shrubs						
American green alder	*Alnus crispa*	X	X	X	X	GM, NR
Sitka alder	*Alnus sinuata*	X	X			
Thinleaf alder	*Alnus tennuifolia*			X	X	
Bog-rosemary	*Andromeda polifolia*	X	X	X	X	GM
Alpine bearberry	*Arctostaphylos alpina*	X	X	X	X	
Red-fruit bearberry	*Arctostaphylos rubra*	X	X	X	X	GM, NR
Kinikinik	*Arctostaphylos uva-ursi*			X	X	
Alaska sagebrush	*Artemisia alaskana*			X	X	
Dwarf Arctic birch	*Betula nana*	X	X	X	X	AM, GM, NR
Paper birch	*Betula papyrifera*				X	NR
Four-angled cassiope	*Cassiope tetragona*	X	X	X	X	AM, GM
Leatherleaf	*Chamaecyparis calyculata*	X	X	X	X	
Bunchberry	*Cornus canadensis*	X	X	X	X	NR
Red-osier dogwood	*Cornus stolonifera*			X	X	
Diapensia	*Diapensia lapponica*	X	X	X	X	AM, GM
Entire-leaf mountain avens	*Dryas integrifolia*	X	X			
White mountain avens	*Dryas octopetala*	X	X	X		TF, AM, GM
Crowberry	*Empetrum nigrum*	X	X	X	X	TF, AM, GM
Common juniper	*Juniperus communis*			X	X	
Tamarack	*Larix laricina*			X	X	
Narrowleaf Labrador tea	*Ledum palustre* ssp. *decumbens*	X	X	X	X	AM, GM, NR
Labrador tea	*Ledum palustris* ssp. *groenlandicum*			X	X	
Twin-flower	*Linnaea borealis*	X	X	X	X	
Alpine-azalea	*Loiseleuria procumbens*	X	X	X	X	AM, GM, NR
Sweet gale	*Myrica gale*			X	X	
White spruce	*Picea glauca*	X	X	X	X	NR
Black spruce	*Picea mariana*			X	X	NR

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Balsam poplar, cottonwood	*Populus balsamifera*	X		X	X	TF, GM, NR
Quaking aspen	*Populus tremuloides*			X	X	NR
Shrubby cinquefoil	*Potentilla fruiticosa*	X	X	X	X	
Kamchatka rhododendron	*Rhododendron camtshaticum*		X			AM
Lapland rosebay	*Rhodedendron lapponicum*	X	X			
Currant	*Ribes* sp.	X	X	X	X	
American red currant	*Ribes triste*	X	X	X	X	NR
Prickly rose	*Rosa acicularis*	X	X	X	X	
Nagoonberry	*Rubus arcticus*	X	X	X	X	TF, GM, NR
Cloudberry	*Rubus chamaemorus*	X	X	X	X	GM, NR
American red raspberry	*Rubus idaeus* var. *strigosus*			X	X	
Feltleaf willow	*Salix alaxensis*	X	X	X	X	TF, AM, GM, NR
Littletree willow	*Salix arbusculoides*	X	X	X	X	NR
Arctic willow	*Salix arctica*	X	X		X	NR
Barren-ground willow	*Salix brachycarpa*	X	X			
Chamisso willow	*Salix chamissonis*	X	X	X		AM, GM
Alaska bog willow	*Salix fuscescens*	X	X	X		TF, GM
Grayleaf (northern) willow	*Salix glauca*	X	X	X	X	TF, AM, NR
Halberd willow	*Salix hastata*	X	X	X	X	
Sandbar willow	*Salix interior*			X	X	
Richardson willow	*Salix lanata* ssp. *richardsonii*	X	X	X	X	
Oval-leafed willow	*Salix ovalifolia*	X	X			TF
Skeleton leaf (veiny-leafed) willow	*Salix phlebophylla*	X	X	X	X	GM, NR
Diamond-leaf willow	*Salix planifolia* ssp. *pulchra*	X	X	X	X	TF, AM, GM, NR
Polar willow	*Salix polaris*			X		GM
Netleaf (net-veined) willow	*Salix reticulata*	X	X	X		TF, AM, GM
Least (round-leaf) willow	*Salix rotundifolia*	X	X	X		AM, GM
Green Mountain ash	*Sorbus scopulina*			X	X	
Beauverd spirea	*Spiraea beauverdiana*	X	X	X	X	GM, NR

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Trisetum	*Trisetum spicatum*	X		X	X	TF, GM, NR
Bog blueberry	*Vaccinium uliginosum*	X	X	X	X	TF, AM, GM, NR
Low-bush cranberry	*Vaccinium vitis-idaea*	X	X	X	X	TF, AM, GM, NR
Highland cranberry	*Viburnum edule*			X	X	
Herbaceous Plants						
Baneberry	*Acatea rubra*			X	X	
Common yarrow	*Achillea millefoilum*	X				TF
Siberian yarrow	*Achillea sibirica*			X	X	
Monkshood	*Aconitium delphinifolium*	X	X	X	X	GM
Musk root (moschatel)	*Adoxa moschatellina*			X	X	GM
Wild chives	*Allium schoenoprasum*	X	X	X	X	
Round leaf orchid	*Amerorchis rotundifolia*	X	X	X	X	
Bog rosemary	*Andromeda polifolia*			X	X	
Rock jasmine	*Androsace chamaejasme*	X	X			AM
Northern jasmine	*Androsace septentrionalis*	X	X			
Drummond’s anemone	*Anemone drummondii*	X	X	X	X	
Narcissus-flower anemone	*Anemone narcissiflora*	X	X	X	X	AM, GM, NR
Northern anemone	*Anemone parviflora*	X	X	X	X	AM
Yellow anemone	*Anemone richardsonii*	X	X	X	X	GM
Anemone	*Anemone* sp.			X	X	
Wild celery	*Angelica lucida*	X	X	X	X	AM
Pussytoes	*Antennaria friesiana*	X	X	X	X	
Cats paws	*Antennaria monocephala*		X	X		AM, GM
Lyre-leaf rockcress	*Arabis lyrata*				X	NR
Pendent grass	*Arctophila fulva*	X	X	X	X	
Bearberry	*Arctostaphylos rubra*		X			AM
Frigid arnica	*Arnica frigida*	X	X	X	X	
Lessing’s arnica	*Arnica lessingii*	X	X	X	X	AM, GM, NR
Arctic wormwood	*Artemisia arctica*	X	X	X	X	AM, GM, NR
Northern wormwood	*Artemisia borealis*	X	X	X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Yellow ball wormwood	*Artemisia senjavinensis*	X	X			
Common wormwood	*Artemisia tilesii*	X	X	X	X	TF, AM, NR
Pussytoes	*Artennaria friesiana*			X		GM
Siberian aster	*Aster sibiricus*	X	X	X	X	NR
Alpine milkvetch	*Astragalus alpinus*	X	X	X	X	NR
Milkvetch	*Astragalus eucosmus*				X	NR
Hairy Arctic milkvetch	*Astragalus umbellatus*	X	X			
Wintercress	*Barbarea orthoceras*	X	X		X	NR
Beckmannia	*Beckmannia erucaeformis*	X	X	X	X	
Broomrape	*Boschniakia rossica*	X	X	X	X	
Moonwort	*Botrychium lunaria*	X	X	X	X	
Alaska boykinia	*Boykinia richardsonii*		X	X	X	AM
Bluejoint grass	*Calamagrostis canadensis*	X	X	X	X	TF, GM, NR
Reed bent grass	*Calamagrostis* sp.	X	X	X	X	
Wild calla lily	*Calla palustris*			X	X	
Marsh marigold	*Caltha palustris*	X	X	X	X	NR
Bluebell	*Campanula lasiocarpa*	X	X	X	X	
Bittercress	*Cardamine bellidifolia*			X		GM
Bittercress	*Cardamine digitata*	X	X	X	X	
Cuckoo flower	*Cardamine pratensis*	X	X	X	X	GM, NR
Sedge	*Carex aquatilis*	X	X	X	X	GM, NR
Sedge	*Carex atherodes*			X	X	
Sedge	*Carex bigelowii*	X	X	X	X	GM, NR
Sedge	*Carex lyngbyaei*	X	X			
Sedge	*Carex nespophila*		X	X	X	AM, GM, NR
Sedge	*Carex* sp.	X	X	X	X	TF, AM
Elegant paintbrush	*Castilleja elegans*	X	X			
Paintbrush	*Castilleja hyperborea*			X		GM
Paintbrush	*Castilleja* sp.	X	X	X	X	
Chickweed	*Cerastium beeringianum*	X	X	X	X	NR
Strawberry blight	*Chenopodium capitatum*			X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Arctic daisy	*Chrysanthemum arcticum*	X	X			
Entire-leaved chrysanthemum	*Chrysanthemum integrifolium*	X	X			
Mackenzie water hemlock	*Cicuta mackenzienana*			X	X	
Alaska spring beauty	*Claytonia sarmentosa*	X	X	X	X	
Spring beauty	*Claytonia tuberosa*			X		GM
Coral root	*Corallorrhiza trifida*	X	X	X	X	
Northern lady's slipper	*Cypripedium passerinum*	X	X	X	X	
Arctic larkspur	*Delphinium glaucum*			X	X	
Deschampsia	*Deschampsia brevifolia*			X	X	
Frigid shooting star	*Dodecatheon frigidum*	X	X	X	X	AM
Douglasia	*Douglasia gormanii*			X	X	
Mustard	*Draba* sp.		X			AM
Draba	*Draba pseudopilosa*			X	X	
Arctic (mountain) avens	*Dryas integrifolia*	X	X	X	X	
Wood fern	*Dryopteris dilatata*				X	NR
Lyme grass	*Elymus arenarius* ssp. *mollis*	X			X	TF, NR
Fireweed	*Epilobium angustifolium*	X	X	X	X	TF, AM, GM
River beauty (dwarf fireweed)	*Epilobium latifolium*	X	X	X	X	TF, AM, GM, NR
Common horsetail	*Equisetum arvense*					TF, AM, GM, NR
Horsetail	*Equisetum fluviatile*				X	NR
Horsetail	*Equisetum pratense*				X	NR
Horsetail	*Equisetum scirpoides*		X			AM
Horsetail	*Equisetum silvaticum*				X	NR
Horsetail	*Equisetum* sp.	X	X	X	X	
Blue fleabane	*Erigreon acris*			X	X	
Fleabane	*Erigeron humilis*	X	X			
Arctic fleabane	*Erigeron hyperboreus*	X	X			
Tall cotton grass	*Eriophorum angustifolium*	X		X	X	TF, GM, NR
Russet cotton grass	*Eriophorum russeolum*			X		GM
Arctic cotton grass	*Eriophorum scheuchzeri*	X	X	X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Sheathed cotton grass	*Eriophorum vaginatum*	X	X	X	X	GM, NR
Arctic forget-me-not	*Eritichum aretioides*	X	X	X	X	
Edward's eutrema	*Eutrema edwardsii*			X		GM
Fescue grass	*Festuca aitaica*		X	X		AM, GM
Fescue grass	*Festuca brevissima*			X		GM
Red fescue	*Festuca rubra*				X	NR
Fescue grass	*Festuca* sp.	X	X	X	X	TF, AM
Northern bedstraw	*Galium boreale*	X	X	X	X	AM, NR
Bedstraw	*Galium trifidium*			X	X	
Whitish gentian	*Gentiana algida*	X	X			
Glaucous gentian	*Gentiana glauca*	X	X	X	X	GM
White geranium	*Geranium erianthum*			X	X	
Glacier avens	*Geum glaciale*		X			AM
Ross avens	*Geum rossii*		X			AM
Alpine eskimo potato	*Hedysarum hedysaroides*	X	X			
Cow parsnip	*Heracleum lanatum*	X	X			
Alpine holy grass	*Hierochloe alpina*		X	X	X	AM, GM, NR
Squirreltail grass	*Hordeum jubatum*	X				TF
Wild iris	*Iris setosa*	X	X	X	X	
Arctic rush	*Juncus arcticus*	X		X	X	TF
Rush	*Juncus castaneus*			X		GM
Glaucous weaselsnout (lagotis)	*Lagotis glauca*	X	X			AM
Vetchling	*Lathyrus palustris*	X	X	X	X	
Alpine milk vetch	*Lathyrus maritimus*	X			X	TF, NR
Bladder pod	*Lesquerella arctica*	X	X			
Alp lily	*Lloydia serotina*	X	X	X	X	
Alpine azalea	*Loiseleuria procumbens*			X	X	
Arctic lupine	*Lupinus arcticus*	X	X	X	X	
Wood rush	*Luzula arcuata*			X		GM
Wood rush	*Luzula confusa*				X	NR
Alpine club moss	*Lycopodium alpinum*			X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Club moss	*Lycopodium annotinum*				X	NR
Bladder campion	*Melandrium apetalum*	X	X	X	X	GM
Bogbean (buckbean)	*Menyanthes trifoliata*	X	X	X	X	
Chiming bells	*Mertensia paniculata*	X	X	X	X	GM
Wild snapdragon	*Mimulus guttatus*			X	X	
Arctic sandwort	*Minuartia arctica*			X	X	GM, NR
Sandwort	*Minuartia obtusiloba*		X			AM
Sandwort	*Minuartia rubella*		X			AM
Shy maiden	*Moneses uniflora*			X	X	
Alpine forget-me-not	*Myosotis alpestris*	X	X			
Yellow pond lily	*Nuphar polysepalum*			X	X	
Oxytrope	*Oxytropis artica* var. *barnebyana*	X	X			
Maydell's oxytrope	*Oxytropis maydelliana*	X	X	X		GM
Blackish oxytrope	*Oxytropis nigrescens*	X	X	X	X	AM, GM
Arctic poppy	*Papaver hultenii*	X	X			
Northern Grass of Parnassus	*Parnassia palustris*	X	X	X	X	
Grass of Parnassus	*Parnassia* sp.	X				TF
Parrya	*Parrya nudicaulis*	X	X	X	X	AM
Capitate lousewort	*Pedicularis capitata*	X	X	X		AM, GM
Wooly lousewort	*Pedicularis kanei*		X	X		AM, GM
Arctic lousewort	*Pedicularis landsdorfii*				X	NR
Oeder's lousewort	*Pedicularis oederi*	X	X	X	X	
Fernweed	*Pedicularis sudetica*	X	X			
Bumblebee flower	*Pedicularis verticillata*	X	X	X	X	
Frigid coltsfoot	*Petasites frigidus*	X		X	X	TF, GM, NR
Butterwort	*Pinguicila vulgaris*	X	X			
Bog orchid	*Platanthera convallariaefolia*					
Small northern bog orchid	*Platanthera obtusata*	X	X	X	X	
Arctic blue grass	*Poa arctica*			X		GM
Kentucky blue grass	*Poa pratensis*			X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Blue grass	*Poa* sp.	X	X	X	X	TF, AM, NR
Tall Jacob's ladder	*Polemonium acutiflorum*	X	X	X	X	TF, GM, NR
Jacob's ladder	*Polemonium pulcherrimum*	X	X			
Bistort	*Polygonum bistorta*	X	X	X	X	AM, GM
Alpine meadow bistort	*Polygonum viviparum*	X	X	X	X	
Two-flowered cinquefoil	*Potentilla biflora*	X	X			
Silverweed	*Potentilla egedii*			X	X	
Arctic cinquefoil	*Potentilla hyparctica*			X		GM
Marsh fivefinger	*Potentilla palustris*	X	X	X	X	GM, NR
One-flowered cinquefoil	*Potentilla uniflora*	X	X			AM
Northern primrose	*Primula borealis*	X	X			AM
Wedge-leafed primrose	*Primula cuneifolia*	X	X			
Pink pyrola	*Pyrola asarifolia*	X	X	X	X	
Wintergreen	*Pyrola chlorantha*				X	NR
Large-flowered wintergreen	*Pyrola grandiflora*	X	X	X	X	TF, AM, GM
Wintergreen	*Pyrola secunda*				X	NR
Pasqueflower	*Pulsatilla patens*			X	X	
Buttercup	*Ranunculus* sp.	X	X	X	X	
Buttercup	*Ranunculus suiphureus*			X		GM
Arctic dock	*Rumex arcticus*	X	X	X	X	GM
Dock	*Rumex fenestratus*				X	NR
Dock	*Rumex graminifolius*	X	X	X	X	
Burnet	*Sanguisorba officinalis*	X	X	X	X	
Narrow-leafed saussurea	*Saussurea viscida*	X	X			
Spotted saxifrage	*Saxifraga bronchialis*	X	X	X		GM
Bulblet saxifrage	*Saxifraga cernua*	X	X	X		GM
Rusty saxifrage	*Saxifraga hieracifolia*	X	X	X		GM
Yellow marsh saxifrage	*Saxifraga hirculus*	X	X	X	X	
Cordate-leaved saxifage	*Saxifraga punctata*	X	X	X		GM
Snow saxifrage	*Saxifraga nivalis*		X			AM
Purple mountain saxifrage	*Saxifraga oppositifolia*		X			AM

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Brook saxifrage	*Saxifrage rivularis*			X		GM
Spiked saxifrage	*Saxifraga spicata*			X	X	
Roseroot	*Sedum rosea*	X	X	X	X	AM, GM, NR
Marsh fleawort (mastodon flower)	*Senecio congestus*	X	X	X	X	
Arctic senecio	*Senecio atropurpureus* ssp. *frigidus*			X		GM
Black-tipped groundsel	*Senecio lugens*	X	X	X	X	
Seabeach scenecio	*Senecio pseudo-arnica*	X	X			
Ragwort	*Senecio* sp.			X	X	
Buffaloberry (soapberry)	*Shepherdia canadensis*	X	X			
Moss campion	*Silene acaulis*	X	X	X	X	AM
Smelowskia	*Smelowskia calycina*	X	X			
Goldenrod	*Solidago multiradiata*	X	X	X	X	AM
Bur-reed	*Sparganium angustifolim*	X	X	X	X	
Ladies' tresses	*Spiranthes romanzoffiana*			X	X	
Chickweed	*Stellaria edwardsii*			X		GM
Chickweed	*Stellaria* sp.				X	NR
Dandelion	*Taraxacum ceratophorum*			X		GM
Dandelion	*Taraxacum officinale*				X	NR
Dandelion	*Taraxacum* sp.	X	X	X	X	
False asphodel	*Tofieldia coccinea*		X		X	AM, NR
Star flower	*Trientalis europea*			X	X	NR
Arrow grass	*Triglochin maritimum*	X	X			
Bladderwort	*Utricularia intermedia*	X	X	X	X	
Capitate valerian	*Valeriana capitata*	X	X	X	X	GM, NR
Mountain heliotrope	*Valeriana sitchensis*			X	X	
Two-flowered violet	*Viola biflora*			X	X	
Death camass	*Zygadenus elegans*	X	X	X	X	AM

Observation Codes:
TF - Nome Field POL
AM - Anvil Mountain
GM - Granite Mountain
NR - North River

Notes:
Species listed alphabetically by scientific name.
Observed species identified during June 1999 site visits by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates).

Sources:
DeLapp, 1987
Hulten, 1968
Jones Technologies, Inc. and Gene Stout and Associates, 2000a
Pratt, 1991
Viereck and Little, 1972
White, 1974

Table A2: Bird Species Potentially Occurring on or near Anvil Mountain, Granite Mountain, Nome Field POL, and North River Sites

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	X	
Arctic Loon	*Gavia arctica*	X	X			
Pacific Loon	*Gavia pacifica*	X	X	X	X	
Common Loon	*Gavia immer*	X	X		X	
Yellow-billed Loon	*Gavia adamsii*	X	X			
Horned Grebe	*Podiceps auritus*	X	X		X	
Red-necked Grebe	*Podiceps grisegena*	X	X		X	
Pelagic Cormorant	*Phalacrocorax pelagicus*	X	X			
Tundra Swan	*Cygnus columbianus*	X	X		X	
Trumpeter Swan	*Cgnus buccinator*				X	
Greater White-fronted Goose	*Anser albiforns*	X	X		X	
Snow Goose	*Chen caerulescens*	X	X		X	
Emperor Goose	*Chen canagica*	X	X		X	
Brant	*Branta bernicla*	X	X		X	
Canada Goose	*Branta canadensis*	X	X		X	
Green-winged Teal	*Anas crecca*	X	X	X	X	TF, GM
Mallard	*Anas platyrhynchos*	X	X		X	
Northern Pintail	*Anas acuta*	X	X		X	
Northern Shoveler	*Anas clypeata*	X	X		X	
Eurasian Wigeon	*Anas penelope*	X	X		X	
American Wigeon	*Anas americana*	X	X		X	
Canvasback	*Aythya valisineria*	X	X		X	
Redhead	*Aythya americana*	X	X		X	
Greater Scaup	*Aythya marila*	X	X		X	
Lesser Scaup	*Aythya affinis*	X	X		X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Common Eider	*Somateria mollissima*	X	X		X	
King Eider	*Somateria spectabilis*	X	X		X	
Spectacled Eider	*Somateria fischeri*	X	X	X	X	
Steller's Eider	*Polysticta stelleri*	X	X	X	X	
Harelquin Duck	*Histrionicus histrionicus*	X	X		X	
Long-tailed Duck	*Clangula hyemalis*	X	X		X	
Black Scoter	*Melanitta nigra*	X	X		X	
Surf Scoter	*Melanitta perspicillata*	X	X		X	
White-winged Scoter	*Melanitta fusca*	X	X		X	
Common Goldeneye	*Bucephala clangula*	X	X		X	
Bufflehead	*Bucephala albeola*	X	X		X	
Common Merganser	*Mergus merganser*	X	X		X	
Red-breasted Merganser	*Mergus serrator*	X	X		X	
Osprey	*Pandion haliaetus*	X	X		X	
Bald Eagle	*Haliaeetus leucocephalus*				X	
Northern Harrier	*Circus cyaneus*	X	X	X	X	GM
Sharp-shined Hawk	*Accipiter striatus*				X	
Northern Goshawk	*Accipiter gentilis*			X	X	NR
Red-tailed Hawk	*Buteo jamaicenis*				X	
Rough-legged Hawk	*Buteo lagopus*		X	X	X	
Golden Eagle	*Aquila chrysaetos*	X	X	X	X	
American Kestrel	*Falco sparverius*	X	X	X	X	
Merlin	*Falco columbarius*				X	
Peregrine Falcon	*Falco peregrinus*	X	X	X	X	
Gyrfalcon	*Falco rusticolus*	X	X	X	X	
Spruce Grouse	*Dendragapus canadensis*				X	
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	X	GM

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Rock Ptarmigan	*Lagopus mutus*	X	X	X	X	
Sandhill Crane	*Grus canadensis*	X	X	X	X	
Black-bellied Plover	*Pluvialis squatarola*	X	X	X	X	
American Golden-Plover	*Pluvialis dominica*	X	X	X	X	GM*
Pacific Golden-Plover	*Pluvialis fulva*	X	X	X	X	
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	X	TF*
Greater Yellowlegs	*Tringa melanoleuca*	X	X		X	
Lesser Yellowlegs	*Tringa flavipes*	X	X		X	
Wood Sandpiper	*Tringa glareola*	X	X			
Wandering Tattler	*Heteroscelus incanus*	X	X		X	
Spotted Sandpiper	*Actitis macularia*	X	X		X	
Whimbrel	*Numenius phaeopus*	X	X	X	X	
Green Sandpiper	*Tringa ochropus*	X	X			
Terek Sandpiper	*Xenus cinereus*	X	X			
Bristle-thighed Curlew	*Numenius tahitiensis*	X	X		X	
Hudsonian Godwit	*Limosa haemastica*	X	X	X	X	
Bar-tailed Godwit	*Limosa lapponica*	X	X	X	X	GM
Ruddy Turnstone	*Arenaria interpres*	X	X	X	X	
Black Turnstone	*Arenaria melanocephala*	X	X	X	X	
Surfbird	*Aphriza virgata*	X	X			
Red Knot	*Calidris canutus*	X	X	X	X	
Great Knot	*Calidris tenuirostris*	X	X			
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	X	TF
Western Sandpiper	*Calidris mauri*	X	X	X	X	TF
Least Sandpiper	*Calidris minutilla*	X	X		X	
Long-toed Stint	*Calidris subminuta*	X	X			
Baird’s Sandpiper	*Calidris bairdii*	X	X			

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	X	
Rock Sandpiper	*Calidris ptilocnemis*	X	X			
Dunlin	*Calidris alpina*	X	X	X	X	
Red-necked Stint	*Calidris ruticollis*	X	X			
Little Stint	*Calidris minuta*	X	X			
Temmick's Stint	*Calidris temminckii*	X	X			
Buff-breasted Sandpiper	*Tryngites subruficollis*	X	X			
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	X	
Common Snipe	*Gallinago gallinago*	X	X	X	X	AM, GM*, NR
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	X	
Red Phalarope	*Phalaropus fulicaria*	X	X	X	X	
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	X	X	
Parasitic Jeager	*Stercorarius parasisticus*	X	X	X	X	
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	X	TF, GM
Bonaparte's Gull	*Larus philadelphia*	X	X		X	
Mew Gull	*Larus canus*	X	X		X	TF
Herring Gull	*Larus argentatus*	X	X		X	
Slaty-backed Gull	*Larus schistisagus*	X	X			
Glaucous-winged Gull	*Larus glaucescens*	X	X		X	
Glaucous Gull	*Larus hyperboreus*	X	X		X	TF
Thayer's Gull	*Larus thayeri*	X	X			
Black-legged Kittiwake	*Rissa tridactyle*	X	X			
Ross' Gull	*Rhodostethia rosea*	X	X			
Sabine's Gull	*Xema sabini*	X	X		X	
Ivory Gull	*Pagophila eburnea*	X	X		X	
Arctic Tern	*Sterna paradisaea*	X	X		X	TF

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Aleutian Tern	*Sterna aleutica*	X	X		X	
Common Murre	*Uria aalge*	X	X			
Thick-billed Murre	*Uria lomvia*	X	X			
Black Guillemot	*Cepphus grylle*	X	X			
Pigeon Guillemot	*Cepphus columba*	X	X			
Marbled Murrelet	*Brachyramphus marmoratus*	X	X			
Kittlitz's Murrelet	*Brachyramphus brevirostris*	X	X			
Parakeet Auklet	*Cyclorrhynchus psittacula*	X	X			
Least Auklet	*Aethia pusilla*	X	X			
Crested Auklet	*Aethia cristatella*	X	X			
Tufted Puffin	*Fratercula cirrhata*	X	X			
Horned Puffin	*Fratercula corniculata*	X	X			
Great Horned Owl	*Bubo virginianus*				X	
Snowy Owl	*Nyctea scandiaca*	X	X	X	X	
Northern Hawk Owl	*Surnia ulula*				X	
Short-eared Owl	*Asio flammeus*	X	X	X	X	GM
Boreal Owl	*Aegolius funereus*				X	
Belted Kingfisher	*Ceryle alcyon*				X	
Olive-sided Flycatcher	*Contopus borealis*				X	NR*
Alder Flycatcher	*Empidonax alnorum*			X	X	NR*
Say's Phoebe	*Sayornis saya*			X	X	
Horned Lark	*Eremophila alpestris*	X	X	X	X	GM
Tree Swallow	*Tachycineta bicolor*	X	X	X	X	TF
Violet-green Swallow	*Tachycineta thalassina*	X	X	X	X	
Bank Swallow	*Riparia riparia*	X	X	X	X	
Cliff Swallow	*Hirundo pyrrhonota*	X	X	X	X	
Barn Swallow	*Hirundo rustica*	X	X	X	X	

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Gray Jay	*Perisoreus canadensis*	X	X	X	X	NR
Common Raven	*Corvus corax*	X	X	X	X	AM, GM, NR
Black-capped Chickadee	*Poecile atricapillus*	X	X	X	X	
Boreal Chickadee	*Poecile hudsonica*				X	
American Dipper	*Cinclus mexicanus*	X	X		X	
Arctic Warbler	*Phylloscopus borealis*	X	X	X	X	
Ruby-crowned Kinglet	*Regulus calendula*	X	X	X	X	NR*
Siberian Rubythroat	*Luscinia alliope*	X	X			
Bluethroat	*Luscinia svecica*	X	X	X	X	
Northern Wheatear	*Oenanthe oenanthe*			X	X	GM*
Gray-cheeked Thrush	*Catharus minimus*	X	X	X	X	
Swainson's Thrush	*Catharus ustulatus*			X	X	NR*
American Robin	*Turdus migratorius*	X	X	X	X	TF, AM, GM, NR*
Varied Thrush	*Ixoreus naevius*	X	X	X	X	NR*
Yellow Wagtail	*Montacilla flava*	X	X	X	X	TF*
White Wagtail	*Montacilla alba*	X	X			
Red-throated Pipit	*Anthus cervinus*	X	X	X	X	
American Pipit	*Anthus rubescens*	X	X	X	X	AM*, GM*
Bohemian Waxwing	*Bombycilla garrulus*				X	
Northern Shrike	*Laninus exubitor*	X	X	X	X	
Orange-crowned Warbler	*Vermivora celata*			X	X	NR*
Yellow Warbler	*Dendroica petechia*	X	X	X	X	TF*, GM*, NR*
Yellow-rumped Warbler	*Dendroica coronata*			X	X	NR*
Blackpoll Warbler	*Dendroica striata*			X	X	
Northern Waterthrush	*Seiurus noveboraxensis*				X	
Wilson's Warbler	*Wilsonia pusilla*	X	X	X	X	GM*, NR*
American Tree Sparrow	*Spizella arborea*	X	X	X	X	NR*

Common Name	Scientific Name	Nome Field POL (TF)	Anvil Mountain (AM)	Granite Mountain (GM)	North River (NR)	Observed
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	X	TF*, AM*, GM*, NR*
Fox Sparrow	*Passerella iliaca*	X	X	X	X	TF*, AM*, GM*, NR*
Lincoln's Sparrow	*Melospiza lincolnii*	X			X	
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	X	TF*, GM*, NR*
Golden-crowned Sparrow	*Zonotrichia atricapilla*	X	X	X	X	AM*, GM*
Dark-eyed Junco	*Junco hyemalis*				X	NR*
Lapland Longspur	*Calcarius lapponicus*	X	X	X	X	AM*, GM*
Snow Bunting	*Plectrophenax nivalis*	X	X	X	X	GM*
McKay's Bunting	*Plectrophenax hyperboreus*	X	X			
Rusty Blackbird	*Euphagus carolinus*	X	X	X	X	
Gray-crowned Rosy-Finch	*Leucosticte arctoa*			X	X	
Pine Grosbeak	*Pinicola enucleator*				X	
White-winged Crossbill	*Loxia leucoptera*				X	
Common Redpoll	*Carduelis flammea*	X	X	X	X	TF, AM, GM, NR
Hoary Redpoll	*Carduelis hornemanni*	X	X	X	X	TF

Observation Codes:
TF – Nome Field POL
AM - Anvil Mountain
GM - Granite Mountain
NR - North River
* - Breeding behavior and/or nests observed.

Notes:
Species listed by phylogenic order.
Species observed by T. Schick (Colorado State University) and J. Trousil (Gene Stout and Associates) during June 1999 site visits.

Sources:
Armstrong, 1998
Harris, 1996
Jones Technologies, Inc. and Gene Stout and Associates, 2000a
Robbins *et al.*, 1983
Skinner, 1999

Appendix 3.0 - Bear. Bear Creek Radio Relay Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Bear Creek Former RRS

3.1 Location and Area

The Bear Creek excess site is in central Alaska, about nine miles northeast of the City of Tanana, and about 130 miles west of Fairbanks, Alaska (INRMP Figure 3.1). The 115-acre site includes for the site proper (Figure 3.1) and was composed of the main facility and a POL storage tank site near the Yukon River.

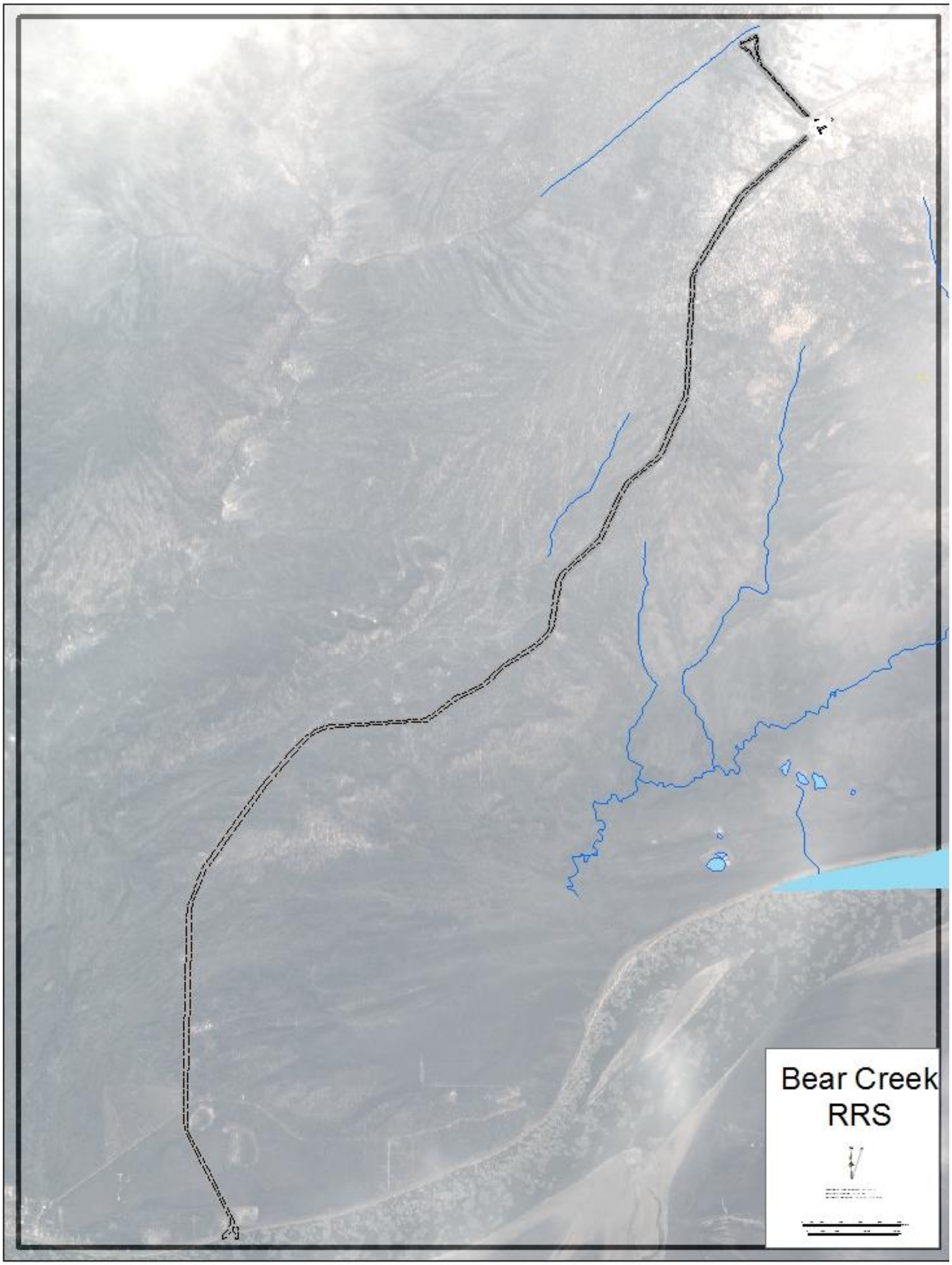
3.2 Installation History

Construction of facilities at Bear Creek occurred in 1956 and 1957. The site is one of the 31 original WACS sites. USAF real estate records indicate it first was the Bear Creek Communications Station, then renamed Bear Creek Air Force Station in 1958, and in 1961 became the Bear Creek Radio Relay Station. The Bear Creek WACS operated as a combined tropospheric scatter/TD-2 microwave station, which relayed radio information to and from Indian Mountain, Kalakaket Creek, and Pedro Dome WACS sites (Reynolds 1988). Bear Creek was active from 1959 to 1981. Site facilities included a dormitory/ equipment/annex building complex, a primary and temporary vehicle maintenance building, four WACS antennas, a water storage tank, an airfield, 20 additional miscellaneous facilities, two POL storage tank areas (one located along the north bank of the Yukon River about eight miles south), and several former disposal areas. A water gallery was located about 3,500 feet northwest of the site. Clean Sweep occurred at the site in 1996, and all facilities were demolished and disposed of (USAF 1998b).

3.3 Surrounding Communities

The City of Tanana is the closest community to the Bear Creek site. Tanana is at the confluence of the Tanana and Yukon rivers. The population of Tanana is 246 (2010) consisting of 85.6 percent Alaska Native or American Indian. Traditional ways of life persist, with subsistence, potlatches, dances, and foot

Figure 3.1 Bear Creek Former RRS



races a part of the culture. Two-thirds of the full-time jobs are with the city, school district, or native council. Fire fighting, trapping, construction work, and commercial fishing are important seasonal cash sources. Tanana is accessible only by air and river transportation (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Tanana was a traditional trading settlement for Koyukon and Tanana Athabascans long before European contact. In 1880 Harper's Station, an Alaska Commercial Company Trading Post, was established 13 miles downriver from the present site of Tanana. In 1881 a Church of England mission was built eight miles downriver, and between 1887 and 1900 the St. James Mission was constructed. From 1898 to 1923 Fort Gibbon operated at Tanana to maintain the telegraph line between Fairbanks and Nome. During World War II an air base was established near Tanana as a refueling stop for the lend-lease aircraft program. The City of Tanana incorporated in 1961.

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Bear Creek site.

4.0 Physical Environment

4.1 Climate

The Bear Creek site has a climate typical of the Alaska Interior with a cold, continental climate and large temperature differences between winter and summer. Tanana experiences a cold, continental climate with temperature extremes. Daily maximum temperatures during July range from 64 to 70°F; daily minimum temperatures during January are -14 to -48°F. Extremes have been measured from -71 to 94°F. Average annual precipitation is 13 inches, with 50 inches of snowfall. The river is ice-free from mid-May through mid-October (www.dced.state.ak.us 2012).

4.2 Landforms

The Bear Creek site is within the unglaciated Yukon-Tanana Upland Physiographic Province. The major structural feature of the area is the Kaltag Fault, which generally controls the location of the Yukon River. The Kaltag Fault is located about one mile south of the Bear Creek site. The site is on a heavily forested ridge at an elevation of 1,650 feet above msl. The topography of the site slopes gently towards the west and southwest (USAF 1998).

4.3 Geology and Soils

Bedrock beneath the site is primarily composed of an Early Paleozoic and Precambrian metamorphic complex of quartz-mica schist, quartzite, phyllite, and slate beds. Other materials associated with this complex include minor amounts of gray schist; medium to dark gray, shaley limestone; tufaceous siltstone; fine-grained and conglomeratic graywache sandstone with stretched or sheared pebbles and slate fragments; and white quartz pods, lenses, and irregular veinlets. This complex is structurally enigmatic, and some unrecognized younger rocks might also be included. Within the region, this complex underlies a limestone, dolomite, greenstone, and chert sequence; however, the contact between these units is not clearly defined (Hazardous Materials Technical Center 1989).

Regionally, the metamorphic complex underlies a sedimentary sequence containing limestone, dolomite, and cherty greenstone. Due to the proximity of the Bear Creek site to the Kaltag Fault, the bedrock is believed to be highly fractured (USAF 1998a).

Soils at the Bear Creek site belong to the Typic Cryachrepts and Histic Pergelic Cryaquepts association. This association includes silty to sandy loam, which grade into gravelly and stony material in areas where permafrost is absent. Surface soils in the mountains north of Tanana are comprised mainly of well-drained, brown silty and gravelly loam with no permafrost and poorly drained, olive brown, gravelly, silty, and sandy loam with discontinuous areas of permafrost. Peat (up to 16 inches thick) and other vegetation overlie these soils. Permafrost, where found, is reported at depths between 10 to 20 inches below ground surface (Hazardous Materials Technical Center 1989). Soils are generally less than 40 inches thick in the area.

4.4 Hydrology

The Bear Creek site is on the top of a ridge, and is devoid of surface water bodies. Drainages of Mission Creek, NC Creek, and Bear Creek occur near the site to the east, south, and west, respectively. Runoff from the site potentially contributes to these creeks, which each discharge into the Yukon River. During active operation of the site, a water pipeline and water collection gallery supplied water.

The depth to groundwater at the site is unknown. A remedial investigation of the site in 1998, with several borings exceeding 50 feet below ground surface, encountered no groundwater. However, thin intervals of saturated soil were occasionally encountered at or slightly below the surface of the bedrock in a few soil borings. Groundwater may be found in joints, fractures, and shear zones deep within bedrock (USAF 1998).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Bear Creek site. Much information included in INRMP Chapter 5.0 that includes Bear Creek site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Bear Creek site and the surrounding area. ***Appendix 3.0-Campion***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Bear Creek site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Bear Creek site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M139 Upper Yukon Tayga-Meadow Province
Description: Low rounded mountains of 2,000-4,000 feet are found within this province, but no glaciers exist here. The landscape is mostly rolling topography, including plateaus and highlands along with gentle slopes and valleys. Severely cold winters and short; hot summers showcase the extreme continental boreal climate that is characteristic of the province. Average precipitation is 10-15 inches with the heaviest precipitation occurring in late summer. On lower slopes are forests of white spruce, paper birch, and quaking aspen; at higher elevations are black spruce forests. Above black spruce forests, the dominant vegetation is alpine meadow. Dominant soils of the province are Inceptisols; permafrost is discontinuous.

5.2 Vegetation

Three dominant soil types at Bear Creek site result in mixed vegetation in the region, and species associated with those soil types include white spruce, paper birch, and quaking aspen; sedges, mosses, low shrubs, and stunted black spruce; and tall shrubs and stunted black spruce (Hazardous Materials Technical Center 1989). Vegetation of the surrounding area consists of upland tussock tundra with herbs and various berry plants, such as cranberries, blueberries, and bearberries interspersed with black spruce (USAF 1998).

During a 2000 vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001b), it was evident that forested areas are dominated by black spruce with the co-dominant trees/shrubs being willows and alders. Very few birch are present, and those observed were only tree/shrub sized. Ground cover is generally sub-alpine with many areas dominated by fruticose lichens and an abundance of mosses, crowberry, bog blueberry, low-bush cranberry, dwarf Arctic birch, and alpine azalea. Some areas of boreal forest ground cover can be found under thick alder stands. The runway area is being heavily invaded by willows to the point of having only about a six-foot wide ATV trail running down its length. *Festuca* and *Poa* species ,along with weedy volunteers, are growing on much of the area where the facilities once stood.

The 2000 vegetation survey (Universe Technologies, Inc. and Gene Stout and Associates 2001b) identified 40 species on the site. A general vegetation map of the Bear Creek site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Bear Creek site.

5.3 Fish and Wildlife

5.3.1 Fish

Potential fish populations in the creeks surrounding the site are unknown. However, fish species that occur in the Yukon River and other waters in the area include king, coho, and chum salmon; Arctic grayling; northern pike; burbot; several species of whitefish; longnosed sucker; lake chub; Alaska blackfish; slimy sculpin; and Arctic lamprey (ADFG 1990b).

5.3.2 Mammals

Mammals observed in the Tanana area include marmot, Arctic ground squirrel, black and brown/grizzly bears, moose, common shrew, dusky shrew, North American lynx, marten, meadow jumping mouse, northern red-backed vole, pygmy shrew, singing vole, tundra vole, yellow-cheeked vole, wolf, and wolverine (University of Alaska 1998).

5.3.3 Birds

A large number of bird species are found in the general area surrounding the Bear Creek site. Some more abundant species include Canada Goose, American Wigeon, Spotted Sandpiper, Common Snipe, Alder Flycatcher, Bank Swallow, Black-capped Chickadee, Ruby-crowned Kinglet, Swainson's Thrush, Varied Thrush, Orange-crowned Warbler, Yellow Warbler, Slate-colored Junco, and Common Redpoll (Sauer *et al.* 1997). Some commonly observed species include Yellow Warbler, Orange-crowned Warbler, Swainson's Thrush, Alder Flycatcher, American Robin, and Fox Sparrow.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur on the Bear Creek site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Bear Creek site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Tanana is about nine miles southwest of the Bear Creek site. A dirt road connects the site to Tanana. Subsistence resource harvesting is critical to the continued existence of Tanana. The cultural preference is for traditional foods ,and the expense of shipping in prepared foods is prohibitive. Social organization in Tanana revolves around kin-based subsistence harvest groups that organize for seasonal fish camps, moose, bear, and caribou hunts. The advent of the fish wheel has made subsistence salmon fishing easier in some cases, but it requires more organization and resource use in the manufacture, maintenance, and placement of the wheel, as well as in processing harvested salmon (Braund and Associates 2004).

The importance of subsistence to Tanana residents is reflected in the high participation rates of households that use (100%), harvest (92%), try to harvest (93%) and receive (98%) subsistence resources. Four species of fish; chum salmon, chinook salmon, coho salmon, and whitefish accounted for approximately 86% of Tanana's annual subsistence harvest in terms of edible pounds in 1987. Tanana residents use areas along the Tanana, Yukon, and Nowitna rivers and their tributaries and sloughs for hunting and fishing. Hunters travel between Ruby and Rampart on the Yukon River, to the headwaters of the Nowitna River, up the Tanana to Manley Hot Springs, and up the Tozitna and Ptarmigan creek drainages. In addition, lakes and wetlands along these rivers are heavily used. Hunters looking for birds and moose often use the road from Tanana to the Bear Creek facility. Often, this use of the road is planned for that period before the rivers have frozen over completely for snowmachine travel, but are too icy for boat travel (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at Bear Creek site include small and big game hunting, gathering of vegetation and berries, and nonconsumptive activities, such as ATV riding along gravel roads and bird watching. The limited hunting that occurs on the site primarily consists of subsistence harvest of animals and collection of vegetation for greens and berries by residents of Tanana.

Appendix 3.0 - Beaver. Beaver Creek Radio Relay Site

3.0 Installation Overview

3.1 Location and Area

The Beaver Creek excess site is located along the Alaskan Highway about three miles north of the community of Northway Junction and about 10 miles northeast of the community of Northway (Figure 3.1). Tok, Alaska is about 45 miles northwest of the site (INRMP Figure 3.1). The 36-acre site lies on a hilltop overlooking the confluence of the Chisana and Nabesna rivers in eastern interior Alaska (Figure 3.1).

3.2 Installation History

Site construction was completed in 1957. USAF real estate records indicate it first was the Tanana Radio Relay Annex, in 1956 became the Beaver Creek Communications Station, was renamed Beaver Creek Air Force Station in 1958, and in 1961 became the Beaver Creek Radio Relay Station. The site consisted of a steel frame building, a radio tower, two diesel underground storage tanks, a parking lot, and fencing surrounding the facility. The USAF leased the Beaver Creek site to Alascom in 1984. Alascom continues to operate a communications facility at the site. Original facilities remain at the Beaver Creek site except for one 20,000-gallon underground storage tank that was removed in 1990 (USAF 1997). Access to the Beaver Creek site is via a gravel road from the Alaska Highway. Two sites have undergone remedial investigations and feasibility studies for fuel and heavy metals contamination; no further remedial action is planned.

3.3 Surrounding Communities

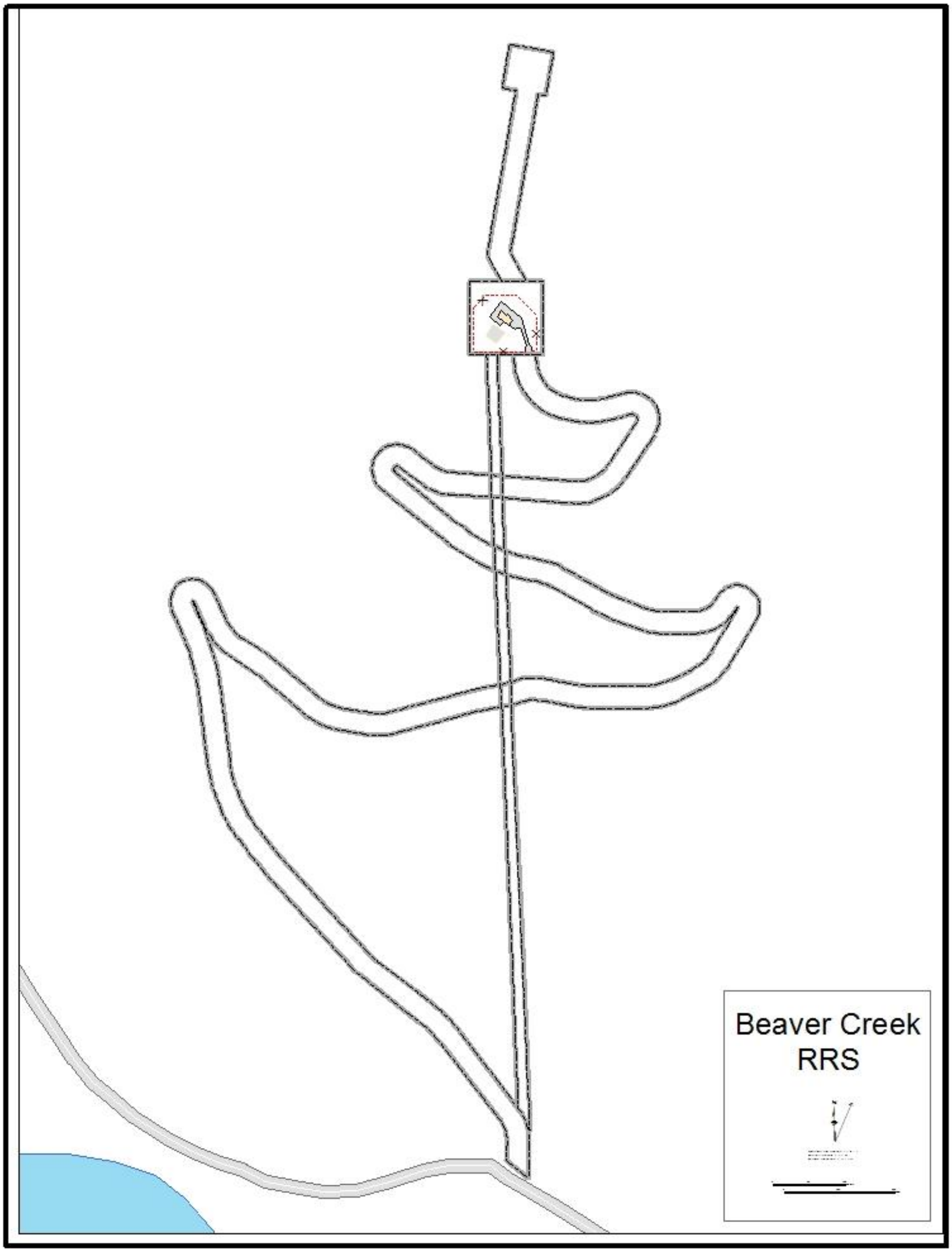
The community of Northway Junction is about 5½ miles from Northway and lies within the Tetlin National Wildlife Refuge. Northway consists of three dispersed settlements: Northway Junction, Northway, and the Native settlement of Northway Village.

The population of Northway Junction is 71 (2010) consisting of 78.9% Alaska Native or American Indian. Most wage employment is with facilities or services for the airport. An FAA Flight Service Station and U.S. Customs office are located at the airport. A motel, cafe, bar, pool hall, grocery store, and electric utility provide some employment. Firefighting, construction, and trapping also provide income. Subsistence is important to the Native population (www.dced.state.ak.us 2012).

3.4 Regional Land Use

The area around Northway was first utilized by semi-nomadic Athabascans who pursued seasonal subsistence activities. The Native village was named in 1942 after Chief Walter Northway, who adopted his name from a Tanana and Nabesna riverboat captain. The Northway airport was a link in the Northwest Staging Route, a cooperative project between the United States and Canada. A chain of air bases through Canada to Fairbanks was used to supply an Alaska defense during World War II and during construction of the Alcan Highway. The development of Northway Junction was due to the airport and highway access (www.dced.state.ak.us 2012).

Figure 3.1 Beaver Creek Former RRS



3.5 Local and Regional Natural Areas

The Tetlin NWR is near the Beaver Creek site and is a landscape made up of forests, wetlands, tundra, lakes, mountains, and glacial rivers bounded by the Alaska Range. This upper Tanana River valley has been called the “Tetlin Passage” because it serves as a major migratory route for birds traveling to and from Canada, the lower 48, and both Central and South America. Many of these birds breed and nest on the refuge. An estimated 116 species breed on Tetlin NWR. Tetlin NWR also supports a variety of large mammals. Dall sheep, moose, wolves, grizzly and black bears, and members of three different caribou herds range on the refuge (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The Beaver Creek site lies in the Continental climate zone, with long, cold winters and relatively warm summers. Temperatures range from -27 to 70°F. The average low temperature in January is -27°F; the average high during July is 69°F. Extreme temperatures have been recorded from -72 to 91°F. Average precipitation is 10 inches per year; snowfall averages 30 inches annually (www.dced.state.ak.us 2012).

4.2 Landforms

The Beaver Creek site is located on a hillside at about 2,500 feet above msl. The area east and north of the site is mountainous with elevations reaching about 3,000 to 4,000 feet above msl. The area west and south of the site is a broad valley with the Chisana and Nabesna rivers running through it. The valley has extensive lake and marsh complexes, and much of the valley is within the Tetlin NWR.

4.3 Geology and Soils

The Beaver Creek site is underlain by bedrock primarily of the Paleozoic and Precambrian age and is comprised of schist, quartzite, and gneiss. Intrusive Cretaceous granitica are present in uplands. River basins consist of deep unconsolidated Quaternary deposits with surficial deposits of fluvial sand and gravel, silts, and peat. Discontinuous permafrost is present in the area to depths of up to 150 feet (USAF 1997). The entire Beaver Creek site is covered with gravel.

4.4 Hydrology

Major surface water features in the area of the Beaver Creek site include two north flowing glacial rivers: the Chisana and Nebesna, which converge and form the Tanana River. This area also has extensive lake and marsh complexes in a broad river valley to the east and south of the site. Beaver Creek is a small tributary of the Chisana River and flows westerly about ½ mile north of the Beaver Creek site. No other surface water features occur near the site. Drainage from the site likely enters Beaver Creek or flows directly into the Chisana River.

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Beaver Creek site. Much information included in INRMP Chapter 5.0 that includes Beaver Creek site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Beaver Creek site and the surrounding area. ***Appendix 3.0-Campion***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Beaver Creek site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Beaver Creek site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M139 Upper Yukon Tayga-Meadow Province
Description: Low rounded mountains of 2,000-4,000 feet are found within this province, but no glaciers exist here. The landscape is mostly rolling topography, including plateaus and highlands along with gentle slopes and valleys. Severely cold winters and short; hot summers showcase the extreme continental boreal climate that is characteristic of the province. Average precipitation is 10-15 inches with the heaviest precipitation occurring in late summer. On lower slopes are forests of white spruce, paper birch, and quaking aspen; at higher elevations are black spruce forests. Above black spruce forests, the dominant vegetation is alpine meadow. Dominant soils of the province are Inceptisols; permafrost is discontinuous.

5.2 Vegetation

There are four distinct terrestrial plant communities in the vicinity of the Beaver Creek site: Upland Spruce-Hardwood Forest, Lowland Spruce-Hardwood Forest, Low Brush-Muskeg Bog, and Alpine Tundra and Barren Ground. The site is in an Upland Spruce-Hardwood Forest, characterized by a fairly dense forest of white spruce, paper birch, quaking aspen, and balsam poplar. Undergrowth typically consists of mosses, grasses, and shrubs (USAF 1997).

The Beaver Creek site is a clearing at the top of a ridge forested primarily with white spruce and paper birch with some large Bebb's willow and Scouler willow in the understory. However, the understory is relatively open. The forest floor is typical of interior Alaska, dominated by moss and grasses. Downslope and along the site access road, large patches of quaking aspen and some white spruce occur. Cleared or disturbed areas are revegetating to alder, grayleaf willow, Bebb's willow, and forbs with some small white spruce, quaking aspen, and balsam poplar.

The vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001b) identified 41 species during a 2000 site visit. A general vegetation map of the Beaver Creek site has not been prepared A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Beaver Creek site.

5.3 Fish and Wildlife

5.3.1 Fish

Potential fish populations in creeks and lakes in the area are unknown. However, fish species that occur in the Tanana River include king, coho, and chum salmon; Arctic grayling; northern pike; burbot; several species of whitefish; longnosed sucker; lake chub; Alaska blackfish; slimy sculpin; and Arctic lamprey (ADFG 1990b).

5.3.2 Mammals

The area is inhabited by black and brown/grizzly bears, moose, caribou, wolves, snowshoe hare, red fox, lynx, mink, martens, beavers, muskrats, weasels, etc.

5.3.3 Birds

Habitats in the area surrounding Beaver Creek site provide nesting and foraging opportunities for a wide variety of bird species. The area lies in a major migration corridor for many birds going to nesting grounds. Sandhill Cranes migrate through in impressive numbers, and Trumpeter Swans migrate through and nest in the area. Wetland areas on the Tetlin NWR are prime breeding and nesting habitat for waterfowl. Osprey, Bald Eagles, and other raptors are commonly seen in the area. The refuge provides habitat for 114 nesting species and an additional 68 species of migrants (USFWS 2007a). Species commonly observed on or near the site include American Robin, Swainson's Thrush, Yellow-rumped Warbler, Dark-eyed Junco, Common Raven, and Gray Jay.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur on Beaver Creek site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Beaver Creek site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The nearest community to the Beaver Creek site is Northway, which consists of three dispersed settlements: Northway Junction, Northway, and the Native settlement of Northway Village. The community of Northway Junction is about three miles south of the site, Northway is about 10 miles southwest of the site, and Northway Village is about eight miles southwest of the site. Subsistence activities are important to the residents of these villages. Subsistence activities provide most food sources, and residents harvest moose, rabbit, ptarmigan, ducks, geese, whitefish, and berries. Some residents travel to the Copper River for salmon. Villages' residents fish in lakes, rivers and sloughs in the Northway Flats, low-lying areas near lower reaches of the Nabesna and Chisana rivers. Moose hunting occurs along water routes near the Tanana, Nabesna, Chisana, and Tetlin rivers and along road-accessible areas near the Alaska Highway, Taylor Highway, Tok Cutoff, and Nabesna Road. Caribou hunting occurs in hills north of Northway, the Taylor Highway corridor, and portions of the Nutzotin Mountains. Residents harvest sheep in the Nutzotin Mountains and areas along the Tok Cutoff. Trapping areas include the Nabesna and Chisana rivers, over most of the Northway Flats, in hills north of Northway and east to the Canadian border and along the Taylor Highway (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Human use of the Beaver Creek site's natural resources probably does not occur due to the site being fenced with a locked gate. The primary use of the site is probably use of the access road to gain access to areas further east of the site. However, evidence of camping was present near the site during a 2000 site visit. The surrounding area is likely used primarily by residents of Northway Junction and Northway for hunting, fishing, trapping, and gathering. Although, the Tetlin NWR is one of only two refuges in Alaska that is accessible by road, and thus, is used by visitors for wildlife viewing, hunting, fishing, and camping.

Appendix 3.0 - Bethel. Bethel Radio Relay Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Bethel Former RRS

3.1 Location and Area

The Bethel excess site is in southwestern Alaska about four miles west of the City of Bethel, Alaska (INRMP Figure 3.1). Bethel is 40 miles inland from the Bering Sea and lies in the Yukon Delta National Wildlife Refuge, about 400 miles west of Anchorage, Alaska. The site occupies 22 acres on a high point (Figure 3.1) about 1.5 miles west of the Bethel Municipal Airport.

3.2 Installation History

The Bethel site was reactivated as an air control and warning station on 24 June 1955 as part of the Bethel Airfield (AF Form 1192 6 Oct 1956) and in 1957 as a radio relay station as part of the WACS to support the air defense system in Alaska. USAF real estate records indicate it was the Bethel Air Force Station in 1958; then after the AC&W function ended in 1964, it became the Bethel Radio Relay Station. Bethel's WACS tropospheric antennas were adjacent to the AC&W site. The installation was a 3-way link between Aniak, Cape Newenham, and Cape Romanzof (Reynolds 1988). The WACS portion of the installation consisted of six tropospheric antennas, two above-ground fuel storage tanks, a pump house, a 204,750-gallon tank, an equipment and power building, a facility support building, and a vehicle maintenance building. The site was deactivated in 1987 and demolished in 1989 and 1990. One tropospheric antenna was left in place at the request of the City of Bethel for use as a long-range visual reference point for pilots and snow-machine operators.

The size of the installation changed drastically over-time. The Air Force relinquished the AC&W site (1,467 acres and several facilities) in 1964; 45 acres were withdrawn by the BLM for the Bureau of Indian Affairs administrative site; and a portion was conveyed to the Bethel Native Corporation, which left 22 acres as Air Force property.

Figure 3.1.B Bethel Former RRS

3.3 Surrounding Communities

Bethel was first established by Yupik Eskimos who called the village “Mumtrekhlogamute”, meaning “Smokehouse People”. In 1880, 41 people lived in Bethel, and it was an Alaska Commercial Company Trading Post. The Moravian Church established a mission in the area in 1884, and in 1905 a post office was opened. Over time, Bethel became a trading, transportation, and distribution center for the region, and federal and State agencies established regional offices (www.dced.state.ak.us 2007).

Bethel has a population of 6.080 (2010) consisting of 65 percent Alaska Native or American Indian. Bethel serves as the regional center for 56 villages in the Yukon-Kuskokwim Delta. Food, fuel, transportation, medical care and other services for the region are provided by businesses in Bethel. There are 6 schools located in the community, attended by 1,375 students. Fifty percent of the jobs in Bethel are government positions, and commercial fishing is an important source of income; 189 residents held commercial fishing permits in 2010 (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Traditional Yupik Eskimo practices and language remain predominant in the Bethel area. Subsistence activities and commercial fishing are major contributors to residents’ livelihoods (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas

The Bethel site lies within the Yukon Delta NWR. Waters of the Yukon and Kuskokwim rivers flow through the Yukon Delta NWR. Almost 70% of this 19 million acre refuge is below 100 feet in elevation, and consists of a broad, flat delta stitched through with rivers and streams and dotted with countless lakes, sloughs, and ponds. Bordering this expanse of tundra and wetlands are forest and shrub habitat and uplands with mountains more than 4,000 feet high. The refuge also includes two large islands; Nelson and Nunivak. Yukon Delta NWR supports one of the largest aggregations of water birds in the world, and it supports one of the most important shorebird nesting areas in the United States. Spawning and rearing habitat for 44 species of fish is provided by the hundreds of miles of rivers and streams. Along the coast of the refuge, the waters of the Bering Sea host a variety of marine mammals, including whales which pass during migration (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The Bethel area is characterized by a cold maritime climate. High humidity, considerable cloudiness, frequent fog, and multiple periods of light rain and snow showers are typical. The wettest season is generally from mid- to late summer (EMCON Alaska, Inc. 1996a). Precipitation averages 16 inches a year, and snowfall averages 50 inches per year. Summer temperatures range from 42 to 62°F. Winter temperatures range from -2 to 19°F (www.dced.state.ak.us 2012).

4.2 Landforms

The Bethel site is located on the Yukon-Kuskokwim Delta in the far southwestern portion of mainland Alaska. Topography in the vicinity of the site is typical of glacial moraine topography, being relatively flat to gently rolling and includes wetlands and many small lakes and ponds. The site is on a topographic high point at an elevation of about 170 feet above msl (EMCON Alaska, Inc. 1996a). Bethel’s tropospheric antenna is a prominent feature of the area’s skyline.

4.3 Geology and Soils

The Bethel area is underlain by Quaternary silt deposits of the Yukon-Kuskokwim Delta, which consist of light- to dark-gray silt and sandy silt containing abundant permafrost. Organic muck occurs locally near the top of these deposits, which become sandier with depth and locally contain pebbles and wood fragments. Organic material, including wood chips and bark, suggest that these are freshwater estuarine deposits. These deposits apparently thicken westward and at Bethel have a minimum thickness of 450 feet. Silt deposits may include eolian and marine members in some areas. Silt underlies much of the Yukon-Kuskokwim Delta, where it forms a wide plain at an altitude of 10-150 feet above msl (Dynamac Corporation 1989a).

The Kuskokwim River, about 3.6 miles east of the site, exhibits Pleistocene deposits of flood plain and low terrace alluvium. These deposits consist mainly of mud, silt, sand, gravel, boulders, and considerable organic matter. The alluvium ranges from 230 to 360 feet in thickness and is related to glacial advances from the nearby Alaska Range. In Illinoian time considerable deposition of alluvium occurred, which were later eroded and dissected by streams and rivers in Sangamon time. In Wisconsinan time deposits of fluvial origin were predominant in this area (Dynamac Corporation 1989a).

The Bethel site is underlain by the Kuskokwim-Kwethluk Complex. The complex is intertwined such that mapping them separately is not feasible. Kwethluk soils occur in small areas from three to 10 acres on low knolls, convex slopes bordering drainage ways, and areas adjacent to drained thaw lakes. Kuskokwim soils are found on level areas between slopes and knolls of Kwethluk soils. The two soils can be identified by their differences in slope, vegetation, drainage, and texture. Kuskokwim soils have a thick surface mat and a large proportion of sedges and sphagnum moss; the water table is generally near the surface; and the texture is silty in the upper part. Kwethluk soils have a sandy texture throughout and have a thin mat with polytrichum moss and low growing shrubs and forbs. The water table is several feet deep by mid-summer (Dynamac Corporation 1989a).

4.4 Hydrology

The major surface water feature in the Bethel area is the Kuskokwim River. The site is not within the Kuskokwim River flood plain. Land surrounding the site includes wetlands, small lakes and ponds, streams, and bogs. There are two small creeks that flow north of the site into small unnamed ponds (Dynamac Corporation 1989a).

Groundwater in the Bethel area is obtained from the flood plain and low-terrace alluvium deposits of the Kuskokwim River in permafrost-free areas close to the river and from deep sands beneath the permafrost. At the Bethel Bureau of Indian Affairs administrative site water well, permafrost was reported to extend from near the surface to a depth of 603 feet. In wells that penetrate the permafrost, the groundwater is under considerable hydrostatic pressure. It rises in wells near Bethel to a static water level about equal to that of the Kuskokwim River. Water below the permafrost is potable, and most water supplied to the population of Bethel is pumped from a location near the center of town (EMCON Alaska, Inc. 1996a).

The local distribution of permafrost in the Bethel area is determined largely by surface insulation and subsurface drainage. Permafrost lies at most shallow depths in areas mantled with peat, organic silt, or a dense mat of living vegetation, and it lies at greatest depths beneath bare soil. Permafrost is absent or lies at great depths beneath lakes and ponds. Permafrost has a significant impact on both surface and groundwater flow in the area (11th Civil Engineering Operations Squadron, Operating Engineers 1992).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Bethel site. Much information included in INRMP Chapter 5.0 that includes Bethel site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Bethel site and the surrounding area. Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Bethel site. Fish and mammal species on Bethel site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Bethel site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 125 Bering Tundra (Northern) Province
Description: As a western extension of the arctic coastal plain, the Bering Tundra is a broad lowland area rising gradually to the east. Winters are cold, and summers are generally cool. Annual precipitation is 17 inches. Along coastal areas the vegetation is mainly sedge and cottongrass; on higher sites are woody plants. In transition areas between beach and forest are birch-willow-alder thickets. Inceptisols over silt, sand, and marine sediments are found along the coast; in the lower Yukon and Kuskokwim Valley bottoms are pockets of Entisols. In most of the area, the permafrost is continuous.

5.2 Vegetation

Vegetation in the immediate area of the Bethel site is primarily cotton grass tussock tundra with shrubby willows and alders growing along drainages. Common habitats of the area include a variety of scrub, peatland, heath meadow, marsh, and bogs. The periphery of the site is heavily vegetated with shrub/scrub species dominated by alders. Outside of the shrub/scrub band of vegetation is primarily subarctic tundra. Dominant plants are sedge grasses.

A vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001d) identified 30 species during a 1999 site visit. A general vegetation map of the Bethel site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Bethel site.

5.3 Fish and Wildlife

5.3.1 Fish

A variety of fish inhabit the Kuskokwim River, its tributaries, and numerous lakes in the Bethel area. Common freshwater fish include Arctic grayling and rainbow trout. All five species of Pacific salmon migrate up the Kuskokwim River.

5.3.2 Mammals

Terrestrial mammals inhabiting the Bethel area include Arctic and dusky shrews; Alaskan hares; brown and collared lemmings; short-tailed weasels; Arctic and red foxes; beavers; mink; muskrats; and wolverines (EMCON Alaska, Inc. 1996a). Larger species include brown/grizzly and black bears, caribou, and moose. Muskox have been observed 20 miles west of the site (11th Civil Engineering Operations Squadron, Operating Engineers 1992).

5.3.3 Birds

Numerous species of waterfowl and shorebirds use the area surrounding the site for resting and feeding during migrations, and many species nest in the area. Waterfowl and shorebirds common to the area include Red-throated, Pacific, and Common Loons; Greater White-fronted and Canada Geese; Mallard, American Wigeon, and Canvasback ducks; Greater and Lesser Yellowlegs; Spotted, Western, Least, and

Pectoral Sandpipers; and Red-necked Phalarope. Many passerine species summer and nest in the area, including several species of Warblers, Sparrows, and Swallows. Permanent residents of the area include the Northern Goshawk, Willow Ptarmigan, Gray Jay, Black-billed Magpie, Black-capped Chickadee, Snow Bunting, and Common and Hoary Redpoll.

5.4 Threatened and Endangered Species

No known threatened or endangered species are known to occur on the Bethel site (Dynamac Corporation 1989a, 11th Civil Engineering Operations Squadron, Operating Engineers 1992, EMCON Alaska, Inc. 1996a). Threatened Steller's and Spectacles Eiders have potential to visit Bethel site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Bethel site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The City of Bethel is about four miles east of the Bethel site. Subsistence activities contribute substantially to residents' diets and livelihoods. Subsistence resources include five species of Pacific salmon, several species of whitefish, burbot, pike, blackfish, sheefish, smelt, Dolly Varden, grayling, and trout, moose, caribou, black and brown bear, three species of seals, muskox, hare, porcupine, beaver, muskrat, mink, marten, land otter, fox, lynx, ptarmigan, waterfowl, eggs, berries and other plants. No quantitative studies and/or systematic subsistence surveys have been conducted for Bethel, and no use area for Bethel is depicted in the available literature (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at Bethel site include small and big game hunting, berry picking, and nonconsumptive activities, such as ATV riding along gravel roads, bird watching, and hiking.

APPENDIX A: Natural Resources of Bethel, Big Mountain, and Naknek Recreation Camps Sites

Table A1: Vascular Plant Species Potentially Occurring on or near Bethel, Big Mountain, and Naknek Recreation Camps Sites

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Trees and Shrubs						
American green alder	*Alnus crispa*		X	X	X	BM
Sitka alder	*Alnus sinuata*		X	X	X	BM
Thinleaf alder	*Alnus tennuifolia*		X	X	X	
Alder	*Alnus* sp.	X	X	X	X	B, NI, NII
Pacific serviceberry	*Amelanchier florida*		X	X	X	
Bog rosemary	*Andromeda polifolia*		X	X	X	BM
Alpine bearberry	*Arctostaphylos alpina*		X	X	X	
Red-fruit bearberry	*Arctostaphylos rubra*	X				B
Bearberry (kinikinik)	*Arctostaphylos uva-ursi*		X	X	X	
Alaska paper birch	*Betula papyrifera* var. *humilis*		X	X	X	
Kenai birch	*Betula papyrifera* var. *kenaica*		X	X	X	NI, NII
Dwarf Arctic birch	*Betula nana*	X				
Alaska cassiope	*Cassiope lycopodiodes*		X	X	X	
Starry cassiope	*Cassiope stelleriana*		X	X	X	
Leatherleaf	*Chamaecyparis calyculata*		X	X	X	
Bunchberry	*Cornus canadensis*		X	X	X	
Lapland cornel	*Cornus suecica*	X	X	X	X	B, BM
Diapensia	*Diapensia lapponica*		X	X	X	
Entire-leaf mountain avens	*Dryas integrifolia*		X	X	X	
Mountain avens	*Dryas octopetala*		X	X	X	BM
Crowberry	*Empetrum nigrum*	X	X	X	X	
Narrowleaf Labador tea	*Ledum decumbens*	X	X	X	X	B
Twin-flower	*Linnaea borealis*		X	X	X	
Alpine-azalea	*Loiseleuria procumbens*		X	X	X	
Luetkea	*Luetkea pectinata*		X	X	X	

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Sweet gale	*Myrica gale*		X	X	X	
Aleutian mountain heath	*Phyllodoce aleutica*		X	X	X	
White spruce	*Picea glauca*		X	X	X	NII, BM
Black spruce	*Picea mariana*		X	X	X	NII, BM
Balsam poplar	*Populus balsamifera*		X	X	X	NI, BM
Kamchatka rhododendron	*Rhododendron camtschaticum*		X	X	X	
Skunk currant	*Ribes glandulosm*		X	X	X	
Swamp gooseberry	*Ribes lacustre*		X	X	X	
American red currant	*Ribes triste*		X	X	X	
Prickly rose	*Rosa acicularis*		X	X	X	
Noogan-berry	*Rubus arcticus*	X	X	X	X	B
Cloudberry	*Rubus chamaemorus*	X	X	X	X	B, NII
Feltleaf willow	*Salix alaxensis*		X	X	X	NI, BM
Littetree willow	*Salix arbusculoides*		X	X	X	
Arctic willow	*Salix arctica*	X	X	X	X	B, BM
Undergreen willow	*Salix commutata*		X	X	X	
Alaska bog willow	*Salix fuscescens*		X	X	X	
Grayleaf willow	*Salix glauca*		X	X	X	
Low blueberry willow	*Salix myrtillifolia*		X	X	X	
Skeletonleaf willow	*Salix phlebophylla*		X	X	X	
Netleaf willow	*Salix reticulata*		X	X	X	
Least willow	*Salix rotundifolia*		X	X	X	
Scouler willow	*Salix scouleriana*		X	X	X	
Willow	*Salix* sp.	X	X	X	X	B, BM
Sprouting willow	*Salix stolonifera*		X	X	X	
Pacific red-elder	*Sambucus callicarpa*		X	X	X	
Green Mountain ash	*Sorbus scopulina*		X	X	X	
Sitka Mountain ash	*Sorbus sitchensis*		X	X	X	

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Beauverd spirea	*Spiraea beauverdiana*		X	X	X	BM
Dwarf blueberry	*Vaccinium caespitosum*		X	X	X	BM
Bog blueberry	*Vaccinium uliginosum*	X	X	X	X	NI
Low-bush cranberry	*Vaccinium vitis-idaea*	X	X	X	X	B, NII
Highland cranberry	*Viburnum edule*		X	X	X	
Herbaceous Plants						
Baneberry	*Acatea rubra*		X	X	X	
Northern yarrow	*Achillea borealis*		X	X	X	NI
Siberian yarrow	*Achillea sibirica*	X	X	X	X	B, BM
Monkshood	*Aconitium delphinifolium*	X	X	X	X	
Wild chives	*Allium schoenoprasum*		X	X	X	
Northern jasmine	*Androsace sepientrionalis*		X	X	X	
Pasque flower	*Anemone drummondii*		X	X	X	
Narcissus-flower anemone	*Anemone narcissiflora*		X	X	X	
Yellow anemone	*Anemone richardsonii*		X	X	X	BM
Wild celery	*Angelica lucida*	X	X	X	X	B
Cats paws	*Antennaria monocephala*		X	X	X	
Pussytoes	*Antennaria* sp.		X	X	X	BM
Lyre-leaf rockcress	*Arabis lyrata*		X	X	X	NI
Rose-purple orchis	*Archis aristata*		X	X	X	
Pendent grass	*Arctophila fulva*		X	X	X	
Frigid arnica	*Arnica frigida*		X	X	X	BM
Lessing's arnica	*Arnica lessingii*		X	X	X	
Arctic wormwood	*Artemisia arctica*		X	X	X	
Northern wormwood	*Artemisia borealis*		X	X	X	
Purple wormwood	*Artemisia globularia*		X	X	X	
Common wormwood	*Artemisia tilesii*	X	X	X	X	B
Goatsbeard	*Aruncus sylvester*		X	X	X	
Siberian aster	*Aster sibiricus*		X	X	X	

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Wintercress	*Barbarea orthoceras*		X	X	X	
Broomrape	*Boschniakia rossica*		X	X	X	BM
Moonwort	*Botrychium boreale*		X	X	X	
Moonwort	*Botrychium lunaria*		X	X	X	
Bluejoint grass	*Calamagrostis canadensis*		X	X	X	NI, NII
Reed bent grass	*Calamagrostis* sp.		X	X	X	
Marsh marigold	*Caltha palustris*		X	X	X	
Bluebell	*Campanula lasiocarpa*	X	X	X	X	B, BM
Cuckoo flower	*Cardamine pratensis*		X	X	X	
Sedge	*Carex aquatilis*		X	X	X	
Sedge	*Carex bigelowii*		X	X	X	
Sedge	*Carex lyngbyaei*		X	X	X	
Sedge	*Carex nesophila*	X	X	X	X	B, BM
Sedge	*Carex* sp.	X	X	X	X	B, NII, BM
Paintbrush	*Castilleja* sp.		X	X	X	
Coastal paintbrush	*Castilleja unalaschensis*		X	X	X	
Bering Sea chickweed	*Cerastium beeringianum*		X	X	X	
Chickweed	*Cerastium fischerianum*	X	X	X	X	B
Arctic daisy	*Chrysanthemum arcticum*		X	X	X	
Mackenzie water hemlock	*Cicuta mackenzieana*		X	X	X	
Lichen	*Cladonia* sp.	X				B
Spring beauty	*Claytonia chamissoi*		X	X	X	
Alaska spring beauty	*Claytonia sarmentosa*		X	X	X	BM
Coral root	*Corallorrhiza trifida*		X	X	X	
Pink lady's slipper	*Cypripedium guttatum*		X	X	X	
Hair moss	*Dicranum* sp.	X				
Long leaved sundew	*Drosera angelica*		X	X	X	
Yellow dryas	*Dryas drummondii*		X	X	X	
Eight petaled dryas	*Dryas octopetala*		X	X	X	

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Fireweed	*Epilobium angustifolium*	X	X	X	X	B, NI, BM
Dwarf fireweed	*Epilobium latifolium*		X	X	X	BM
Horsetail	*Equisetum arvense*		X	X	X	NI
Horsetail	*Equisteum* sp.	X	X	X	X	B, BM
Bue fleabane	*Erigeron acris*		X	X	X	
Fleabane	*Erigeron humilis*		X	X	X	
Cotton grass	*Eriophorum gracile*	X	X	X	X	B, NII, BM
Arctic cotton grass	*Eriophorum scheuchzeri*		X	X	X	
Cotton grass	*Eriophorum* sp.	X				B
Fescue grass	*Festuca* sp.		X	X	X	
Chocolate lily	*Fritillaria camschatcensis*		X	X	X	
Northern bedstraw	*Galium boreale*		X	X	X	NI
White gentian	*Gentiana algida*		X	X	X	BM
Wild geranium	*Geranium erianthum*		X	X	X	NI
Ross avens	*Geum rossii*		X	X	X	
Wild sweet pea	*Hedysarum mackenzii*		X	X	X	NI
Cow parsnip	*Heracleum lanatum*		X	X	X	NI, BM
Wild iris	*Iris setosa*		X	X	X	
Lagotis	*Lagotis glauca*		X	X	X	BM
Vetching	*Lathyrus palustris*		X	X	X	
Labrador tea	*Ledum palustre* ssp. *groenlandicum*		X	X	X	NI, BM
Duckweed	*Lemna* sp.	X				
Leutkea	*Leutkea pectinata*		X	X	X	
Alp lily	*Lloydia serotina*		X	X	X	BM
Alpine azalea	*Loiseleuria procumbens*		X	X	X	BM
Arctic lupine	*Lupinus arcticus*		X	X	X	NII, BM
Nootka lupine	*Lupinus nootkatensis*		X	X	X	
Alpine club moss	*Lycopodium alpinum*		X	X	X	NII
Club moss	*Lycopodium* sp.	X	X	X	X	BM

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Bladder campion	*Melandrium apetalum*		X	X	X	
Bogbean	*Menyanthes trifoliata*		X	X	X	
Monkey flower	*Mimulus guttatus*		X	X	X	
Arctic sandwort	*Minuartia arctica*		X	X	X	NI, BM
Grove sandwort	*Moehringia lateriflora*		X	X	X	NI
Alpine forget-me-not	*Myosotis alpestris*		X	X	X	
Yellow pond lily	*Nuphar polysepalum*	X	X	X	X	
White pond lily	*Nuphar tetragona*	X				
Bog cranberry	*Oxycoccus microcarpus*	X	X	X	X	B
Maybell’s oxytrope	*Oxytropis maydelliana*		X	X	X	BM
Blackish oxytrope	*Oxytropis nigrescens*		X	X	X	BM
Arctic poppy	*Papaver lapponicum*		X	X	X	
Grass of parnassus	*Parnassia palustris*		X	X	X	
Parrya	*Parrya nudicaulis*		X	X	X	
Capitate lousewort	*Pedicularis capitata*		X	X	X	
Wooly lousewort	*Pedicularis kanei*		X	X	X	BM
Labrador lousewort	*Pedicularis labradorica*	X				B
Arctic lousewort	*Pedicularis landsdorfii*	X				B
Oeder’s lousewort	*Pedicularis oederi*		X	X	X	
Lousewort	*Pedicularis* sp.	X				
Bumble bee flower	*Pedicularis verticillata*		X	X	X	
Northern coltsfoot	*Petasites hyperboreus*		X	X	X	B, NII
Aleutian heather	*Phyllodoce aleutica*		X	X	X	
Bog violet	*Pinguicula vulgaris*	X	X	X	X	B
Small north bog orchid	*Platanthera obtrusata*		X	X	X	
Blue grass	*Poa* sp.		X	X	X	
Tall Jacob’s ladder	*Polemonium acutiflorum*		X	X	X	BM
Northern Jacob’s ladder	*Polemonium boreale*	X				B
Pink plumes	*Polygonum bistorta*		X	X	X	BM

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Alpine meadow bistort	*Polygonum viviparum*		X	X	X	
Pondweed	*Potamogeton* sp.	X				
Pacific silver weed	*Potentilla egedii*		X	X	X	
Tundra rose	*Potentilla fruticosa*		X	X	X	BM
Marsh fivefinger	*Potentilla palustris*		X	X	X	NII
Pixie eyes	*Primula cuneifolia*		X	X	X	
Pink pyrola	*Pyrola asarifolia*		X	X	X	
Western buttercup	*Ranunculus occidentalis*		X	X	X	NI, BM
Roseroot	*Rhodiola rosea*		X	X	X	
Sheep sorrel	*Rumex acetosella*		X	X	X	
Arctic dock	*Rumex arcticus*	X	X	X	X	B, BM
Dock	*Rumex beringensis*		X	X	X	
Dock	*Rumex graminifolius*		X	X	X	
Brook saxifrage	*Saxifraga punctata*		X	X	X	
Spotted saxifrage	*Saxifraga bronchialis*		X	X	X	
Yellow marsh saxifrage	*Saxifraga hirculis*		X	X	X	
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*		X	X	X	
Rosewort	*Sedum rosea*		X	X	X	BM
Mastodon flower	*Senecio congestus*		X	X	X	
Black-tipped groundsel	*Senecio lugens*		X	X	X	
Ragwort	*Senecio* sp.		X	X	X	
Sibbaldia procumbens	*Sibbaldia procumbens*		X	X	X	BM
Moss campion	*Silene acaulis*		X	X	X	BM
Goldenrod	*Solidago multiradiata*		X	X	X	BM
Bur-reed	*Sparganium augustifolium*	X	X	X	X	
Sphagnum moss	*Sphagnum* sp.		X	X	X	BM
Alaska spirea	*Spiraea beauverdiana*	X				B
Ladies' tresses	*Spiranthes romanzoffiana*		X	X	X	
Dandelion	*Taraxacum* sp.		X	X	X	NII

Common Name	Scientific Name	Bethel (B)*	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Star flower	*Trientalis europaea*	X	X	X	X	B, NII, BM
Arrow grass	*Trilochin maritimum*		X	X	X	
Mountain helotrope	*Valeriana capitata*		X	X	X	
False hellebore	*Veratrum viride*		X	X	X	BM
American brook lime	*Veronica americana*		X	X	X	
Two-flowered violet	*Viola biflora*		X	X	X	
Violet	*Viola epipsila*	X				
Alaska violet	*Viola langsdorffii*		X	X	X	
Great spurred violet	*Viola selkirkii*		X	X	X	

Observation Codes:
B - Bethel
NI - Naknek I
NII - Naknek II
BM - Big Mountain

Sources:
EMCON Alaska, Inc., 1996a
Hulten, 1968
Jones Technologies, Inc. and Gene Stout and Associates, 1999b
Pratt, 1989; 1991
Viereck and Little, 1972
White, 1974

Notes:
Species listed alphabetically by scientific name.
Species observed during July 1999 site visits by G. Stout and N. Weston (Gene Stout and Associates).
* List of potential species is incomplete due to limited references specific to the Bethel area.

Table A2: Bird Species Potentially Occurring on or near Bethel, Big Mountain, and Naknek Recreation Camps Sites

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Red-throated Loon	*Gavia stellata*	X	X	X	X	
Pacific Loon	*Gavia pacifica*	X	X	X	X	NII
Common Loon	*Gavia immer*	X	X	X	X	
Arctic Loon	*Gavia arctica*	X				
Horned Grebe	*Podiceps auritus*		X	X	X	
Red-necked Grebe	*Podiceps grisegena*	X	X	X	X	
Mottled Petrel	*Pterodroma inexpectata*		X	X	X	
Sooty Shearwater	*Puffinus griseus*		X	X	X	
Short-tailed Shearwater	*Puffinus tenuirostris*		X	X	X	
Fork-tailed Storm-petrel	*Oceanodroma furcata*		X	X	X	
Leach's Storm-petrel	*Oceanodroma leucorhoa*		X	X	X	
Double-crested Cormorant	*Phalacrocorax auritus*		X	X	X	
Pelagic Cormorant	*Phalacrocorax pelagicus*		X	X	X	
Red-faced Cormorant	*Phalacrocorax urile*		X	X	X	
Tundra Swan	*Cygnus columbianus*	X	X	X	X	
Whooper Swan	*Cygnus cygnus*		X	X	X	
Greater White-fronted Goose	*Anser albiforns*	X	X	X	X	
Snow Goose	*Chen caerulescens*		X	X	X	
Emperor Goose	*Chen canagica*	X	X	X	X	
Brant	*Branta bernicla*	X	X	X	X	
Canada Goose	*Branta canadensis*	X	X	X	X	
Aleutian Cackling Goose	*Branta hutchinsii leucopareia*		X	X	X	
Green-winged Teal	*Anas crecca*	X	X	X	X	
Mallard	*Anas platyrhynchos*	X	X	X	X	
Northern Pintail	*Anas acuta*	X	X	X	X	B, NII, BM
Northern Shoveler	*Anas clypeata*	X	X	X	X	

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Gadwall	*Anas strepera*		X	X	X	
Eurasian Wigeon	*Anas penelope*		X	X	X	
American Wigeon	*Anas americana*	X	X	X	X	
Canvasback	*Aythya valisineria*	X	X	X	X	
Redhead	*Aythya americana*		X	X	X	
Ring-necked Duck	*Aythya collaris*		X	X	X	
Tufted Duck	*Aythya fuligula*		X	X	X	
Greater Scaup	*Aythya marila*	X	X	X	X	
Lesser Scaup	*Aythya affinis*	X				
Common Eider	*Somateria mollissima*		X	X	X	
King Eider	*Somateria spectabilis*		X	X	X	
Spectacled Eider	*Somateria fischeri*	X	X	X	X	
Steller's Eider	*Polysticta stelleri*	X	X	X	X	
Harlequin Duck	*Histrioncus histrioncus*		X	X	X	
Black Scoter	*Melanitta nigra*	X	X	X	X	NII
Surf Scoter	*Melanitta perspicillata*		X	X	X	
White-winged Scoter	*Melanitta fusca*		X	X	X	
Common Goldeneye	*Bucephala clangula*	X	X	X	X	BM
Long-tailed Duck	*Clangula hyemalis*	X	X	X	X	
Barrow's Goldeneye	*Bucephala islandica*		X	X	X	
Bufflehead	*Bucephala albeola*	X	X	X	X	
Hooded Merganser	*Lophodytes cucullatus*		X	X	X	
Common Merganser	*Mergus merganser*	X	X	X	X	
Red-breasted Merganser	*Mergus serrator*	X	X	X	X	
Osprey	*Pandion haliaetus*	X	X	X	X	
Bald Eagle	*Haliaeetus leucocephalus*	X	X	X	X	NI, BM
Northern Harrier	*Circus cyaneus*	X	X	X	X	
Sharp-shinned Hawk	*Accipter striatus*		X	X	X	
Northern Goshawk	*Accipiter gentilis*	X	X	X	X	

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Rough-legged Hawk	*Buteo lagopus*	X	X	X	X	
Golden Eagle	*Aquila chrysaetos*		X	X	X	
American Kestrel	*Falco sparverius*		X	X	X	
Merlin	*Falco columbarius*	X	X	X	X	
Peregrine Falcon	*Falco peregrinus*		X	X	X	
Gyrfalcon	*Falco rusticolus*	X	X	X	X	
Spruce Grouse	*Dendragapus canadensis*		X	X	X	
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	X	
Rock Ptarmigan	*Lagopus mutus*		X	X	X	
Ruffed Grouse	*Bonasa umbellus*	X				
Sandhill Crane	*Grus canadensis*	X	X	X	X	
Black-bellied Plover	*Pluvialis squatarola*	X	X	X	X	
Pacific Golden-Plover	*Pluvialis fulva*	X				B*
American Golden-Plover	*Pluvialis dominica*	X	X	X	X	
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	X	
Greater Yellowlegs	*Tringa melanoleuca*	X	X	X	X	BM
Lesser Yellowlegs	*Tringa flavipes*	X				
Solitary Sandpiper	*Tringa solitaria*	X	X	X	X	
Wandering Tattler	*Heteroscelus incanus*		X	X	X	
Spotted Sandpiper	*Actitis macularia*	X	X	X	X	
Whimbrel	*Numenius phaeopus*	X	X	X	X	
Bristle-thighed Curlew	*Numenius tahitiensis*		X	X	X	
Hudsonian Godwit	*Limosa haemastica*	X	X	X	X	
Bar-tailed Godwit	*Limosa lapponica*	X	X	X	X	
Marbled Godwit	*Limosa fedoa*		X	X	X	
Ruddy Turnstone	*Arenaria interpres*	X	X	X	X	
Black Turnstone	*Arenaria melanocephala*	X	X	X	X	
Surfbird	*Aphriza virgata*		X	X	X	
Sanderling	*Calidris alba*		X	X	X	

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Semipalmated Sandpiper	*Calidris pusilla*		X	X	X	
Western Sandpiper	*Calidris mauri*	X	X	X	X	
Least Sandpiper	*Calidris minutilla*	X	X	X	X	
Baird's Sandpiper	*Calidris bairdii*		X	X	X	
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	X	
Sharp-tailed Sandpiper	*Calidris acuminata*		X	X	X	
Rock Sandpiper	*Calidris ptilocnemis*	X	X	X	X	
Dunlin	*Calidris alpina*	X	X	X	X	
Short-billed Dowitcher	*Limnodromus griseus*	X	X	X	X	
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	X	
Common Snipe	*Gallinago gallinago*	X	X	X	X	B, BM
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	X	
Red Phalarope	*Phalaropus fulicaria*	X	X	X	X	B
Pomarine Jaeger	*Stercorarius pomarinus*		X	X	X	
Parasitic Jaeger	*Stercorarius parasisticus*	X	X	X	X	
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	X	B
Bonaparte's Gull	*Larus philadelphia*	X	X	X	X	BM
Mew Gull	*Larus canus*	X	X	X	X	NI, NII
Herring Gull	*Larus argentatus*		X	X	X	
Glaucous-winged Gull	*Larus glaucescens*	X	X	X	X	
Glaucous Gull	*Larus hyperboreus*	X	X	X	X	NI, BM
Black-legged Kittiwake	*Rissa tridactyle*		X	X	X	
Sabine's Gull	*Xema sabini*	X	X	X	X	
Ivory Gull	*Pagophila eburnea*		X	X	X	
Arctic Tern	*Sterna paradisaea*	X	X	X	X	NII
Aleutian Tern	*Sterna aleutica*	X	X	X	X	
Common Murre	*Uria aalge*		X	X	X	
Thick-billed Murre	*Uria lomvia*		X	X	X	
Marbled Murrelet	*Brachyramphus marmoratus*		X	X	X	

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Kittlitz's Murrelet	*Brachyramphus brevirostris*		X	X	X	
Least Auklet	*Aethia pusilla*		X	X	X	
Whiskered Auklet	*Aethia pygmaea*		X	X	X	
Rock Dove	*Columba livia*		X	X	X	
Great-horned Owl	*Bubo virginianus*	X	X	X	X	
Snowy Owl	*Nyctea scandiana*		X	X	X	
Northern Hawk Owl	*Surnia ulula*		X	X	X	
Short-eared Owl	*Asio flammeus*	X	X	X	X	
Boreal Owl	*Aegolius funereus*		X	X	X	
Belted Kingfisher	*Ceryle alcyon*	X	X	X	X	
Downy Woodpecker	*Picoides pubescens*	X	X	X	X	
Hairy Woodpecker	*Picoides villosus*		X	X	X	
Three-toed Woodpecker	*Picoides tridactylus*		X	X	X	
Olive-sided Flycatcher	*Contopus borealis*		X	X	X	
Alder Flycatcher	*Empidonax alnorum*	X	X	X	X	B*
Tree Swallow	*Tachycineta bicolor*	X	X	X	X	B, NI, NII
Violet-green Swallow	*Tachycineta thalassina*		X	X	X	
Bank Swallow	*Riparia riparia*	X	X	X	X	
Cliff Swallow	*Hirundo pyrrhonota*	X	X	X	X	B
Gray Jay	*Perisoreus canadensis*	X	X	X	X	
Black-billed Magpie	*Pica pica*	X	X	X	X	NI
Common Raven	*Corvus corax*	X	X	X	X	B
Black-capped Chickadee	*Poecile atricapilla*	X	X	X	X	
Boreal Chickadee	*Poecile hudsonica*	X	X	X	X	
Red-breasted Nuthatch	*Sitta canadensis*		X	X	X	
Brown Creeper	*Certhia americana*		X	X	X	
Winter Wren	*Troglodytes troglodytes*		X	X	X	
American Dipper	*Cinclus mexicanus*		X	X	X	
Golden-crowned Kinglet	*Regulus satrapa*		X	X	X	

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Arctic Warbler	*Phylloscopus borealis*	X				
Ruby-crowned Kinglet	*Regulus calendula*	X	X	X	X	
Northern Wheatear	*Oenanthe oenanthe*		X	X	X	
Gray-cheeked Thrush	*Catharus minimus*	X	X	X	X	
Swainson's Thrush	*Catharus ustalatus*		X	X	X	
Hermit Thrush	*Catharus guttatus*	X	X	X	X	
American Robin	*Turdus migratorius*	X	X	X	X	B*, NII, BM
Varied Thrush	*Ixoreus naevius*	X	X	X	X	B*
Yellow Wagtail	*Montacilla flava*	X	X	X	X	
American Pipit	*Anthus rubescens*		X	X	X	
Bohemian Waxwing	*Bombycilla garrulus*		X	X	X	
Northern Shrike	*Laninus excubitor*	X	X	X	X	
Orange-crowned Warbler	*Vermivora celata*	X	X	X	X	NI
Yellow Warbler	*Dendroica petechia*	X	X	X	X	B*
Yellow-rumped Warbler	*Dendroica coronata*	X	X	X	X	
Blackpoll Warbler	*Dendroica striata*	X	X	X	X	NI, NII
Northern Waterthrush	*Seiurus noveboracensis*	X	X	X	X	
Wilson's Warbler	*Wilsonia pusilla*	X	X	X	X	B*, NI, NII
American Tree Sparrow	*Spizella arborea*	X	X	X	X	B*
Chipping Sparrow	*Spizella passerina*		X	X	X	
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	X	B*, NII, BM
Fox Sparrow	*Passerella iliaca*	X	X	X	X	B*, NI, BM
Song Sparrow	*Melospiza melodia*	X	X	X	X	
Lincoln's Sparrow	*Melospiza lincolnii*	X	X	X	X	
Golden-crowned Sparrow	*Zonotrichia atricapilla*	X	X	X	X	BM
White-crowned Sparrow	*Zonotrichia leuophrys*	X	X	X	X	B*, BM
Dark-eyed (slate-colored) Junco	*Junco hyemalis*	X	X	X	X	B*
Lapland Longspur	*Calcarius lapponicus*	X	X	X	X	B

Common Name	Scientific Name	Bethel (B)	Naknek I (NI)	Naknek II (NII)	Big Mountain (BM)	Observed
Snow Bunting	*Plectrophenax nivalis*	X	X	X	X	BM
McKay's Bunting	*Plectrophenax hyperboreus*	X	X	X	X	
Rusty Blackbird	*Euphagus carolinus*	X	X	X	X	BM
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*		X	X	X	
Pine Grosbeak	*Pinicola enucleator*	X	X	X	X	
Red Crossbill	*Loxia curvirostra*		X	X	X	
White-winged Crossbill	*Loxia leucoptera*		X	X	X	
Common Redpoll	*Carduelis flammea*	X	X	X	X	B, NI, NII, BM
Hoary Redpoll	*Carduelis hornemanni*	X	X	X	X	

Observation Codes:
B - Bethel
NI - Naknek I
NII - Naknek II
BM - Big Mountain
* - Breeding behavior and/or nests observed.

Notes:
Species listed by phylogenic order.
Species observed by J. Trousil (Gene Stout and Associates) during July 1999 site visits.

Sources:
Anonymous, undated(a)
Anonymous, undated(b)
Armstrong, 1998
EMCON Alaska, Inc., 1996a
Jones Technologies, Inc. and Gene Stout and Associates, 1999b
MacGowan, 1994
Moore, 1996
Morgan, 1999
Ruhl, 1997
Ruhl and Moore, 1996
Scharf, 1993
USFWS, 1993a

Appendix 3.0 - Big. Big Mountain Radio Relay Site

3.0 Installation Overview

Figure 3.0 Aerial View of Big Mountain Former RRS, Upper Camp

3.1 Location and Area

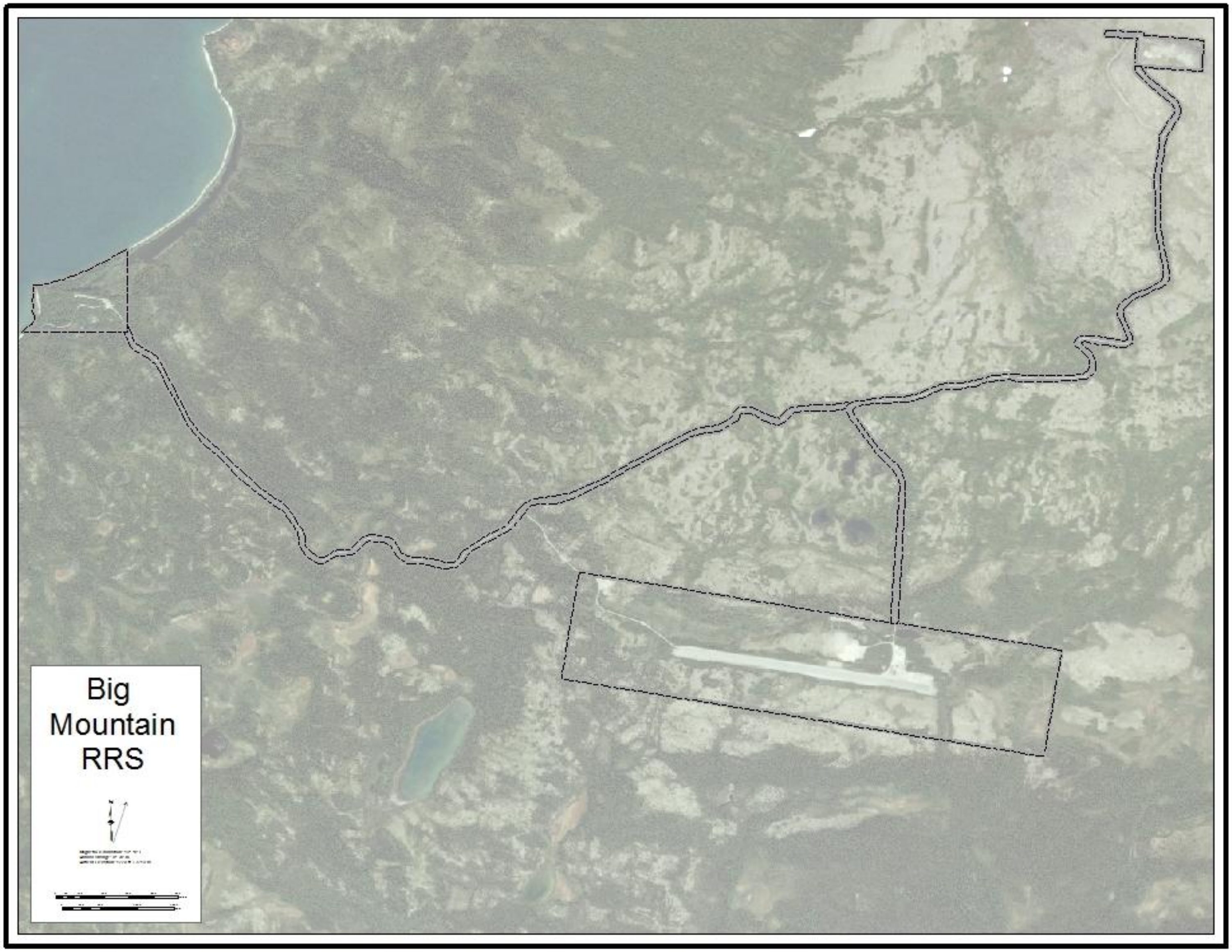
The Big Mountain excess site is at the northern end of the Alaska Peninsula on the south shore of Iliamna Lake, about 17 miles west of the community of Kokhanok and about 225 miles southwest of Anchorage, Alaska (INRMP Figure 3.1). The site proper encompasses 402 acres and is composed of an Upper Camp and Lower Camp connected by an access road (Figure 3.1).

3.2 Installation History

Construction of Air Force facilities at Big Mountain occurred in 1957. The site was one of 31 WACS sites and operated as a tropospheric scatter station until communication satellites rendered the station obsolete in the 1960s. USAF real estate records indicate it first was the Big Mountain Communications Station, renamed Elmendorf/Iliamna Radio Relay Station Annex, then Big Mountain Air Force Station in 1958, and in 1961 became Big Mountain Radio Relay Station. As a WACS it linked Diamond Ridge, King Salmon, and Sparrevohn (Reynolds 1988). Big Mountain was upgraded in the 1960s with Alaska Telephone Switching Station capabilities, and operated as one of four hubs for the entire telephone network. Big Mountain was operated by RCA Alaska Communications, beginning in 1967, as part of a transfer of government-owned communication facilities to private operators.

The facility was permanently deactivated in 1979. Deactivated facilities of Upper Camp included four tropospheric antennas, two dish antennas, a dormitory building, a equipment and power building, a water storage tank, two fuel storage tanks, and a temporary vehicle storage building. Deactivated facilities of Lower Camp included a small storage building, a fuel storage tank, the gravel airstrip that is inactive and not maintained, and a former landfill area (DOWL/Ogden Joint Venture 1998a). Demolition and remediation of the Big Mountain site under the Clean Sweep program occurred during 2004 and 2005.

Figure 3.1 Big Mountain Former RRS



3.3 Surrounding Communities

The Big Mountain site is in a remote area on the south shore of Iliamna Lake about 17 miles west of Kokhanok. Kokhanok is a fishing village accessible by air and water with a population of 170 consisting of 80% Alaska Native or American Indian. The school is the largest employer in Kokhanok. Commercial fishing has declined since several limited entry permits were sold. Some residents travel to the Bristol Bay area each summer to fish. In 2010, nine persons held commercial fishing permits. People heavily rely on subsistence activities; many families have a summer fish camp near the Gibraltar River. Salmon, trout, grayling, moose, bear, rabbit, porcupine, and seal are utilized. Subsistence activities are a focal point of the culture and lifestyle (www.dced.state.ak.us 2012).

Igiugig is located on the south shore of the Kvichak River, which flows from Iliamna Lake, about 30 miles west of the Big Mountain site. Commercial and subsistence fishing sustain the community. The population of 50 is 40 percent American Indian or Alaska Native (2010). Igiugig is accessible primarily by water and air. There are several commercial lodges that serve sports anglers and hunters seasonally in Igiugig (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Subsistence and commercial fishing, as well as sport fishing and hunting are primary regional land uses (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas

The Big Mountain site is near the Katmai National Park and Preserve. Katmai was originally created as a National Monument in 1918 to preserve the famed Valley of Ten Thousand Smokes, a spectacular forty square mile, 100- to 700-foot deep ash flow deposited by Novarupta Volcano. Katmai was designated a National Park and Preserve in 1980. North-central and northwestern portions of Katmai are commonly termed “the lake region”. Naknek Lake is the principal part of the hydrologic system of lakes, ponds, rivers, streams, and marshes formed in valleys dammed by glacial deposits. The southwestern portion of Katmai is part of the Bristol Bay coastal plain, with relatively flat terrain and many poorly drained lakes. Katmai National Park and Preserve is famous for volcanoes, brown bears (in recent years, the number of bears visiting Brooks River has grown to almost 100), pristine waterways with abundant fish, remote wilderness, and rugged coastline. One of the primary purposes of Katmai is to protect habitats for populations of fish and wildlife, including, but not limited to, high concentrations of brown bears and their denning areas, and maintain unimpaired watersheds and water habitat vital to red salmon spawning (www.nps.gov 2007).

4.0 Physical Environment

4.1 Climate

Big Mountain site and the Iliamna Lake region have a continental climate typical of the Interior Basin of Alaska. Average summer temperatures range from 42 to 62°F; winter temperatures average 6 to 30°F. The record high is 91 °F, and the record low is -47 °F. Precipitation averages 26 inches annually, with 64 inches of snow (www.dced.state.ak.us 2012). The continental climate is characterized by extreme seasonal variations in temperature and by low total precipitation. The mean annual temperature for Big Mountain is 35°F (DOWL/Ogden Joint Venture 1998a).

4.2 Landforms

The immediate area around the Big Mountain site is characterized by knob and kettle topography (SAIC 1993b). The region is dominated by the Alaska Peninsula Aleutian Mountain Range to the east and the relatively flat kettle-type terrain to the west. The Upper Camp is on the peak of Big Mountain at 2,161 feet above msl. Iliamna Lake is about two miles north of the Upper Camp and lies at 50 feet above msl. The Lower Camp and airstrip are on an east-west orientation below the southern slope of Big Mountain.

4.3 Geology and Soils

Virtually all geologic history in the Big Mountain area is centered on volcanic activity. Most bedrock in the area is composed of volcanic rock of Tertiary age, and glacial debris mantles much of the area. Most rocks are informally classified as basalt, andesite, tuff, and volcanic rubble. Unconsolidated deposits consist of sandy, cobbley gravels. Cobbles and gravels are predominantly composed of well-rounded granitic rocks with some angular and subangular volcanic rocks. Sands in the area are rich in quartz with variable occurrences of silt (DOWL/Ogden Joint Venture 1998a).

Soils at the Big Mountain site are classified as Typic Cryandepts, which are commonly associated with very gravelly, hilly to steep-rough mountainous land. Soils are shallow, well-drained volcanic ash over very gravelly glacial till on valley sides and rounded hills. Soils consist of 10-20 inches of dark brown loamy volcanic ash over dark brown, very gravelly loam under a mat of litter and roots. Soils are strongly acid. Generally, there is little or no soil cover on mountain peaks and ridges (DOWL/Ogden Joint Venture 1998a).

4.4 Hydrology

Iliamna Lake is the largest body of surface water in the area. Regional drainage tends to flow towards the lake or north-northwest in the area surrounding the site. Big Mountain is a topographic high point and is predominantly rocky and devoid of surface water bodies. A radial drainage pattern is apparent on Big Mountain, and the area surrounding the site can be classified as multibasinal. This drainage pattern is heavily influenced by glacial deposition and discontinuous permafrost, giving it the characteristically hummocky, knob and kettle topography. Water from Upper Camp follows one of several unnamed intermittent streams. Water draining from the northern, northwestern, and northeastern sides of the mountain enters these unnamed streams and empties directly into Iliamna Lake. Water from the western and southern sides of the mountain drains into the Belinda Creek drainage basin, flowing down tributaries into Belinda Creek, which empties into Iliamna Lake (SAIC 1993b).

Ground water in the vicinity of the site most likely occurs within joints and fractures of underlying volcanic rocks, within the matrix of more permeable deposits, and along bedding planes of these deposits. Depth to ground water is unpredictable. Ground water discharge at topographic lowpoints, including seeps, marshes, and shallow ponds, suggests a near surface shallow aquifer under unconfined conditions. Discontinuous permafrost in the area may impede downward and lateral movement of ground water and may also act as a confining layer. It appears ground water gradients mirror surface water flow, draining radially from the Upper Camp area and in a western and southwestern direction from Lower Camp and the airstrip area (DOWL/Ogden Joint Venture 1998a).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Big Mountain site. Much information included in INRMP Chapter 5.0 that includes Big Mountain site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Big Mountain site and the surrounding area. ***Appendix 3.0-Bethel***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Big Mountain site. Fish and mammal species on Big Mountain site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Big Mountain site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 126 Bering Tundra (Southern) Province
Description: This is a moraine- and outwash-mantled lowland province that rises from sea level to heights of 300-500 feet. Winters are cold, and summers are cool and short. Average precipitation is 13-34 inches. Dominant vegetation is moist and wet tundra communities. Inceptisols are dominant soils of the province; permafrost is sporadic or absent.

5.2 Vegetation

The Upper Camp area of the Big Mountain site is above tree line and is generally barren in windswept areas. The area surrounding Upper Camp is vegetated with tundra, including, dryas, grasses, sedges, bryophytes, lichens, and fireweed. Dwarf scrub species, such as mountain avens, heaths, forbs, grasses, and sedges, are common on well-drained slopes and comprise the dominant communities. On lower slopes and along stream banks and drainages, taller scrub communities occur and are dominated by Sitka alder, feltleaf willow, and other willows. Mixed alder and willow communities dominate Lower Camp and around the airstrip.

The vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001d) identified 50 plant species during a 1999 site visit. A general vegetation map of the Big Mountain site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Big Mountain site.

5.3 Fish and Wildlife

5.3.1 Fish and Amphibians

The network of rivers, streams, and lakes of the Big Mountain area produce some of the world’s finest sport fishing and is the largest producer of sockeye salmon in the world. About two-thirds of the Bristol Bay salmon harvest is produced from the Kvichak River drainage (DOWL/Ogden Joint Venture 1998b).

Small intermittent streams that drain into Iliamna Lake may contain such small fish as sculpin, trout in early life stages, and first-year northern pike. Belinda Creek likely contains larger fish, including rainbow trout, Arctic grayling, Dolly varden, and northern pike in addition to smaller forage fish. Amphibians are uncommon in this area of Alaska (DOWL/Ogden Joint Venture 1998a); however, wood frogs were observed in small ponds along the access road to the Upper Camp during a 1999 site visit.

5.3.2 Mammals

Large terrestrial mammals inhabiting the area are brown bear, caribou, and moose. The Arctic and red fox, wolf, wolverine, and several species of small mammals potentially occur in the area of the site (DOWL/Ogden Joint Venture 1998a). The most common small mammal observed during a 1999 site visit (Universe Technologies, Inc. and Gene Stout and Associates 2001c) was the Arctic ground squirrel.

5.3.3 Birds

In general, birds common to the interior or southwestern Alaska can be found in the Big Mountain region. As many as 135 species of birds have been reported in the Iliamna Lake area. Numerous waterfowl and shorebirds use Iliamna Lake for feeding and resting during migrations. Passerine species common to the area include Golden-crowned Sparrow, Wilson's Warbler, Orange-crowned Warbler, Snow Bunting, Hermit Thrush, Gray Jay, and Common Raven. Common game birds in the area include the Spruce Grouse and Willow and Rock Ptarmigan. Bird species commonly observed at Big Mountain include American Robin, Savannah Sparrow, Golden-crowned Sparrow, White-crowned Sparrow, Snow Bunting, and Common Redpoll.

5.4 Threatened and Endangered Species

No threatened, endangered, or rare species are known to inhabit the Iliamna Lake area (DOWL/Ogden Joint Venture 1998a) where the Big Mountain site is located. Threatened Steller's and Spectacled Eiders and the candidate Kittlitz's Murrelet have potential to visit Big Mountain site.

5.5 Wetlands

It is estimated that significant areas of wetlands exist within a 15-mile radius of the site (DOWL/Ogden Joint Venture 1998a). No wetland areas occur at the Upper Camp, but isolated pockets of wetlands may occur along the slopes of Big Mountain. Several large ponds occur at the base of the mountain close to the access road. A small stream flows just north of the airstrip, and several beaver dams built along this stream have created ponds and a marsh area immediately adjacent to the Lower Camp area.

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Big Mountain site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Nearest communities to the Big Mountain site include Igiugig, Kokhanok, Iliamna, Pedro Bay, and Newhalen. Kokhanok is the nearest, about 17 miles east. Residents of Kokhanok rely heavily on subsistence resources including salmon, trout, grayling, moose, bear, rabbit, porcupine and seal. The Kokhanok subsistence area encompasses all of Iliamna Lake and extends from Kvichak River in the west to Kamishak Bay in the east and from Naknek Lake in the south to the Tazmina Lakes in the north. The communities of Kokhanok, Iliamna, Newhalen and Pedro Bay have similar annual rounds of seasonal subsistence activities (Braund and Associates 2004).

Newhalen depends heavily on subsistence resources due to the lack of year-round jobs and a cultural preference for traditional foods. Newhalen residents harvest salmon, trout, grayling, moose, caribou, rabbit, porcupine and seal. Residents of Newhalen utilize the same subsistence area as residents of Iliamna, which includes Iliamna Lake and extends from the west along the Mulchatna River to Igiugig in the south, to just east of Pedro Bay and south (with the exception of the Mulchatna River) of Nondalton (Braund and Associates 2004).

Many residents of Iliamna participate in subsistence hunting and fishing activities and utilize salmon, trout, grayling, moose, caribou, bear, seal, porcupine and rabbits. The harvest of subsistence resources continues to play a major role in Iliamna. Local dietary preferences and the expense of importing food are important factors (Braund and Associates 2004).

Subsistence is an important part of Igiugig residents' lifestyle, with salmon, trout, whitefish, moose, caribou, and rabbit providing major subsistence resources. Residents of Igiugig utilize a subsistence area that extends around the western portion of Iliamna Lake and southwest along the Kvichak River, and includes Kukaklek Lake and Nonvianuk Lake (Braund and Associates 2004).

Subsistence foods are important to the community of Pedro Bay because of local preferences for traditional foods and limited availability and high costs of imported food. Residents of Pedro Bay use a subsistence area that encompasses the northeast portion of Iliamna Lake and extends north to encompass the Tazamina Lakes, east to encompass Pile and Iliamna rivers and the Summit lakes (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreational activities are limited due to the isolated location of Big Mountain site. Access to the area is limited with aircraft providing the only year-round access. Hunters use a small building at Lower Camp for camping, and sport fishermen may use the airstrip to access Belinda Creek and Reindeer Bay.

Appendix 3.0 - Driftwood. Driftwood Bay Radio Relay Site

3.0 Installation Overview

3.1 Location and Area

The Driftwood Bay excess site is located on Unalaska Island, one of the Fox Islands, in the Aleutian Islands of southwestern Alaska. Driftwood Bay is on the north shore of the island, about 13 miles northwest of the city of Unalaska, and about 800 miles from Anchorage (INRMP Figure 3.1). The site encompasses 459 acres. The Upper Camp is on a hillside about ½ mile from the Bering Sea coast, and the Lower Camp (runway) is located in a valley about two miles east of the Upper Camp (Figure 3.1). The Air Force holdings are within the Alaska Maritime National Wildlife Refuge.

3.2 Installation History

The Driftwood Bay site was initially developed as a DEW Line station with WACS facilities and became operational in 1959. The installation consisted of two tropospheric antennas; two receiver antennas; a composite building with dormitories, office space, storage, a vehicle maintenance shop, and equipment for standby power generation; two underground fuel storage tanks; and a water tank. About two miles east of the WACS site were runway facilities, which consisted of a maintenance building, four above-ground fuel storage tanks, and the airstrip, which has a general north-south orientation. A water supply pump house, an ammunition storage shed, and a fuel pipeline were along an access road that connected Upper Camp and Lower Camp. A disposal area is about one mile south of the airstrip. The DEW Line station was closed in 1969. Driftwood Bay RRS was deactivated in 1977 and all buildings and structures were demolished or removed in 1991 (Hart Crowser, Inc. 1997b). Tank farm remediation occurred in 2010, and soil remediation occurred in 2011.

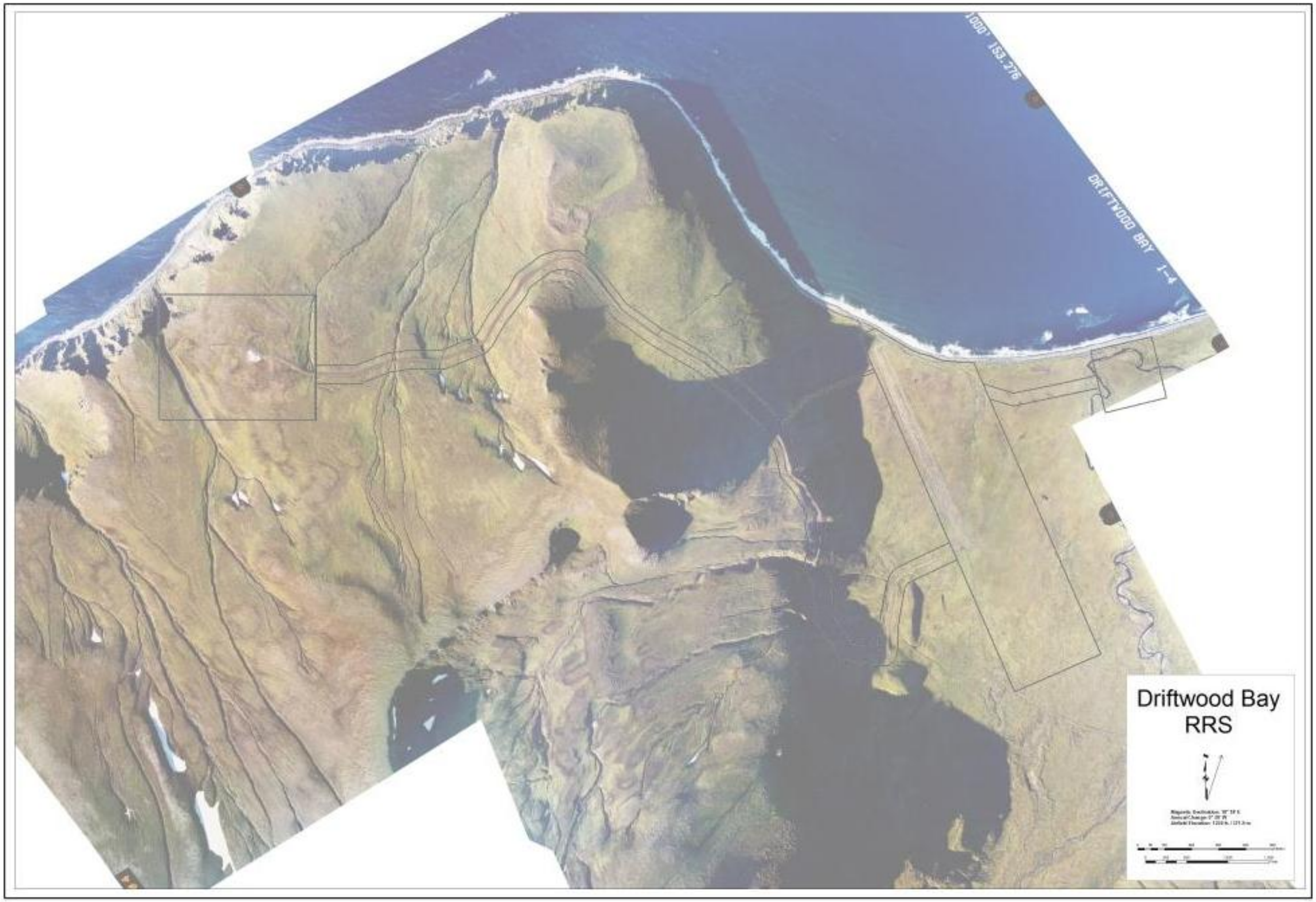
3.3 Surrounding Communities

The city of Unalaska is about 13 miles southeast of the Driftwood Bay site. The population of Unalaska is 4,376 consisting of 39.2 percent white and 32.6 percent Asian (2010). Unalaska's economy is based on commercial fishing, fish processing, and fleet services, such as fuel, repairs, maintenance, trade, and transportation. The community enjoys a strategic position as the center of a rich fishing area and is used for transferring cargo between Pacific Rim trading partners. The Great Circle shipping route from major west coast ports to the Pacific Rim passes within 50 miles of Unalaska, and Dutch Harbor provides a natural protection for fishing vessels. Onshore and offshore processors provide some local employment. However, non-resident workers are usually brought in during the peak season. In 2010, 31 residents held commercial fishing permits. Unalaska also has a small tourist industry (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Unalaska became a port for the fur seal industry in 1768. In 1787 many hunters and their families were enslaved and relocated by the Russian American Company to the Pribilof Islands to work in the fur seal harvest. In 1825 the Russian Orthodox Church of the Holy Ascension of Christ was constructed and remained strong in the community for many years. The Japanese attacked Unalaska in 1942, and almost all of the Aleuts on the Island were interned to southeast Alaska for the duration of World War II. The Russian Orthodox Church was nearly destroyed during this time. However, the Church remains and is the oldest Russian Orthodox cruciform-style church in North America (www.dced.state.ak.us 2012). Unalaska’s economy is based on commercial fishing, fish processing, trade and transportation, and fleet services, such as fuel, repairs, and maintenance.

Figure 3.1 Driftwood Bay Former RRS



3.5 Local and Regional Natural Areas

Driftwood Bay site is within the Alaska Maritime NWR. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The Driftwood Bay site has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. January temperatures range from 25 to 35°F; summers range from 43 to 53°F. Average annual precipitation is 58 inches (www.dced.state.ak.us 2012).

Summer temperatures average 50.3°F, and winter temperatures average 33.7°F. Extreme temperatures of -8°F and 80°F have been recorded. Up to 50 inches of snow and 33 inches of rain falls during winter. Average annual wind speed at Driftwood Bay is 9.55 miles per hour from the southeast.

4.2 Landforms

The Driftwood Bay upper site is on the north shore of Unalaska Island on a hillside about 1,275 feet above msl. Red Cinder Dome, about one mile southeast, is a prominent topographic feature near the site. The most prominent feature on the Island is Makushin Volcano, which is about six miles southeast of the site. The volcano is active and is about 6,680 feet high. The airstrip is close to sea level and occupies a gently undulating valley floor.

4.3 Geology and Soils

Unalaska Island is primarily of volcanic origin from activities of the Makushin Volcano. Oldest deposits are from the Tertiary period consisting of altered and andesitic intrusive and extrusive rocks and sedimentary rocks of similar origin. Granodiorite batholiths and exposed igneous masses are also present. Much of the island is discontinuously veneered by a mantle of volcanic ash, cinders, till, humus, and soil. The latest Makushin Volcano smoke and ash activity occurred in the early 1950s.

Driftwood Bay's upper site is predominantly Makushin volcanics that consist of basalt and andesite lava, argoclastic and minor sedimentary rocks, which are overlain by till of assorted material derived from disintegration of rock and mixtures of ground moraine and layers of ash, lapilli, and cinders. Till depth in the upper site area exceeds 20 feet. The low-lying ground near the airstrip is composed of Makushin volcanics and Eider Point basalt of the Tertiary and Quaternary periods, overlain by unconsolidated, recent surficial alluvial, beach, and eolian deposits (CH2M Hill 1994b).

4.4 Hydrology

Surface water from the Driftwood Bay upper site generally flows north, via sheetflow and small streamlets, entering the Bering Sea. Water in the airstrip area flows into Snuffy and Humpy creeks, which discharge into Driftwood Bay. Snuffy and Humpy creeks are year-round drainage features fed by snowmelt and subsurface waters. East of the airstrip are about ¾ of a square mile of wet tundra and small shallow ponds. The ponds total about 10 acres (CH2M Hill 1994b).

Only small amounts of water are contained in the unconsolidated material, and the water table is generally found in bedrock. Groundwater recharges Snuffy and Humpy creeks. The depth to groundwater under the site is unknown. The site is free of permafrost (CH2M Hill 1994b).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Driftwood Bay site. Much information included in INRMP Chapter 5.0 that includes Driftwood Bay site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Driftwood Bay site and the surrounding area. Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Driftwood Bay site. ***Appendix 3.0-Campion***, Appendix A contains lists of fish (Table A2) and mammals (Table A3) on Driftwood Bay site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Driftwood Bay site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M127 Aleutian Oceanic Meadow-Heath Province
Description: Islands that chiefly make up this province are mountainous, containing more than 75 volcanoes. Slopes are steep all to the water's edge with shores rocky and craggy. The climate is similar to the arctic coastal plain although winters are less severe; temperatures range between 18 to 27F. Winds are severe, and smaller islands receive less precipitation than larger islands; annual precipitation ranges from 21 inches to more than 78 inches. In the Aleutian Province there are no trees; the vegetation is a few shrubs and in the lower elevations are a variety of tall grasses, flowering plants, and ferns. Dominant soils are Inceptisols; permafrost is absent.

5.2 Vegetation

Vegetation at the Driftwood Bay site consists of species associated with alpine, moist, and wet tundra. Alpine tundra is found at higher elevations and is associated with well drained soils, such as the upper site. Various grasses, such as fescue and bentgrass, and lichens and forbs, such as aster, cinquefoil, and lupine, colonize barren areas exposed to wind. Sheltered areas support alpine azalea, bearberry, cranberry, moss campion, and mountain avens. Crowberries, coltsfoot, and yarrow are found occasionally in select areas (Selkregg 1984).

Moist tundra is the predominant habitat type at the Driftwood Bay site. The moist tundra community consists of a well developed mat of mosses with sedges, tufted grasses, and forbs growing in the base mat. Crowberries, blueberries, bistort, lousewort, monkshood, violets, ferns, and wormwood are also found in these communities (Selkregg 1984).

Beach areas are dominated by ryegrass, which is mixed with fescues, bluegrasses, and seabeach senecio. On dunes and higher beach sands, cow parsnips, angelica, and cinquefoil may also be found. There are no trees on the site, and the few bushes consist of willows. Fireweed can be found scattered over drier areas (Selkregg 1984).

A general vegetation map of the Driftwood Bay site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Driftwood Bay site.

5.3 Fish and Wildlife

5.3.1 Fish

Humpy Creek is the only anadromous fish stream near the Driftwood Bay site, but pink salmon are the only salmon species known to spawn there. However, Dolly varden and Arctic char also likely spawn in Humpy Creek. Fry and smolt of various species are present in Humpy Creek year-round. Coastal habitats in the Driftwood Bay area provide known feeding grounds for Pacific herring. No shellfish populations have been documented within Driftwood Bay (CH2M Hill 1994b).

5.3.2 Mammals

Terrestrial mammals inhabiting Unalaska Island include red fox, Arctic fox, Arctic ground squirrel, collared lemming, tundra vole, Norway rat (USFWS 1988), and domestic cattle and horses. Marine mammals inhabiting or migrating through the Aleutian Island are commonly observed off Driftwood Bay (CH2M Hill 1994b).

5.3.3 Birds

Pelagic species commonly found in the Unalaska region (Driftwood Bay) include fulmars, cormorants, gulls, kittiwakes, auklets, and puffins. Pelagic Cormorant, Marbled Murrelet, and Tufted Puffin are known to nest on Unalaska Island. Black Oystercatcher and Rock Sandpiper are permanent residents. Turnstones, sandpipers, and phalaropes are common migratory shorebirds. Numerous waterfowl species are found along the eastern Aleutian Islands including Emperor Goose, Canada Goose, Scaup, Goldeneye, Bufflehead, Long-tailed Duck, Green-winged Teal, Grebes, Common Eider, and Brant. Bald Eagles and Common Ravens are common and Gyrfalcons, hawks, and Snowy Owls may be seen on occasion (CH2M Hill 1994b).

5.4 Threatened and Endangered Species

The endangered Short-tailed Albatross, threatened Steller’s and Spectacled Eiders, and candidate Yellow-billed Loon are federally-listed species in the Aleutians. All are potentially on or near Driftwood Bay site, but Steller’s Eider is the only one known near Driftwood Bay. Endangered marine mammals of the Aleutians include North Pacific right, sperm, blue, bowhead, and fin whales and Steller sea lions. The threatened northern sea otter in southwest Alaska may be in waters near the site (USFWS 2011).

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Driftwood Bay site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Unalaska is located about 13 miles southeast from the Driftwood Bay site. Almost all subsistence resources harvested by residents of Unalaska are marine-based (marine mammals, fish, and invertebrates). The expense of imported food and local dietary preferences reinforce the importance of subsistence resources to the community. The concentration of resources within the region reduces the need to travel for long distances to acquire food. Residents of Unalaska generally confine subsistence harvest activities to eastern waters of Unalaska Island (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at Driftwood Bay site are limited due to the absence of game species for hunting; fishing in the area is limited to Humpy Creek; and other activities, such as collection of plants or berries, bird watching, and hiking, are available but are not known to occur at the site.

Subsistence fishing activities were observed off the mouth of Humpy Creek in June 2000 during an attempted site visit (Universe Technologies, Inc. and Gene Stout and Associates 2001e).

APPENDIX A: Natural Resources of Driftwood Bay, Nikolski, and Port Heiden Sites

Table A1: Vascular Plant Species Potentially Occurring on or near Driftwood Bay, Nikolski, and Port Heiden Sites

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay* (DB)	Nikolski* (N)	Observed **
Common yarrow	*Achillea millefolium*	X	X		PH, DB
Sitka alder	*Alnus sinuata*	X			PH
Anaphales margaritacea	*Anaphales margaritacea*		X		DB
Bog rosemary	*Andromeda polifolia*	X			
Rock Jasmine	*Androsace chamaejasme*	X			
Narcissus-flower anemone	*Anemone narcissiflora*	X	X		DB
Northern anemone	*Anemone parviflora*	X			
Yellow anemone	*Anemone richardsonii*	X			
Wild celery	*Angelica lucida*	X	X		PH, DB
Cats paws	*Antennaria monocephala*	X			PH
Lyre-leaf rockcress	*Arabis lyrata*	X			
Pendent grass	*Arctophila fulva*	X			
Alpine bearberry	*Arctostaphylos alpina*	X			PH
Bearberry (kinikinik)	*Arctostaphylos uva-ursi*	X	X		PH, DB
Armeria maritima	*Armeria maritjma*	X			PH
Tall meadow arnica	*Arnica chamissonis*	X			
Lessing's arnica	*Arnica lessingii*	X			
Arctic wormwood	*Artemisia arctica*	X			
Purple wormwood	*Artemisia globularia*	X			
Common wormwood	*Artemisia tilesii*	X			
Unalaska wormwood	*Artemisia unalaskensis*		X		DB
Goatsbeard	*Aruncus Sylvester*	X			
Siberian aster	*Aster sibiricus*	X			
Northern aster	*Aster subspicatus*	X			
Alpine milk vetch	*Astragalus alpinus*	X			
Hairy arctic milk vetch	*Astragalus umbellatus*	X			
Lady fern	*Athyrium filix-femina*	X	X		DB
Wintercress	*Barbarea orthoceras*	X			PH
Dwarf Arctic birch	*Betula nana*	X			PH
Broomrape	*Boschniakia rossica*	X			
Moonwort	*Botrychium boreale*	X			
Moonwort	*Botrychium lanceolatum*	X			
Moonwort	*Botrychium lunaria*	X			
Rattlesnake fern	*Botrychium virginianum*	X			
Brome	*Bromus inermis*	X			
Bluejoint grass	*Calamagrostis canadensis*	X	X		PH, DB
Reed bentgrass	*Calamagrostis* sp.	X			
Mountain marigold	*Caltha leptosepala*	X			
Marsh marigold	*Caltha palustris*	X			
Bluebell	*Campanula lasiocarpa*	X			
Cuckoo flower	*Cardamine pratensis*	X			
Sedge	*Carex aquatilis*	X			
Sedge	*Carex lyngbyaei*	X			
Sedge	*Carex macrochaeta*	X	X		PH, DB
Alaska cassiope	*Cassiope lycopodiodes*	X			
Starry cassiope	*Cassiope stelleriana*	X			
Paintbrush	*Castilleja* sp.	X			
Coastal paintbrush	*Castilleja unalaschensis*	X	X		DB
Bering Sea chickweed	*Cerastrium berringianum*	X			
Chickweed	*Cerastium fischeranum*	X			
Chrysanthemum bipinnatum	*Chrysanthemum bipinnatum*	X			PH
Spring beauty	*Claytonia chamissoi*	X			
Alaska spring beauty	*Claytonia sarmentosa*	X			

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay* (DB)	Nikolski* (N)	Observed **
Coptis trifolia	*Coptis trifolia*		X		DB
Coral root	*Corallorrhiza trifida*	X			
Bunchberry	*Cornus canadensis*	X			
Lapland cornel	*Cornus suecica*	X			
Pink lady's slipper	*Cypripedium guttatum*	X			
Rose-purple orchis	*Dactylorhiza aristata*	X	X		DB
Deschampsia	*Deschampsia caespitosa*	X			
Mountain avens	*Dryas interifolia*	X			
White mountain avens	*Dryas octopetala*	X			
Wood fern	*Dryopteris dilatata*				
Lyme grass	*Elymus mollis*				
Crowberry	*Empetrum nigrum*	X	X		PH, DB
Fireweed	*Epilobium angustifolium*	X	X		PH, DB
Dwarf fireweed	*Epilobium latifolium*	X			PH
Common horsetail	*Equisetum arvense*	X	X		PH, DB
Horsetail	*Equisetum silvaticum*	X			
Fleabane	*Erigeron humilis*	X			
Arctic fleabane	*Erigeron hyperboreus*	X			
Arctic cotton grass	*Eriophorum scheuchzeri*	X			
Fescue grass	*Festuca altaica*	X			PH
Fescue grass	*Festuca* sp.	X			PH
Indian rice	*Fritillaria camschatcensis*	X			
Northern bedstraw	*Galium boreale*	X			
Whitish gentian	*Gentiana algida*	X			
Wild geranium	*Geranium erianthum*	X	X		PH, DB
Ross avens	*Gerum rossii*	X			PH
Cow parsnip	*Heracleum lanatum*	X	X		PH, DB
Alpine holy grass	*Hierochloe alpina*				
Wild iris	*Iris setosa*	X			
Glaucous weaselsnout	*Lagotis glauca*	X			PH
Vetchling	*Lathyrus palustris*	X			
Narrowleaf Labrador tea	*Ledum decumbens*	X			
Labrador tea	*Ledum palustre*	X			PH
Beach lovage	*Ligusticum scoticum*		X		DB
Twin-flower	*Linnaea borealis*	X	X		DB
Heart-leaf tway blade	*Listera cordata*		X		DB
Alp lily	*Lloydia serotina*	X			
Alpine azalea	*Loiseleuria procumbens*	X			PH
Alaska spirea	*Luetkea pectinata*	X			
Arctic lupine	*Lupinus arcticus*	X			
Nootka lupine	*Lupinus nootkatensis*	X			
Wood rush	*Luzula arcuata*				
Alpine club moss	*Lycopodium alpinum*	X			
Club moss	*Lycopodium clavatum*		X		DB
Club moss	*Lycopodium selago*				
Bladder campion	*Melandrium apetalum*	X			
Bogbean (buckbean)	*Menyanthes trifoliata*	X			
Wild snapdragon	*Mimulus guttatus*	X			
Arctic sandwort	*Minuartia arctica*	X			
Alpine mitrewort	*Mitella pentandra*	X			
Grove sandwort	*Moerhingia laterifolia*	X			PH
Alpine forget-me-not	*Myosotis alpestris*	X			
Yellow pond lily	*Nuphar polysepalum*	X			
Blackish oxytrope	*Oxytropis nigrescens*	X			
Oxytrope	*Oxytropis* sp.	X			PH
Alaska poppy	*Papaver alaskanum*	X			
Grass of Parnassus	*Parnassia kotzebuei*	X			PH

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay* (DB)	Nikolski* (N)	Observed **
Parrya	*Parrya nudicaulis*	X			
Capitate lousewort	*Pedicularis capitata*	X			
Oeder's lousewort	*Pedicularis oederi*	X			
Bumblebee flower	*Pedicularis verticillata*	X			
Frigid coltsfoot	*Petasites frigidus*	X			PH
Aleutian (moutain) heather	*Phyllodoce aleitica*	X	X		DB
Butterwort	*Pinguicila vulgaris*	X			
Plantago macrocarpa	*Plantago macrocarpa*		X		DB
Bog orchid	*Platanthera convallariaefolia*	X			
White bog orchid	*Platanthera convallariaefolia*	X			
Small northern bog orchid	*Platanthera obtusata*	X			
Blue grass	*Poa* sp.	X			
Tall Jacob's ladder	*Polemonium acutiflorum*	X			
Jacob's ladder	*Polemonium pulcherrimum*	X			
Alpine meadow bistort	*Polygonum viviparum*	X	X		PH, DB
Marsh fivefinger	*Potentilla palustris*	X			
Wedge-leafed primrose	*Primula cuneifolia*	X			
Pink pyrola	*Pyrola asarifolia*	X	X		PH, DB
Wintergreen	*Pyrola minor*				
Eschscholtz buttercup	*Ranunculus eschscholtzii*	X			
Buttercup	*Ranunculus* sp.	X			
Kamchatka rhododendron	*Rhododendron camtshaticum*	X	X		DB
Nagoonberry	*Rubus arcticus*	X	X		PH, DB
Cloudberry	*Rubus chamaemorus*	X			
Salmonberry	*Rubus spectabilis*	X	X		DB
Arctic dock	*Rumex arcticus*	X			
Dock	*Rumex graminifolius*	X			
Feltleaf willow	*Salix alaxensis*	X			PH
Arctic willow	*Salix arctica*	X	X		PH, DB
Barclay willow	*Salix barclayi*	X	X		DB
Barren-ground willow	*Salix brachycarpa*	X			
Undergreen willow	*Salix commutata*	X			
Alaska bog willow	*Salix fuscescens*	X			
Grayleaf willow	*Salix glauca*	X			
Oval-leafed willow	*Salix ovalifolia*	X			
Diamondleaf willow	*Salix planifolia pulchra*	X			PH
Netleaf willow	*Salix reticulata*	X			PH
Least willow	*Salix rotundifolia*	X			
Sprouting willow	*Salix stolonifera*	X			
Pacific red-elder	*Sambucus callicarpa*	X			
Burnet	*Sanguisorba stipulata*	X	X		PH, DB
Spotted saxifrage	*Saxifraga bronchialis*	X			
Whiplash saxifrage	*Saxifraga flagellaris*	X			
Yellow marsh saxifrage	*Saxifraga hirculis*	X			
Brook saxifrage	*Saxifraga nelsoniana*	X			
Red stemmed saxifrage	*Saxifraga lyalii*	X			
Purple mountain saxifrage	*Saxifraga oppositifolia*	X			
Heart-leaf saxifrage	*Saxifraga punctata*	X			
Thyme-leaved saxifrage	*Saxifraga serpyllifolia*	X			
Roseroot	*Sedum rosea*	X			PH
Marsh fleawort (mastodon flower)	*Senecio congestus*	X			

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay* (DB)	Nikolski* (N)	Observed **
Seabeach scenecio	*Senecio pseudo-arnica*	X			
Sibbaldia procumbens	*Sibbaldia procumbens*				
Campion moss	*Silene acaulis*	X			
Goldenrod	*Solidago multiradiata*	X			PH
Ladies' tresses	*Spiranthes romanzoffiana*	X			
Dandelion	*Taraxacum* sp.	X			
False asphodel	*Tofieldia coccinea*	X			PH
Star flower	*Trientalis europea*	X			PH
Arrow grass	*Triglochin maritimum*	X			
Early blueberry	*Vaccinium ovalifolium*	X	X		DB
Bog cranberry	*Vaccinium oxycoccus*	X			
Bog blueberry	*Vaccinium uliginosum*	X			PH
Lowbush cranberry	*Vaccinium vitis-idaea*	X	X		PH, DB
Valerian	*Valeriana capitata*	X			
Two-flowered violet	*Viola biflora*	X			
Alaska violet	*Viola langsdorffii*	X			PH

Observation Codes:
PH - Port Heiden
DB - Driftwood Bay
N - Nikolski

Table A2: Bird Species Potentially Occurring on or near Driftwood Bay, Nikolski, and Port Heiden Sites

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay (DB)	Nikolski (N)	Observed *
Red-throated Loon	*Gavia stellata*	X	X	X	
Pacific Loon	*Gavia pacifica*	X	X	X	
Common Loon	*Gavia immer*	X	X	X	
Yellow-billed Loon	*Gavia adamsii*	X	X	X	
Horned Grebe	*Podiceps auritus*	X	X	X	
Red-necked Grebe	*Podiceps grisegena*	X	X	X	
Northern Fulmar	*Fulmarus glacialis*	X	X	X	
Short-tailed Shearwater		X	X	X	
Sooty Shearwater	*Puffinus griseus*	X	X	X	
Fork-tailed Storm -petrel	*Oceanodroma furcata*	X	X	X	
Leach's Storm Petrel	*Oceanodroma leucorhoa*	X	X	X	
Double-crested Cormorant	*Phalacrocorax auritus*	X	X	X	
Pelagic Cormorant	*Phalacrocroax pelagicus*	X	X	X	
Red-faced Cormorant	*Phalacrocroax urile*	X	X	X	
Tundra Swan	*Cygnus columbianus*	X	X	X	
Greater White-fronted Goose	*Anser albifrons*	X	X	X	
Snow Goose	*Chen caerulescens*	X	X	X	
Emperor Goose	*Philacte canagica*	X	X	X	
Brant	*Branta bernicla*	X	X	X	
Canada Goose	*Branta canadensis*	X	X	X	
Aleutian Cackling Goose	*Branta hutchinsii leucopareia*		X	X	
Green-winged teal	*Anas crecca*	X	X	X	
Mallard	*Anas platyrhynchos*	X	X	X	
Northern Pintail	*Anas acuta*	X	X	X	
Blue-winged Teal	*Anas discors*	X	X	X	
Northern Shoveler	*Spatula clypeata*	X	X	X	
Gadwall	*Anas strepera*	X	X	X	
Eurasian Wigeon	*Anas penelope*	X	X	X	
American Wigeon	*Anas americana*	X	X	X	
Canvasback	*Aythya valisineria*	X	X	X	
Redhead	*Aythya americana*	X	X	X	
Ring-necked Duck	*Aythya collaris*	X	X	X	
Tufted Duck	*Aythya fuligula*	X	X	X	
Greater Scaup	*Aythya marila*	X	X	X	
Common Eider	*Somateria mollissima*	X	X	X	
King Eider	*Somateria spectabilis*	X	X	X	
Spectacled Eider	*Somateria fisheri*	X	X	X	
Steller's Eider	*Polysticta stelleri*	X	X	X	
Harlequin Duck	*Histrionicus histrionicus*	X	X	X	
Long-tailed Duck	*Clangula hyemalis*	X	X	X	
Black Scoter	*Melanitta nigra*	X	X	X	
Surf Scoter	*Melanitta perspicillata*	X	X	X	
White-winged Scoter	*Melanitta fusca*	X	X	X	
Common Goldeneye	*Bucephala clangula*	X	X	X	
Barrow's Goldeneye	*Bucephala islandica*	X	X	X	
Bufflehead	*Bucephala albeola*	X	X	X	
Common Merganser	*Mergus merganser*	X	X	X	
Red-breasted Merganser	*Mergus serrator*	X	X	X	
Osprey	*Pandion haliaetus*	X	X	X	
Bald Eagle	*Haliaeetus leucocephalus*	X	X	X	PH
Northern Harrier	*Circus cyaneus*	X	X	X	
Sharp-shinned Hawk	*Accipiter striatus*	X	X	X	

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay (DB)	Nikolski (N)	Observed *
Northern Goshawk	*Accipiter gentillis*	X			
Red-tailed Hawk	*Buteo jamaicenis*	X			
Rough-legged Hawk	*Buteo lagopus*	X	X	X	
Golden Eagle	*Aquila chrysaetos*	X	X	X	
American Kestrel	*Falco sparverius*	X	X	X	
Merlin	*Falco columbarius*	X	X	X	
Peregrine Falcon	*Falco peregrinus*	X	X	X	
Gyrfalcon	*Falco rusticolus*	X	X	X	
Spruce Grouse	*Dendragapus canadensis*	X			
Willow Ptarmigan	*Lagopus lagopus*	X	X	X	PH
Rock Ptarmigan	*Lagopus mutus*	X	X	X	
Sandhill Crane	*Grus canadensis*	X	X	X	PH
American Golden-Plover	*Pluvialis dominica*	X	X	X	PH
Pacific Golden-Plover	*Pluvialis fulva*	X	X	X	PH
Black-bellied Plover	*Squatarola squatarola*	X	X	X	
Semipalmated Plover	*Charadrius semipalmatus*	X	X	X	PH
Black Oystercatcher	*Haematopus bachmani*		X	X	
Greater Yellowlegs	*Tringa melanoleuca*	X	X	X	
Lesser Yellowlegs	*Tringa flavipes*	X			
Wood Sandpiper	*Tringa glareola*	X	X	X	
Solitary Sandpiper	*Tringa solitaria*	X			
Wandering Tattler	*Heteroscelus incanus*	X	X	X	
Spotted Sandpiper	*Actitis macularia*	X			
Whimbrel	*Numenius phaeopus*	X	X	X	
Bristle-thighed Curlew	*Numenius tahitiensis*	X	X	X	
Hudsonian Godwit	*Limosa haemastica*	X	X	X	
Bar-tailed Godwit	*Limosa lapponica*	X	X	X	
Marbled Godwit	*Limosa fedoa*	X			
Ruddy Turnstone	*Arenaria interpres*	X	X	X	
Black Turnstone	*Arenaria melanocephala*	X	X	X	
Surfbird	*Aphriza virgata*	X	X	X	
Red Knot	*Calidris canutus*	X	X	X	
Sanderling	*Crocethia alba*	X	X	X	
Semipalmated Sandpiper	*Calidris pusilla*	X	X	X	
Western Sandpiper	*Calidris mauri*	X	X	X	
Least Sandpiper	*Calidris minutilla*	X	X	X	
Baird’s Sandpiper	*Calidris bairdii*	X	X	X	
Pectoral Sandpiper	*Calidris melanotos*	X	X	X	
Sharp-tailed Sandpiper	*Erolia acuminata*	X	X	X	
Rock Sandpiper	*Calidris ptilocnemis*	X	X	X	PH
Dunlin	*Calidris alpina*	X	X	X	
Short-billed Dowitcher	*Limnodromus griseus*	X	X	X	
Long-billed Dowitcher	*Limnodromus scolopaceus*	X	X	X	
Common Snipe	*Gallinago gallinago*	X	X	X	
Wilson’s Phalarope	*Steganopus tricolor*	X			
Red-necked Phalarope	*Phalaropus lobatus*	X	X	X	
Red Phalarope	*Phalaropus fulicaria*	X	X	X	
Pomarine Jaeger	*Stercorarius pomarinus*	X	X	X	
Parasitic Jaeger	*Stercorarius parasiticus*	X	X	X	PH
Long-tailed Jaeger	*Stercorarius longicaudus*	X	X	X	
Bonaparte’s Gull	*Larus philadelphia*	X	X	X	
Mew Gull	*Larus canus*	X	X	X	PH
Ring-billed Gull	*Larus delawarensis*	X			
Herring Gull	*Larus argentatus*	X	X	X	
Slaty-backed Gull	*Larus schistisagus*	X			
Glaucous-winged Gull	*Larus glaucescens*	X	X	X	PH
Glaucous Gull	*Larus hyperboreus*	X	X	X	

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay (DB)	Nikolski (N)	Observed *
Black-legged Kittiwake	*Rissa tridactyle*	X	X	X	
Red-legged Kittiwake	*Rissa brevirostris*	X	X	X	
Sabine's Gull	*Xema sabini*	X	X	X	
Arctic Tern	*Sterna paradisaea*	X	X	X	PH
Aleutian Tern	*Sterna aleutica*	X	X	X	
Common Murre	*Uria aalge*	X	X	X	
Thick-billed Murre	*Uria lomvia*	X	X	X	
Pigeon Guillemot	*Cepphus columba*		X	X	
Ancient Murrelet	*Synthliboramphus antiquum*	X	X	X	
Cassin's Auklet	*Ptychoramphus aleutica*	X	X	X	
Parakeet Auklet	*Cyclorrhynchus psittacula*	X	X	X	
Least Auklet	*Aethia pusilla*	X	X	X	
Rhinoceros Auklet	*Cerorhinca monocerata*	X	X	X	
Tufted Puffin	*Fratercula cirrhata*	X	X	X	
Horned Puffin	*Fratercula corniculata*	X	X	X	
Rock Dove	*Columba livia*	X			
Snowy Owl	*Nyctea scandiaca*	X	X	X	
Short-eared Owl	*Asio flammeus*	X	X	X	
Northern Saw-whet Owl	*Aegolius acadicus*	X			
Rufous Hummingbird	*Selasphorus rufus*	X			
Alder Flycatcher	*Empidonax alnorum*	X			
Horned Lark	*Eremophila alpestris*	X			
Tree Swallow	*Tachycineta bicolor*	X			PH
Violet-green Swallow	*Tachycineta thalassina*	X			
Bank Swallow	*Riparia riparia*	X			
Cliff Swallow	*Hirundo pyrrhonota*	X			
Barn Swallow	*Hirundo rustica*	X	X	X	
Gray Jay	*Perisoreus canadensis*	X			
Black-billed Magpie	*Pica pica*	X			
Northwestern Crow	*Corvus caurinus*	X	X	X	
Common Raven	*Corvus corax*	X	X	X	PH
Black-capped Chickadee	*Poecile atricapilla*	X			
Boreal Chickadee	*Poecile hudsonica*	X			
Winter Wren	*Troglodytes troglodytes*	X	X	X	
American Dipper	*Cinclus mexicanus*	X	X	X	
Gray-cheeked Thrush	*Catharus minimus*	X			PH
Swainson's Thrush	*Catharus ustulatus*	X			
Hermit Thrush	*Hylocichla guttata*	X			
American Robin	*Turdus migratorius*	X	X	X	PH
Varied Thrush	*Ixoreus naevius*	X			
Yellow Wagtail	*Montacilla flava*	X	X	X	
White Wagtail	*Montacilla alba*	X			
American Pipit	*Anthus rubescens*	X			
Bohemian Waxwing	*Bombycilla garrulous*	X			
Northern Shrike	*Laninus exubitor*	X	X	X	
Orange-crowned Warbler	*Vermivora celata*	X	X	X	PH
Yellow Warbler	*Dendroica petechia*	X	X	X	PH
Yellow-rumped Warbler	*Dendroica coronata*	X	X	X	
Blackpoll Warbler	*Dendroica striata*	X			
Wilson's Warbler	*Wilsonia pusilla*	X			
American Tree Sparrow	*Spizella arborea*	X			
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X	PH
Fox Sparrow	*Passerella iliaca*	X	X	X	
Lincoln's Sparrow	*Melospiza lincolnii*	X			
Golden-crowned Sparrow	*Zonotrichia atricapilla*	X	X	X	PH

Common Name	Scientific Name	Port Heiden (PH)	Driftwood Bay (DB)	Nikolski (N)	Observed *
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	PH
Lapland Longspur	*Calcarius lapponicus*	X	X	X	PH
Snow Bunting	*Plectrophenax nivalis*	X	X	X	
Rusty Blackbird	*Euphagus carolinus*	X			
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	X	X	X	
Common Redpoll	*Carduelis flammea*	X	X	X	PH
Hoary Redpoll	*Carduelis hornemanni*	X	X	X	

Observation Codes:
PH – Port Heiden
DB – Driftwood Bay
N - Nikolski

Appendix 3.0 – Granite. Granite Mountain Radio Relay Site

3.0 Installation Overview

Figure 3.0 Aerial Views of Granite Mountain Former RRS, Upper Camp (Before and After Demolition)

3.1 Location and Area

The Granite Mountain excess site is on the isthmus of the Seward Peninsula north of Norton Bay, about 40 miles north of the community of Koyuk and about 120 miles northeast of Nome, Alaska (INRMP Figure 3.1). The facility encompasses 258 acres and was composed of an Upper Camp and Lower Camp connected by an access road (Hart Crowser, Inc. 1997d) (Figure 3.1).All structures have been removed.

3.2 Installation History

Initial construction of facilities at Granite Mountain occurred in 1956 and 1957. The site is one of the 31 original WACS sites. USAF real estate records indicate it was Granite Mountain Communications Station, then renamed Granite Mountain Air Force Station in 1958, then in 1961 became the Granite Mountain RRS. Granite Mountain operated as a combined tropospheric scatter/TD-2 microwave station, which relayed radio information to and from North River, Anvil Mountain, and Kotzebue WACS sites. Granite Mountain became active in 1957 and was abandoned in 1973. A portion of the facility was leased to Alascom in 1976, and in 1986 the BLM and FAA also leased portions. All structures have been demolished. Abandoned facilities of the Upper Camp include several former disposal areas, and a landfill. Abandoned facilities of the Lower Camp include the 4,000-foot gravel runway, and several former disposal areas. Demolition and remediation of the Granite Mountain site under the Clean Sweep program occurred in 2009 (Figure 3.1).

3.3 Surrounding Communities

No persons are thought to live year-round in the area near the Granite Mountain site; however, cabins in the area are used intermittently by miners and hunters. Transportation to the site is primarily limited to aircraft using the Lower Camp’s landing strip; however, a trail connects the site to villages to the south.

3.4 Regional Land Use

The Granite Mountain site is in a remote area about 40 miles north of the community of Koyuk. Koyuk is at the mouth of the Koyuk River at the northeastern end of Norton Bay, about 90 miles northeast of Nome. The population of Koyuk is 332 consisting of 88.9% American Indian or Alaska Native. The Koyuk economy is based on subsistence, supplemented by limited part-time jobs. Unemployment is high. There is a small amount of commercial fishing, primarily for herring, and some income is derived from reindeer herding. There is a school in the community, which is attended by 99 students. A clinic is also located in Koyuk. Access to Koyuk is limited to air and sea (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Granite Mountain site.

4.0 Physical Environment

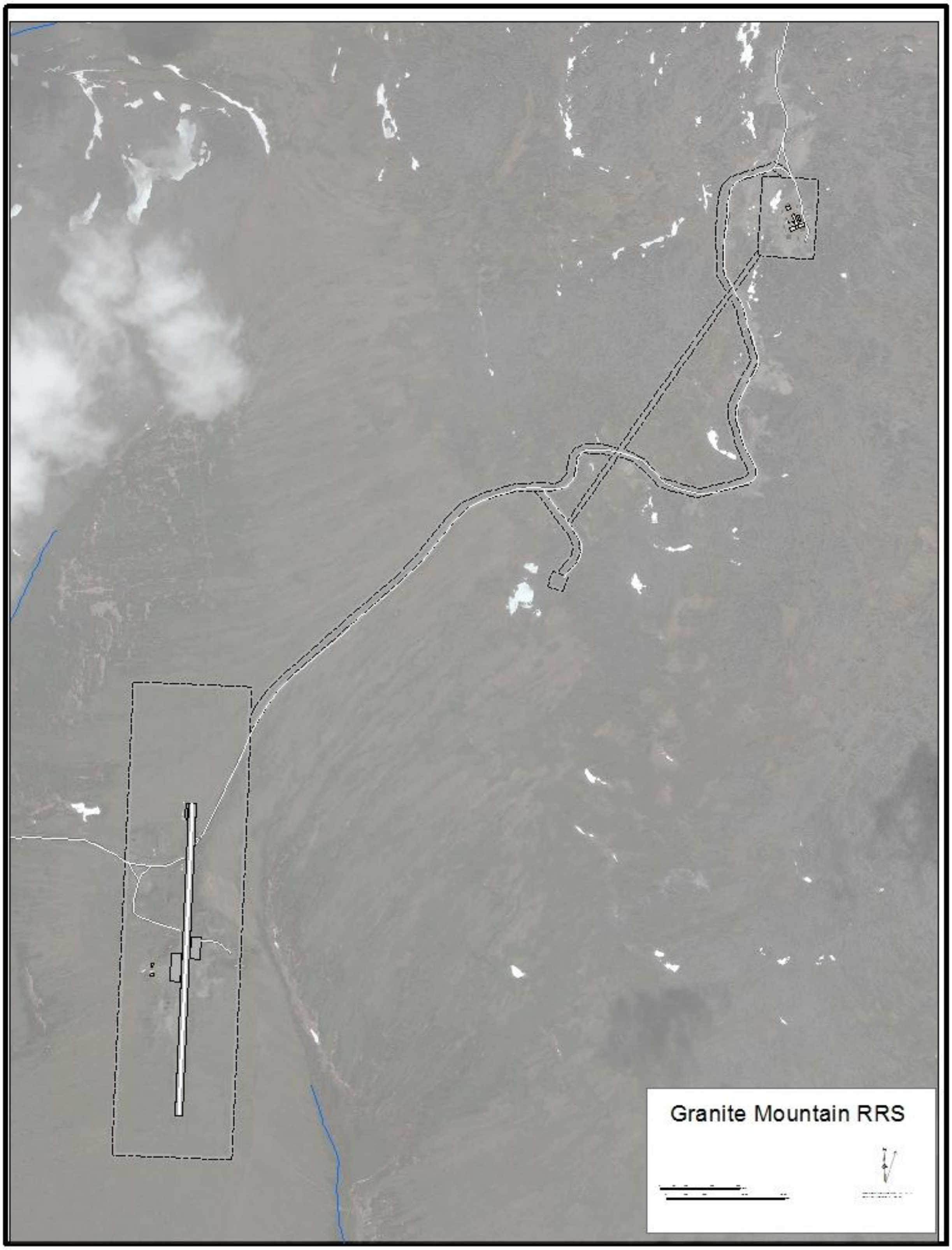
4.1 Climate

Koyuk has a subarctic climate with a maritime influence. Average summer temperatures range from 46 to 62°F; winter temperatures average -8 to 8°F. Annual precipitation averages 19 inches, with 40 inches of snowfall. Extremes from -49 to 87°F have been recorded. Norton Bay is usually ice-free from May to October (www.dced.state.ak.us 2012).

4.2 Landforms

The Granite Mountain site is within the Seward Peninsula Physiographic Province, characterized by highlands with rolling topography and gentle slopes (Dynamac Corporation 1989b). The Upper Camp is on a local topographic high point at 2,835 feet above msl. The peak of Granite Mountain is on the

Figure 3.1 Granite Mountain Former RRS



Continental Divide. The Lower Camp is about 1,600 feet below the Upper Camp on a slight north-south oriented ridgeline on the western slope of Granite Mountain.

4.3 Geology and Soils

The Granite Mountain site is on the Granite Mountain Pluton, which is composed of biotite quartz monzonite rock of mid-Cretaceous age. Outcrops of this unit are a predominant surface feature around the peak of Granite Mountain. The Granite Mountain Pluton is surrounded by an andesitic volcanic unit of early Cretaceous age. This unit is predominantly composed of andesitic trachyandesitic crystal and lithic tuffs, tuffaceous volcanic greywacke, massive andesitic breccia, agglomerate, conglomerate, and intercalated flows of porphyritic pyroxene andesite and basalt. In the vicinity of Granite Mountain these rocks are characteristically hornfelsic and propylitically altered to a hard, pale green aggregate of chlorite, epidote, calcite, and sodic plagioclase (Jacobs Engineering Group, Inc. 1994).

The Granite Mountain site is in the Pergelic Cryaquepts-Perelic Cryorthents, very gravelly, hilly to steep soil association. The six principal components comprising the association, in order of percent composition in the area, are: Pergelic Cryaquepts, poorly drained; Pergelic Cryaquepts, well drained; Histic Pergelic Cryaquepts, well drained; Histic Pergelic Cryaquepts, poorly drained; Peregelic Ruptic-Histic Cryaquepts; and rough mountain land. Poorly drained soils are found on long uniform slopes, foot slopes, valley bottoms, and steep north-facing slopes. Well drained soils occur on high ridges and steep south-facing slopes. Common frost features are solifluction lobes, frost boils, and stone stripes (Jacobs Engineering Group, Inc. 1994).

4.4 Hydrology

Granite Mountain is on a topographic high point and is predominantly rocky and devoid of surface water bodies. Headwaters of many creeks, which are often springs, originate off the flanks of Granite Mountain. Surface water flow originating from rain or snowmelt drains east or west of the Upper Camp into the Peace River or Kiwalik River drainages. Surface water in the area of the Lower Camp drains east and south into Granite Creek and Spring Creek, which are tributaries of Sweepstakes Creek. Sweepstakes Creek discharges into the Peace River (Jacobs Engineering Group, Inc. 1994). Granite Creek is the closest surface water feature to the site, about ½ mile.

Much of the rainfall or snowmelt infiltrates the thin soil layer and enters joints and fractures of underlying granitic rock. These joints and fractures and the extreme topography of the mountain influence the direction of flow. Some groundwater discharges from the mountain at lower elevations in the form of springs, such as a spring about 1.5 to 2 miles northeast of the runway near the access road. Permafrost in the region is almost continuous and ranges in thickness from 15 to more than 260 feet. Surface layers of soil thaw to depths of 1-10 feet. Permafrost serves as a relatively impermeable boundary between any water collected seasonally in the active layer and the underlying subpermafrost aquifer (Jacobs Engineering Group, Inc. 1994).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Granite Mountain site. Much information included in INRMP Chapter 5.0 that includes Granite Mountain site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Granite Mountain site and the surrounding area. ***Appendix 3.0-Anvil***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Granite Mountain site. Fish and mammal species on Granite Mountain site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Granite Mountain site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M125 Seward Peninsula Tundra-Meadow Province
Description: The landscape of this province contains broad convex hills and flat divides cut by sharp V-shaped valleys. Rising above coastal lowlands and interior basins are isolated groups of rugged glaciated mountains with elevations of 2,500-4,700 feet. Winters are long and cold followed by short, cool summers. Average precipitation is 18 inches with heavy snowfall in winter and heavier concentrations of rain in summer. At lower elevations are moist and wet tundra communities; alpine tundra communities are found in high mountains. The vegetation is mostly sedge tussocks with scatterings of willows and birches; isolated spruce-hardwood forests also exist. Dominant soils for the province are Inceptisols; permafrost can be found throughout the province.

5.2 Vegetation

Vegetation types in western Alaska form a mosaic of patterns related to slope and aspect and the presence or absence of permafrost. Vegetation includes alpine tundra, small willows, lichens, and mosses found at higher elevation sites (Hart Crowser, Inc. 1997c).

The Granite Mountain area, especially at lower elevations, is composed of gently sloping, non-patterned ground covered with sedge/willow tundra that is wet or moist depending on the microsite. These areas are dominated by such species as *Carex aquatilis*, *C. bigelowii*, *Eriophorum angustifolium*, *E. russeolum*, *Salix planifolia* ssp. *pulchra*, and *S. fuscescens*.

These areas alternate with more well-drained sites characterized by drier polygon tundra, typically with boulders in the polygon troughs. These areas are dominated by species, such as *E. vaginatum*, *Betula nana*, *Vaccinium vitis-idea*, *V. uliginosum*, and *Rubus chamaemorus*. Small creeks in the area are lined with willow thickets up to three meters tall and dominated by *Salix planifolia* ssp. *pulchra*.

Some surface flow areas, perhaps associated with springs, have water spreading across rocky terrain and result in extensive willow tickets with an understory of wet tundra vegetation. There are substantial areas of frost-heaved boulder talus on steeper slopes that are thickly covered with both crustose lichens and dark-colored foliose lichens. The top of Granite Mountain is primarily granitic boulders and stone polygon tundra. This area is covered with arctic/alpine vegetation, characterized by species such as *Antennaria friesiana*, *Salix phlebophylla*, *Epilobium latifolium*, and *Saxifraga bronchialis*.

The vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001c) identified 80 species during a 1999 site visit. A general vegetation map of the Granite Mountain site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Granite Mountain site.

5.3 Fish and Wildlife

5.3.1 Fish

No significant fishery occurs in the streams near the Granite Mountain site (Jacobs Engineering Group, Inc. 1994). Streams within one mile of the site do not appear capable of supporting fish year-round (Hart Crowser, Inc. 1997c).

5.3.2 Mammals

Large terrestrial mammals inhabiting the area are brown bear, caribou, and moose. The Arctic and red fox, wolf, wolverine, and several species of small mammals potentially occur in the area of the site. The most common small mammal observed on the site during a 1999 site visit (Universe Technologies, Inc. and Gene Stout and Associates 2001c) was the Arctic ground squirrel. Caribou were also observed during the site visit, and evidence of significant caribou use of the Upper Camp was obvious and may be related to the shade and possible relief from bot flies that the WACS antennas provide.

5.3.3 Birds

The moist tundra and brush environment within and adjacent to the site provides nesting and foraging habitat for a variety of bird species. Bird species found breeding in the willow thicket areas include Yellow Warbler, Wilson’s Warbler, White-crowned Sparrow, and Fox Sparrow. In open tundra areas Lapland Longspur, American Golden Plover, Common Snipe, and Savannah Sparrow breed. On the rocky ridge top of the Upper Camp breeding American Pipit, Northern Wheatear, and Snow Bunting can be found. In addition, the potential exists for several federally-listed threatened or endangered species to occur in the area, including the threatened Spectacled Eider and the threatened Steller’s Eider (USFWS 2004b).

The USFWS breeding bird survey (Andres and Brann 1997) on Army National Guard training areas in the Nome region is an applicable addition to the database for the Seward Peninsula.

5.4 Threatened and Endangered Species

No known threatened or endangered species are known in the area, and no federal or state designated critical habitats or wilderness areas are in the immediate vicinity of USAF property at Granite Mountain. There is low potential for either the Spectacled or Steller’s Eider to nest or visit the Granite Mountain site since there is no suitable habitat.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Granite Mountain site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The Granite Mountain site is about 33 miles from Koyuk and about 40 miles from Buckland. Cultural preferences, the relative lack of wage employment, and the expense of imported food and goods all contribute to the importance of subsistence resource harvesting to the community of Koyuk. Main sources of meat are fish, reindeer, seal, beluga whale, and moose. Participation rates are very high for Koyuk. No subsistence use area data are available for Koyuk. Subsistence foods are important to Buckland because of cultural preferences and the expense of imported foods. Residents depend on reindeer, beluga whale, and seal for survival. Participation rates are not as great as Koyuk but are still significant. The use area for Buckland residents encompasses the eastern portion of Kotzebue Sound, Hotham Inlet, Selawik Lake, and Eschscholtz Bay and extends from the Kobuk River in the north to the Koyuk River in the south and to the Tagagawik River in the east (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreational activities are limited due to the isolation and location of Granite Mountain. Access to the area is limited with aircraft providing the only year-round access. Hunters use facilities of the Lower Camp for camping and processing game. Miners in the area may use natural resources on the site periodically.

Appendix 3.0 – Kalakaket. Kalakaket Creek Radio Relay Site

3.0 Installation Overview

Figure 3.0 Aerial View of Former Kalakaket Creek RRS

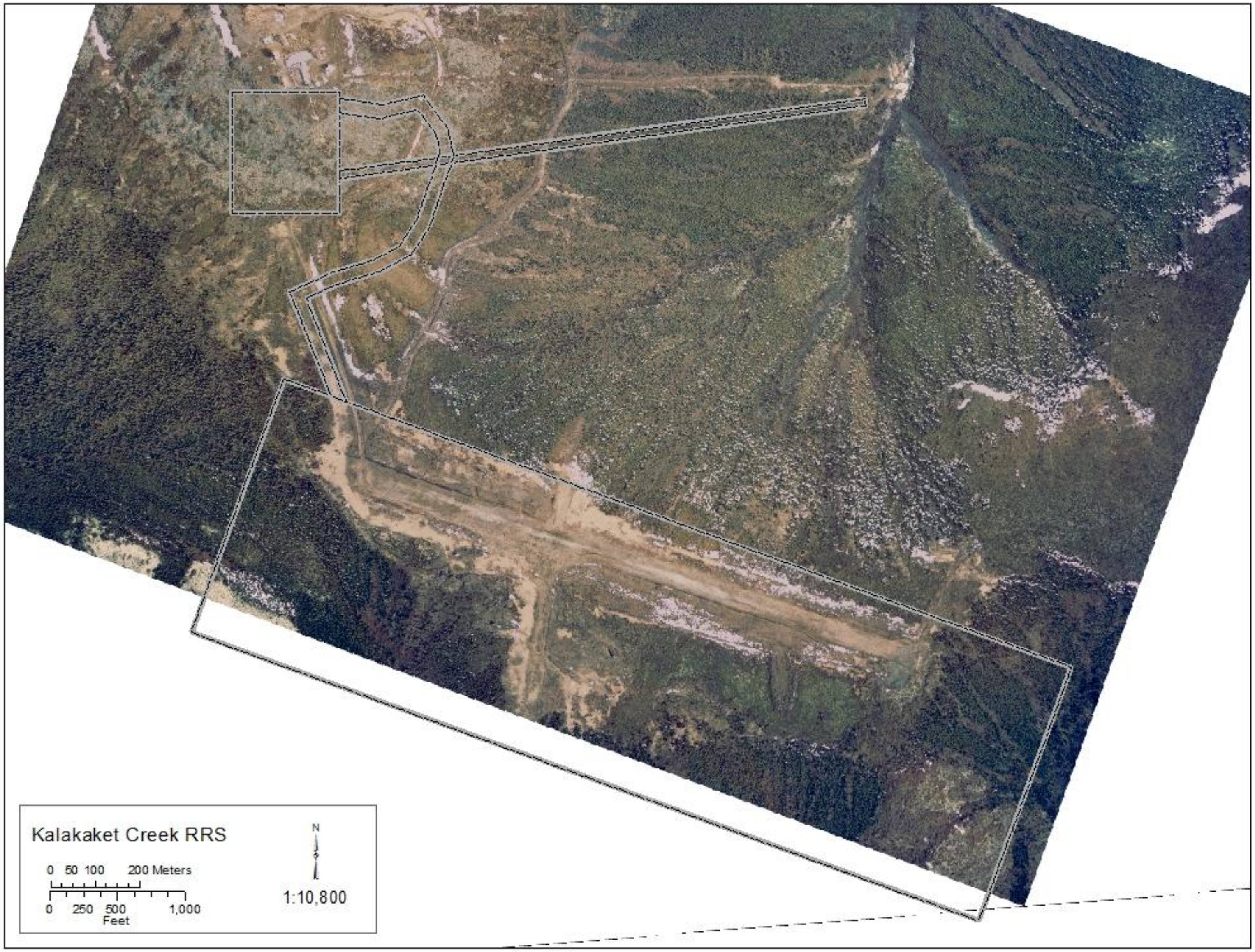
3.1 Location and Area

The Kalakaket Creek excess site is in west central Alaska about 22 miles south of the City of Galena, Alaska. The site is about 270 miles west of Fairbanks and 325 miles north of Anchorage, Alaska (INRMP Figure 3.1). The site occupies 316 acres on a fairly level mountaintop (Figure 3.1).

3.2 Installation History

Initial construction of Air Force facilities at Kalakaket Creek occurred in 1957. The site is one of the 31 original WACS sites. USAF real estate records indicate it first was the Kalakaket Creek Communications Station, renamed Kalakaket Creek Air Force Station in 1958, and in 1961 became the Kalakaket Creek Radio Relay Station. Kalakaket Creek operated as a combined tropospheric scatter/TD-2 microwave station, which relayed radio information to and from other WACS sites (Reynolds 1988). Kalakaket Creek became active in 1957 and was deactivated in 1973. Abandoned facilities of Upper Camp include a dormitory/equipment/annex building complex, an equipment maintenance building, six antennas (four tropospheric antennas and two dish antennas), two water storage tanks, two fuel oil storage tanks, and a septic tank. Abandoned facilities of Lower Camp include a temporary garage, a fuel storage tank, the

Figure 3.1 Kalakaket Creek Former RRS



4,000-foot gravel runway, and two former disposal areas. A water supply well and pumphouse, and a former disposal area are located between the Upper and Lower camps. A gravel access road connects Upper and Lower camps (CH2M Hill 1993b). Demolition and remediation of the Kalakaket Creek site under the Clean Sweep program occurred in 2009.

3.3 Surrounding Communities
Galena is the nearest community to the Kalakaket Creek site, about 22 miles north. Galena is discussed in Appendix 3.0-Campion. No persons are thought to live in the area near the Kalakaket Creek site. Year-round transportation to the site is limited to aircraft.

3.4 Regional Land Use
Galena is a trade and transportation center for the middle Yukon River area. Federal, state, city, school, and village government employment dominates, but Galena has other jobs in air transportation and retail businesses. In 2010, 12 residents held commercial fishing permits. Seasonal work, such as construction and BLM fire fighting, provides some income. The Illinois Creek gold mine, 50 miles southwest of Galena, has closed due to low market prices (www.dced.state.ak.us 2012).

Galena is also the transportation hub for surrounding communities, including Ruby and Koyukuk, which are 50 miles east and 30 miles west of Galena, respectively, and Hughes, Nulato, and Huslia, which are located further from Galena. There are no roads connecting Galena with these communities; and outlying travel is by air, boat (summer), or snow machine (winter).

3.5 Local and Regional Natural Areas
The Koyukuk NWR and the Innoko NWR are near the Kalakaket Creek site. Koyukuk NWR encompasses 3.5 million acres and lies within the floodplain of the Koyukuk River, in a basin that extends from the Yukon River to the Purcell Mountains and the foothills of the Brooks Range As many as 100,000 ducks are hatched and raised on Koyukuk NWR lands during a single nesting season. Waterfowl, migratory songbirds, and raptors depend on the rich resources of the refuge for breeding and raising young. Koyukuk Refuge’s Three-Day Slough area, part of the 400,000 acre Koyukuk Wilderness, has some of the most productive moose habitat in Alaska. This region has, at times, supported more than 10 moose per square mile. Some areas still contain densities of five moose or more per square mile. Caribou from the migratory Western Arctic Herd, which numbers more than 450,000, often move into the northernmost reaches of the refuge in winter months. The Koyukuk also supports a resident non-migratory caribou population, which numbers about 300 (USFWS 2007a).

Innoko NWR covers some 3,850,000 acres, with 1,240,000 acres designated as wilderness. The refuge is blessed with a wealth of avian life. It is estimated that 130 species of birds use these lands, and more than 300,000 waterfowl and shorebirds nest on the refuge every spring. The 750,000-acre Northern Innoko NWR, commonly known as Kaiyuh Flats, is managed as part of the Koyukuk/Nowitna Refuge Complex. Rich in wetlands, the Northern Innoko is an extremely productive breeding area for migratory waterfowl and fish. Streams and rivers of the refuge complex support three species of salmon, arctic grayling, sheefish, and many other fish species (USFWS 2007a).

4.0 Physical Environment

4.1 Climate
The Kalakaket Creek site has a cold, continental climate with large temperature differences between winter and summer. Climatic conditions can be extreme. Mean annual temperatures are 20 to 30°F, and the warmest month averages 60°F (Universe Technologies, Inc. and Gene Stout and Associates. 2001b).

The average daily high temperature during July is in the low 70s; the average daily low temperature during January ranges from 10 to below 0 °F. Sustained temperatures of -40 °F are common during winter. Extreme temperatures have been measured from -64 to 92 °F. Annual precipitation averages 12.7 inches, with 60 inches of snowfall. The river is ice-free from mid-May through mid-October (www.dced.state.ak.us 2012).

Over half of rainfall occurs between July and September. Precipitation is comparatively low during winter. Thunderstorms and small hailstorms usually occur several days each year, primarily in June and July. However, due to cold temperatures, snow is persistent from October through April; by spring the accumulation may total several feet. Peak growing months in Galena are May through September, and the frost-free period is normally about 100 days.

Prevailing winds are from the north in winter and the southwest or east in summer. The average wind speed is 3.9 knots with calm winds about one-third of the time.

4.2 Landforms

The Kalakaket Creek site is within the Central Yukon Subregion of the Yukon physiographic region of Alaska. The site lies geographically within the drainage area of the Yukon River between the confluence of the Yukon and Tanana rivers and the confluence of the Koyukuk and Yukon rivers. About 20 percent of the area within the Yukon-Tanana river basins consists of swampy lowlands (Woodward-Clyde Consultants 1991c). Characteristic of the lowland are many large thaw lakes created by melting permafrost. Vegetation types are typical of the boreal forest or taiga of interior Alaska. White spruce occurs in large stands along rivers where soils are better drained. The incidence of fire in the Yukon-Koyukuk area is one of the highest in Alaska. Lowland areas burn about once every 108 years with a slightly longer fire cycle in upland areas. Fires have set vast areas back to earlier seral stages consisting of aspen, birch, and willow (Jones Technologies, Inc. and Gene Stout and Associates 1999d).

Kalakaket Creek's Upper Camp lies on a fairly level mountaintop at an elevation of about 1,950 feet above msl (CH2M Hill 1993d). The Lower Camp and runway are on a relatively flat bench about ½ mile downslope from the Upper Camp at an elevation of about 1,700 feet above msl.

4.3 Geology and Soils

Metamorphosed igneous rocks comprise the surface material at the Kalakaket Creek site. These rocks are underlain by a metamorphic complex of the late Precambrian or early Paleozoic age. The metamorphic complex is composed of quartz-mica schist, quartzitic schist, mica schist albite-chlorite schist, albite-mica schist, ottrelite-mica schist, glaucophane-mica schist, some phyllite, slate, sheared chert, and quartzite (CH2M Hill 1993d).

The Kalakaket Creek site is in the Kuskokwim Highlands, an area generally characterized by soils of the Histic Pergelic Cryaquepts and Typic Cryochrepts association (Soil Conservation Service 1979). These soil associations are extensive and widespread in the central and eastern parts of interior Alaska and form on broad, low plains, low terraces, and mountain foot-slopes. The soils are associated with alluvial and eolian deposits and consist of silt loam, sandy loam, and gravelly loam, with organic soil coverings. Permafrost in the area of the site is discontinuous (CH2M Hill 1993d).

4.4 Hydrology

The Kalakaket Creek site is about 1¾ mile east of Kalakaket Creek. Kalakaket Creek discharges into Kala Creek, which discharges into the Yukon River. Both creeks are characterized by low gradient, meandering courses, and spring flooding. Surface water runoff from northern and western portions of the site flows to the north or northwest into a small tributary of Kalakaket Creek. Runoff from the southern portion of the site and the airfield flows toward the southwest into another tributary. Runoff from the eastern and southeastern portions of the site flows to the east into an unnamed creek that flows directly into Kala Creek.

The depth to groundwater at the Kalakaket Creek site is unknown. Due to the proximity to Kalakaket and Kala creeks, a riverbed talik aquifer may exist near the site. Groundwater at shallow depths is likely seasonal due to permafrost at shallow depths. The remaining aquifers beneath the site are subpermafrost aquifers (CH2M Hill 1993d).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Kalakaket Creek site. Much information included in INRMP Chapter 5.0 that includes Kalakaket Creek site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Kalakaket Creek site and the surrounding area. ***Appendix 3.0-Campion***, Appendix A contains lists of vascular plants (Table A1), fish (Table A2), mammals (Table A3), and birds (Table A4) on Kalakaket Creek site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Kalakaket Creek site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M130 Subarctic Division – Mountain Provinces
Province: M131 Yukon Intermontane Plateaus Tayga-Meadow Province
Description: Hills interspersed with valleys and low mountains make up this province. The area experiences mild winters and cool summers with the climate transitioning from maritime to extreme continental. Average precipitation is 16 inches with the heaviest occurring in late summer. Dominant vegetation for the province is black spruce forest, but many hills and ridges consist of sedges and shrubs. At higher elevations are alpine meadows. Dominant soils for the area are Inceptisols.

5.2 Vegetation

The vegetative cover of the Kalakaket Creek site is characterized as upland spruce-hardwood forest. This forest consists of fairly dense white spruce, birch, aspen, and balsam poplar. Undergrowth in the area normally consists of mosses and grasses on drier sites and brush on moist slopes. Typical undergrowth includes willow species, alder, ferns, rose, and horsetail (Selkregg 1984).

A general vegetation map of the Kalakaket Creek site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Kalakaket Creek site.

5.3 Fish and Wildlife

5.3.1 Fish

Kalakaket Creek provides habitat for Arctic grayling, Arctic char, and round whitefish. Kala Creek provides habitat for round whitefish and Arctic grayling. Anadromous species of all five Pacific salmon species use both watersheds for habitat (ADFG 1986a, 1986b).

5.3.2 Mammals

The area surrounding Kalakaket Creek site supports terrestrial wildlife species typical for interior Alaska. Galena Mountain and Kokrines Hills support resident herds of caribou. The marten is one of the most important furbearers to trappers in the Koyukuk area and is widely trapped by local residents. The Koyukuk and Innoko refuges support some of the most dense beaver populations in the state (Jones Technologies, Inc., and Gene Stout and Associates 1999d).

5.3.3 Birds

Some of the more common waterfowl that nest or stop over in the area during their migratory flights include the American Wigeon, Mallard, Green-winged Teal, Loons, Horned and Red-necked Grebe, Northern Pintail, Surf and White-winged Scoter, and Canada and White-fronted Geese. Numerous waterfowl, on their way to and from nesting areas, stop to feed and rest on the Yukon River. Nearby Innoko and Koyukuk NWRs provide nesting habitat and migration resting areas for waterfowl and shorebirds. This area also provides habitat for a variety of shorebirds, such as the Common Snipe, Spotted Sandpiper, Solitary Sandpiper and Semi-palmated Plover and occasionally, Whimbrels, Godwits, and Lesser Yellowlegs can be sighted in the area.

Several raptors, notably Bald Eagles, Ospreys, Red-tailed Hawks, Great Grey Owls, Short-eared Owls, and Peregrine Falcons, are found in the area. Passerine species include the American Robin, Yellow Warbler, Yellow-rumped Warbler, Hermit Thrush, Cliff Swallow and White-crowned Sparrow. Aquatic birds include the Mew, Herring, and Glaucous Gull (Jones Technologies, Inc., and Gene Stout and Associates 1999d).

5.4 Threatened and Endangered Species

No known threatened or endangered species occur on the Kalakaket Creek site (CH2M Hill 1993b and species lists).

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Kalakaket Creek site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The nearest community to the Kalakaket Creek site is Galena. The importance of subsistence to Galena residents is reflected in the high participation rates of households that use (100%), harvest (93%), and share (95%) subsistence resources. Galena residents rely heavily on large mammals and fish. Specifically, chum salmon and moose account for about 78% of Galena's annual subsistence harvest in terms of edible pounds (Braund and Associates 2004).

The Koyukon Indians traditionally used seasonal camps to access resources. Currently, these camps are maintained and visited when time and money permit. Fish camps tend to be near Galena on the main channel of the Yukon River and on sloughs in the area. Hunting areas for moose and caribou extend downstream to Nulato and upstream almost 50 miles beyond Ruby, and in the Koyukuk River and its tributaries beyond Huslia. Some caribou are taken on the Selawik, Unalakleet and Tagagawik rivers, which are on the far sides of mountain ranges up to 110 miles away. Moose and waterfowl are taken to the northeast in an area bounded by the Koyukuk and Dalbi rivers (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Recreational opportunities at the Kalakaket Creek site are primarily limited to hunting and trapping. The Lower Camp's runway allows relatively easy access by small plane. The runway may be used during fall and winter hunts by both subsistence and recreational hunters.

Appendix 3.0 – Naknek. Naknek Recreation Annex 1 (Rapids Camp) and Annex 2 (Lake Camp)

3.0 Installation Overview

3.1 Location and Area

Naknek Recreation Annex 1 (Rapids Camp) and Annex 2 (Lake Camp) (both excess sites) are located in the northeastern section of the Alaska Peninsula. Rapids Camp (25 acres) is on the north shore of the Naknek River (Figure 3.1) about four miles southeast of the City of King Salmon. Lake Camp (55 acres) is about 400 feet from the shoreline of Naknek Lake (Figure 3.1) and about six miles east of the City of King Salmon. King Salmon is 290 air miles southwest of Anchorage, Alaska (INRMP Figure 3.1).

3.2 Installation History

Naknek Recreation Camps provided support (recreation facilities) for King Salmon AFS, now called King Salmon Airport. USAF real estate records (AF Form 1192, 28 Feb 1958) indicate the former Naknek Rest Camp (established and activated in 1949) was renamed Naknek Recreation Annex #1 and Naknek Recreation Annex #2. Later they were called Naknek #1 or Rapids Camp and Naknek #2 or Lake Camp.

Rapids Camp was a fishing and camping recreational facility used between 1956 and 1977. Facilities included one lodge building, one recreation building, three support buildings, utility lines, roads, fuel storage tanks, and water tanks (Dynamac Corporation, Inc. 1989c). Remediation at Rapids Camps was deemed completed in 2008 after a well was closed.

Lake Camp was a fishing, hunting, and recreation facility used during 1956-76. Facilities included a lodge and a recreation building, a waste treatment building, a boat storage building, and a floating dock. The lodge and recreation buildings were destroyed by fire in 1978 (Dynamac Corporation, Inc. 1989b). In 2010 PCB-contaminated soil was removed, and in 2009 and 2012 other remedial actions occurred.

3.3 Surrounding Communities

Surrounding communities for the Naknek sites are discussed in Appendix 3.0-Salmon.

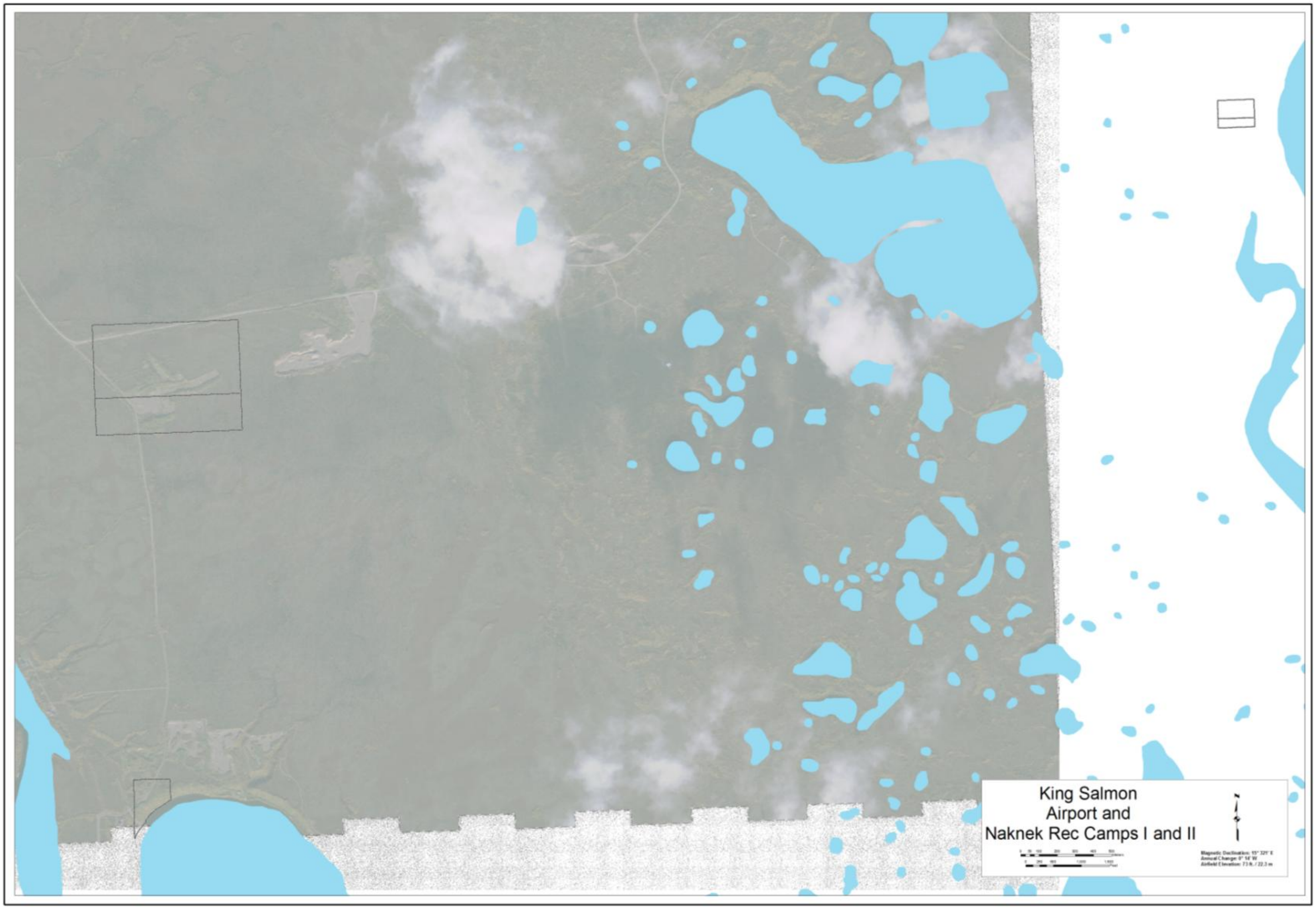
3.4 Regional Land Use

Regional land use is discussed in appendix 3.0 – Salmon.

3.5 Local and Regional Natural Areas

Naknek camps sites are near Katmai National Park and Preserve. Katmai was originally created as a National Monument in 1918 to preserve the famed Valley of Ten Thousand Smokes, a spectacular forty square mile, 100- to 700-foot deep ash flow deposited by Novarupta Volcano. Katmai was designated a National Park and Preserve in 1980. North-central and northwestern portions of Katmai are commonly termed "the lake region". Naknek Lake is the principal part of the hydrologic system of lakes, ponds, rivers, streams, and marshes formed in valleys dammed by glacial deposits. The southwestern portion of Katmai is part of the Bristol Bay coastal plain, with relatively flat terrain and many poorly drained lakes. Katmai National Park and Preserve is famous for volcanoes, brown bears (in recent years, the number of bears visiting Brooks River has grown to almost 100), pristine waterways with abundant fish, remote wilderness, and rugged coastline. One of the primary purposes of Katmai is to protect habitats for populations of fish and wildlife, including, but not limited to, high concentrations of brown bears and their denning areas, and maintain unimpaired watersheds and water habitat vital to red salmon spawning (www.nps.gov 2007).

Figure 3.1 Naknek Recreation Camps



4.0 Physical Environment

4.1 Climate
The climate for the Naknek sites is discussed in Appendix 3.0-Salmon.

4.2 Landforms
The King Salmon area lies on poorly drained lowlands northwest of the Aleutian Range, specifically in the Nusahgak-Bristol Bay lowland section of the Coastal Western Alaska physiographic province. The area exhibits characteristics of past intense glaciation during Pleistocene time. Glaciated zones are bounded by well defined moraines with little gully development along morainal ridges. Details of erosional relief are preserved; kettle holes contain lakes; and most area drainage is not integrated (Jones Technologies, Inc. and Gene Stout and Associates 1999b).

4.3 Geology and Soils
The King Salmon area consists mostly of low moraine hills with many shallow lakes. Natural erosion has drained some lakes, and only their beds remain. A high terrace borders much of the Naknek River and is separated from it by an escarpment ranging from 50 to 100 feet in height. In some places sand dunes occur above the escarpment; they are generally stable and fully vegetated (HQ AAC/DEPV 1988). Rapids Camp is on the terrace and steep escarpment north of the Naknek River and on the narrow flood plain adjacent to the river. Lake Camp is also on the terrace and escarpment west of the Naknek River near the mouth of Naknek Lake.

The entire King Salmon area is reportedly underlain by at least 315 feet of glacial outwash plain sediments (SAIC 1993c). Sediments include stratified silt, sand, and clay deposits. Marine deposits appear to be interlayered with terrestrial materials near the lower extent of the sequence.

Soils of the King Salmon area generally consist of glacially deposited interbedded sands and gravels overlain by a 3- to 4-foot layer of volcanic ash and silty sand. The top 2-4 inches consist of a tough, fibrous, organic layer. Permafrost is discontinuous and usually only occurs at considerable depth.

The terrace and escarpment of Rapids Camp are composed of unconsolidated glacial outwash deposits of Pleistocene age; the flood plain is composed of unconsolidated recent fluvial deposits. The terrace of Lake Camp overlies morainal deposits of the Iliamna Stade and is composed of thick sand deposits (Dynamac Corporation, Inc. 1989c). Soils at the Naknek Recreation Camps consist of the Typic Cryandepts-Histic Pergelic Cryaquepts complex (Reiger *et al*. 1979).

4.4 Hydrology
The area surrounding King Salmon is characterized by glaciated zones bounded by well defined moraines, with little gully development along morainal ridges. Many kettle basins containing lakes are present throughout the area. Most area drainage is not fully integrated.

The Naknek River is a principal drainage feature of the Katmai National Park and flows westward from Naknek Lake to its outfall into Bristol Bay. Surface runoff from Rapids Camp flows south into the Naknek River, and runoff from Lake Camp flows into Naknek Lake. The lower portion of Rapids Camp is within the flood plain of the Naknek River. Lake Camp is beyond the flood plain of Naknek Lake.

Groundwater at King Salmon occurs in three aquifers. A near-surface shallow aquifer is present under unconfined conditions. This aquifer is comprised of moderately well sorted sands and silty sands with discontinuous areas that contain coarse gravel. The thickness of the water-bearing interval typically varies from 5 to 15 feet. Hydraulic conductivity within the unconfined aquifer averages about 350 feet/day with values ranging from 15 to 1,370 feet/day (SAIC 1993a).

A confined intermediate aquifer lies below the upper aquitard at depths ranging from 60 to 80 feet. Data relative to this aquifer are limited, but thickness appears to vary from 15 to 40 feet. The intermediate aquifer is characterized by interbedded sequences of silty sands, sandy gravels, and silty sandy gravels (SAIC 1993a).

A second aquitard is present at the base of the intermediate aquifer. The thickness of this second aquitard is 10-20 feet. Beneath the intermediate aquifer and second aquitard is a third aquifer, approximately 200 feet below ground surface, which is generally referred to as the “deep” aquifer (SAIC 1993a).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Naknek Recreation Camps. Much information included in INRMP Chapter 5.0 that includes Naknek Recreation Camps is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Naknek Recreation Camps site and the surrounding area. ***Appendix 3.0-Bethel***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Naknek Recreation Camps site. Fish and mammal species on Naknek Recreation Camps site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Naknek Recreation Camps site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 126 Bering Tundra (Southern) Province
Description: This is a moraine- and outwash-mantled lowland province that rises from sea level to heights of 300-500 feet. Winters are cold, and summers are cool and short. Average precipitation is 13-34 inches. Dominant vegetation is moist and wet tundra communities. Inceptisols are dominant soils of the province; permafrost is sporadic or absent.

5.2 Vegetation

The King Salmon area has relatively few trees, and most plants are low-growing and small in size. The moist tundra, a tussock community with a complex plant association, is characterized by a variety of shrubs, herbs, grasses, and sedges, rooted in a continuous mat of lichens and mosses. Grasses and sedges are found in depressions while crowberry, dwarf birch, several willow species, and blueberry are on raised hummocks and hills. In summer the tundra blooms with monkshood, lousewort, buttercup, lupine, fireweed, and other wild flowers.

All Air Force facilities have been removed from Naknek Recreation Camps. The camps have naturally revegetated with low successional stage species and are dominated by alders. Open areas are dominated by bluejoint grass.

A vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001d) identified 17 and 15 species at the Rapids Camp and Lake Camp, respectively during 1999 site visits. A general vegetation map of the Rapids Camp and Lake Camp has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Naknek Recreation Camp site.

5.3 Fish and Wildlife

5.3.1 Fish

Naknek River is the most prominent water body in the vicinity of the Rapids Camp and Lake Camp. Sockeye salmon originating in the Naknek River are a major contributor to the Bristol Bay sockeye salmon harvest, the world's largest. Approximately one million sockeye salmon escape up the Naknek River in June and July each year. In addition to the commercial fishery, Naknek River provides excellent recreational opportunities for tourists and local inhabitants, particularly for king salmon, coho salmon, and rainbow trout fishing. All five species of Pacific salmon migrate to the upper reaches of the Naknek River, as do rainbow trout and Arctic grayling.

5.3.2 Mammals

The Northern Alaska Peninsula caribou herd ranges south of Iliamna Lake. The Northern Alaska Peninsula caribou herd wintering grounds include a large area north of the Naknek River, including the vicinity of King Salmon. Additionally, bands of caribou from the Mulchatna herd roam southward in the winter, intermingling with the Northern Alaska Peninsula herd.

Moose are residents of the King Salmon area, commonly occurring in wetland areas and early successional forest stands. After snow has driven them from higher altitudes, moose concentrate in areas northeast and south of King Salmon. In summer they are dispersed throughout the region; however, they favor high, well-drained areas of willow and alder and areas along rivers where forage is good.

Brown bears are also resident in the area. Bears move to sub-alpine areas after emerging from their dens in April or May. During spring and summer brown bears concentrate along salmon streams. They return to the higher altitudes for berries in late summer.

Red foxes, porcupines, snowshoe hares, and short-tailed weasels prefer brushy areas in broken terrain. Open areas attract least weasels, lemmings, shrews, voles, Arctic ground squirrels, and tundra hares. Mink, beavers, muskrats, and river otters are found in or near water. Red squirrels and wolverines are also found throughout the area. Wolves are not abundant, but they do range throughout the Alaska Peninsula, and coyotes and lynx are present in low numbers in the King Salmon area.

Marine mammals that may use the Naknek River in the King Salmon vicinity include the beluga whale, from late March through late April and again in the fall (October). Killer whales may occur while chasing beluga whales. Harbor seals are common. A gray whale was documented in this area about 1990 (Jones Technologies, Inc. and Gene Stout and Associates 1999b).

5.3.3 Birds

Numerous species of waterfowl and shorebirds feed and rest in the Bristol Bay area, including King Salmon, during their migrations, and many passerine and predatory birds occur in the area. The Naknek River is a significant spring staging area for Greater White-fronted Goose, Tundra Swan, many species of ducks and shorebirds, and Arctic Tern (USFWS 1993a). Important shorebird species known to stage in spring include the Hudsonian Godwit, Least Sandpiper, and Short-billed Dowitcher. Some unusual, rare or uncommon species, such as Ring-necked Duck, Steller's Eider, a Bewick's race Tundra Swan, Eurasian Wigeon, and Canvasback, have been documented (Jones Technologies, Inc. and Gene Stout and Associates 1999b). Mallard, Gadwall, Green-winged Teal, American Wigeon, Greater Scaup, Goldeneyes, Bufflehead, and Mergansers stop-over in spring and fall. Other large birds that frequent the area include Sandhill Crane, Tundra Swan, Canada Goose, and Loons.

Shorebird species include Rock, Least, and Western Sandpipers; Ruddy Turnstone; Hudsonian and Bar-tailed Godwits; American Golden, Semipalmated, and Black-bellied Plovers; Dunlin; and Phalarope. Glaucous-winged and Mew Gull, Arctic Tern, and Black-legged Kittiwake potentially are found near Rapids Camp and Lake Camp.

Passerines known or expected to occur in the area include Song, White-crowned, and American Tree Sparrow; American Robin; Yellow-rumped, Blackpoll, and Wilson's Warbler; and Gray-cheeked Thrush. Bald Eagle, Osprey, Northern Goshawk, Rough-legged Hawk, Merlin, and Great-horned, Boreal, and Short-eared Owls are also present in the area.

5.4 Threatened and Endangered Species

The Steller's Eider was documented on the Naknek River in 1992 (USFWS 1993b). No other threatened or endangered species likely use the King Salmon area although the threatened Spectacled Eider and candidate Kittlitz's Murrelet are possible. A reported observation of six Aleutian Canada Geese, now named Aleutian Cackling Geese and delisted, occurred in April 1996.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Naknek Recreation Camp site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Subsistence resources are relied upon by King Salmon residents. Cultural preferences and the relatively high cost of imported food foster continued use of subsistence resources. The importance of subsistence to King Salmon residents is reflected in the high participation rates of households that harvest (88%) subsistence resources. The annual subsistence round at King Salmon is defined by the seasonal salmon runs in local streams. Residents also rely heavily on land mammals. Fish account for 54% and land mammals for 46% of the annual subsistence harvest in terms of total pounds. The importance of subsistence resources is even more significant to residents of Naknek and South Naknek due to the mixed economy of Naknek and the seasonality of wage work at South Naknek (Braund and Associates 2004).

5.6.2 Outdoor Recreation

There are no organized outdoor recreation opportunities at the Rapids Camp or Lake Camp. Demand for hunting near the sites consists essentially of big game hunting for caribou, brown bear, and moose. Small game hunting is limited, but hares, grouse, and ptarmigan can be found. Waterfowl staging areas along the Naknek River provide hunting opportunities, and fur trapping occurs in the area. The Naknek River provides recreational fishing opportunities. Various salmon species are targeted, although other species may be taken, such as rainbow trout, Dolly Varden, and northern pike.

Appendix 3.0 – Nikolski. Nikolski Radio Relay Site

3.0 Installation Overview

3.1 Location and Area
The Nikolski excess site is about one mile north of the village of Nikolski on Umnak Island. Umnak Island is one of the Fox Islands in the Aleutian Islands chain of southwestern Alaska. Nikolski is on the southern portion of Umnak Island, about 116 miles west of Unalaska and 900 miles from Anchorage (INRMP Figure 3.1). The site occupies 323 acres on a high point about one mile east of Nikolski Bay (Figure 3.1). Air Force holdings are within the Alaska Maritime National Wildlife Refuge.

3.2 Installation History
The Nikolski site was developed in 1957 and accepted in 1959 as a DEW Line station collocated with WACS facilities. The installation consisted of four tropospheric antennas and a composite building with dormitories, office space, storage, and equipment for standby power generation. A landfill and a demolition debris disposal area are located about ¼-mile east of the site. A POL storage and distribution facility was located about six road miles south of the site and a fuel pipeline extended from the POL tank area to the site. An airstrip, a drum storage area, and a deactivated airstrip lighting vault are adjacent to the village of Nikolski. The DEW Line station was closed in 1969. The WACS component of the site was deactivated in 1978 and demolished in 1988. POL facilities and the drum storage area have also been removed. Public laws require conveyance of AF lands at Nikolski to Native corporations. Conveyance of the uncontaminated landing strip property was completed in 2005. The next phase of conveyance involves approximately 240 acres of land, of which 190 acres are suitable for conveyance. The remaining 50 acres of land in the High Hill and Mona Lisa Beach areas may require additional research and remediation until they are suitable for final conveyance.

3.3 Surrounding Communities
The village of Nikolski is about one mile south of the Nikolski site. Nikolski has a population of 18 (2010). The village is reputed to be the oldest continuously-occupied community in the world. Archaeological evidence from Ananiuliak Island, on the north side of Nikolski Bay, dates to 8,500 years ago. The Chaluka archaeological site, in the village of Nikolski, indicates 4,000 years of virtually continuous occupation (www.dced.state.ak.us 2012).

3.4 Regional Land Use
In 1834 Nikolski was the site of sea otter hunting. In 1920 a boom in fox farming occurred. A sheep ranch was established in 1926 and still operates as part of the Aleutian Livestock Company. The population of Nikolski is 31 consisting of 69.2 percent Alaska Native or part Native. Residents are known as Unangan, and Aleut is spoken in three-quarters of homes. Subsistence activities, sheep and cattle raising, and fishing-related employment sustain the community. Most residents support themselves by working outside the village at crab canneries and on processing ships (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas
Nikolski site is within the Alaska Maritime NWR. The NWR is spread along most of the 47,300 miles of Alaska's coastline. The refuge includes more than 2,500 islands, islets, spires, rocks, reefs, waters and headlands extending from Forrester Island to the north of Canada's Queen Charlotte Islands deep in the southeastern tongue of the state, to the westernmost tip of the Aleutians, and north to Cape Lisburne on the Arctic Ocean. No other maritime refuge in America is as large or as productive. Alaska Maritime's

Figure 3.1 Nikolski Former RRS

seashore lands provide nesting habitat for approximately 40 million seabirds, or about 80% of Alaska's nesting seabird population. The refuge hosts seabird populations of both national and international significance. Activities focus on long-term ecosystem monitoring, marine resources research, and invasive species management (USFWS 2007a).

4.0 Physical Environment

4.1 Climate

The Nikolski site has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. Temperatures range from 11 to 65°F. Annual snowfall averages 41 inches; total precipitation averages 21 inches. Strong winds are frequent during the winter, and fog during the summer, which limits accessibility (www.dced.state.ak.us 2012). Summer temperatures average 50.3°F, and winter temperatures average 33.7°F. Extreme temperatures of -8°F and 80°F have been recorded. Prevailing winds at Nikolski average 16 miles per hour from the south-southeast.

4.2 Landforms

The Nikolski site is located in the southwestern portion of Umnak Island, which consists of low rolling hills with flat to moderately sloped terrain between the hills. The site is on High Hill, a topographic high point of the southwestern portion of the island, at about 700 feet above msl. POL facilities were located at about 100 feet above msl (Hart Crowser, Inc. 1997d). Umnak Island is almost separated into two islands, becoming very narrow at Inanudak Bay. Prominent topographical features of the southern half of the island are Mount Vsevidof and Mount Recheshnoi. Tulik Volcano and Okmok Caldera are prominent on the northern half of the island.

4.3 Geology and Soils

The Aleutian Islands formed in a large curve, the Aleutian Arc, as a result of convergence of oceanic plates from the north and south. Oceanic plates from the south pushed under the northern plate forming an area known as the Aleutian Trench. Hot magma extruded and intruded in the form of volcanoes and plutons which are the Aleutian Islands (EMCON Alaska, Inc. 1995b).

Umnak Island is composed of volcanic, volcaniclastic sedimentary and intrusive rocks. The plain that surrounds the site to the foot of Mount Vsevidof is predominantly albitized bedded argillite and tuff and albite rich lava flows and shallow intrusives. Numerous cobbles of felsite scoria are present along the shore of Nikolski Bay. High Hill is a classic volcanic neck, exhibiting vertical sides and excellent columnar jointing. This neck rock is durable basaltic porphyry that boldly rises from the shoreline (611 CES/CEVO 1998).

The Aleutian Islands are generally characterized by soils of the Typic Cryandepts association. These soils occupy mountain-foot slopes, plateaus, and valleys and are generally well drained. Soils are characterized by a thin organic layer underlain by sandy and silty volcanic ash with cinders. Soils of the Nikolski site are considered to be predominantly medium-textured soils with moderate infiltration rates (CH2M Hill 1994c).

4.4 Hydrology

Surface water flows radially off the site, with water flowing north and west entering the Bering Sea and water flowing east and south entering Sheep Creek drainage and discharging into Nikolski Bay. Nikolski Bay and the Bering Sea are about ½ mile from the site. The area surrounding the site has a number of lakes, some approaching a mile in diameter. When the site was active, drinking water was pumped from a lake about ½ half mile southeast of the site (CH2M Hill 1994c).

There are no known records of groundwater in the site's area. Regional groundwater characteristics are controlled by bedrock fractures, joints, induration, and characteristics of underlying soils. Permafrost does not occur in the area (CH2M Hill 1994c).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Nikolski site. Much information included in INRMP Chapter 5.0 that includes Nikolski site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Nikolski site and the surrounding area. ***Appendix 3.0-Driftwood***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Nikolski site. ***Appendix 3.0-Campion***, Appendix A contains lists of fish (Table A2) and mammals (Table A3) on Nikolski site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Nikolski site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain

Division: M120 Tundra Division – Mountain Provinces

Province: M127 Aleutian Oceanic Meadow-Heath Province

Description: Islands that chiefly make up this province are mountainous, containing more than 75 volcanoes. Slopes are steep all to the water's edge with shores rocky and craggy. The climate is similar to the arctic coastal plain although winters are less severe; temperatures range between 18 to 27F. Winds are severe, and smaller islands receive less precipitation than larger islands; annual precipitation ranges from 21 inches to more than 78 inches. In the Aleutian Province there are no trees; the vegetation is a few shrubs and in the lower elevations are a variety of tall grasses, flowering plants, and ferns. Dominant soils are Inceptisols; permafrost is absent.

5.2 Vegetation

Many trees were introduced by the Americans during World War II, which resulted in small groves at Nikolski on Umnak Island (Sekora 1973). Vegetation of the Aleutian Islands, including Umnak Island and the Nikolski site, is similar to alpine types and is classified as maritime tundra (USFWS 1988). High upland areas and mountain slopes support a variety of lichens, mosses, and low-growing alpine plants. Lowland areas are covered with tall herbaceous meadows.

A general vegetation map of the Nikolski site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Nikolski site.

5.3 Fish and Wildlife

5.3.1 Fish and Aquatic Invertebrates

Freshwater environments within the general area of the Nikolski site provide habitat for coho, pink, and sockeye salmon and Arctic char. All five Pacific salmon species use the area for spawning (CH2M Hill 1994c). Urchins, octopus, mollusks and other fauna occur near or on the reef in Nikolski Bay.

5.3.2 Mammals

Terrestrial mammals inhabiting Umnak Island include red fox, Arctic fox, Arctic ground squirrel, collared lemming, tundra vole, Norway rat, reindeer, and domestic sheep, cattle, and horses (CH2M Hill 1994c).

Marine mammals that may occur in coastal waters of Umnak Island include the threatened northern sea otter; the endangered Steller sea lion; the endangered finback whale (USFWS 2011); harbor and northern fur seals; and blue, sperm, minke, North Pacific Right, and killer whales (USFWS 1988).

5.3.3 Birds

Pelagic species commonly found in the Unalaska region (Driftwood Bay) include fulmars, cormorants, gulls, kittiwakes, auklets, and puffins. Pelagic Cormorant, Marbled Murrelet, and Tufted Puffin are known to nest on Unalaska Island. Black Oystercatcher and Rock Sandpiper are permanent residents. Turnstones, sandpipers, and phalaropes are common migratory shorebirds. Numerous waterfowl species are found along the eastern Aleutian Islands including Emperor Goose, Canada Goose, Scaup, Goldeneye, Bufflehead, Long-tailed Duck, Green-winged Teal, Grebes, Common Eider, and Brant. Bald Eagles and Common Ravens are common and Gyrfalcons, hawks, and Snowy Owls may be seen on occasion (CH2M Hill 1994c).

5.4 Threatened and Endangered Species

The endangered Short-tailed Albatross, threatened Steller’s and Spectacled Eiders, and candidate Yellow-billed Loon are federally-listed species in the Aleutians. All are potentially on or near Nikolski site, but Steller’s Eider is the only one known near the site. Endangered marine mammals of the Aleutians include North Pacific right, sperm, blue, bowhead, and fin whales and Steller sea lions. The threatened northern sea otter in southwest Alaska may be in waters near the site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Nikolski site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The village of Nikolski is about three miles south of the Nikolski site. Subsistence plays a crucial role in the village of Nikolski, because economic opportunities are extremely limited. Beyond cultural preferences for subsistence food, the costs for importing foods are very high. Residents who have left Nikolski for jobs in other communities often depend on some sharing of resources from those who still live in the village. The marine environment of Nikolski is the primary use area. While no specific subsistence use area data are available for Nikolski, the Fox Island group is likely the main area used for subsistence harvesting. Umnak Island, on which Nikolski is located, encompasses a variety of habitats conducive to harvested species. Feral cattle and sheep are grazed on the island and ranched, rather than herded. Nikolski residents harvest these cattle and sheep annually (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at the Nikolski site are limited due to the absence of game species for hunting; fishing in the area surrounding the site is available, but recreational fishing has not been documented (CH2M Hill 1994c); and nonconsumptive activities, such as ATV riding along gravel roads, bird watching, and hiking, are available, but use is minimal due to the small population of the village of Nikolski. Village residents harvest mollusks and other indigenous species from a reef within Nikolski Bay and may harvest salmon and other fish species from local creeks and lakes (Hart Crowser, Inc. 1997d). Lakes in the vicinity of the village of Nikolski that support salmon runs are an important subsistence resource to village residents (USFWS 1988).

Appendix 3.0 – Nome. Nome Field POL Site

3.0 Installation Overview

Figure 3.0 Ground Level View of Nome Field POL Site

3.1 Location and Area

The Nome Field POL (petroleum, oil and lubricants) Site (excess site) is on the southern coast of the Seward Peninsula about two miles west of the City of Nome. Nome is about 580 miles northwest of Anchorage, Alaska (INRMP Figure 3.1). The site occupies seven acres near the Snake River (Figure 3.1).

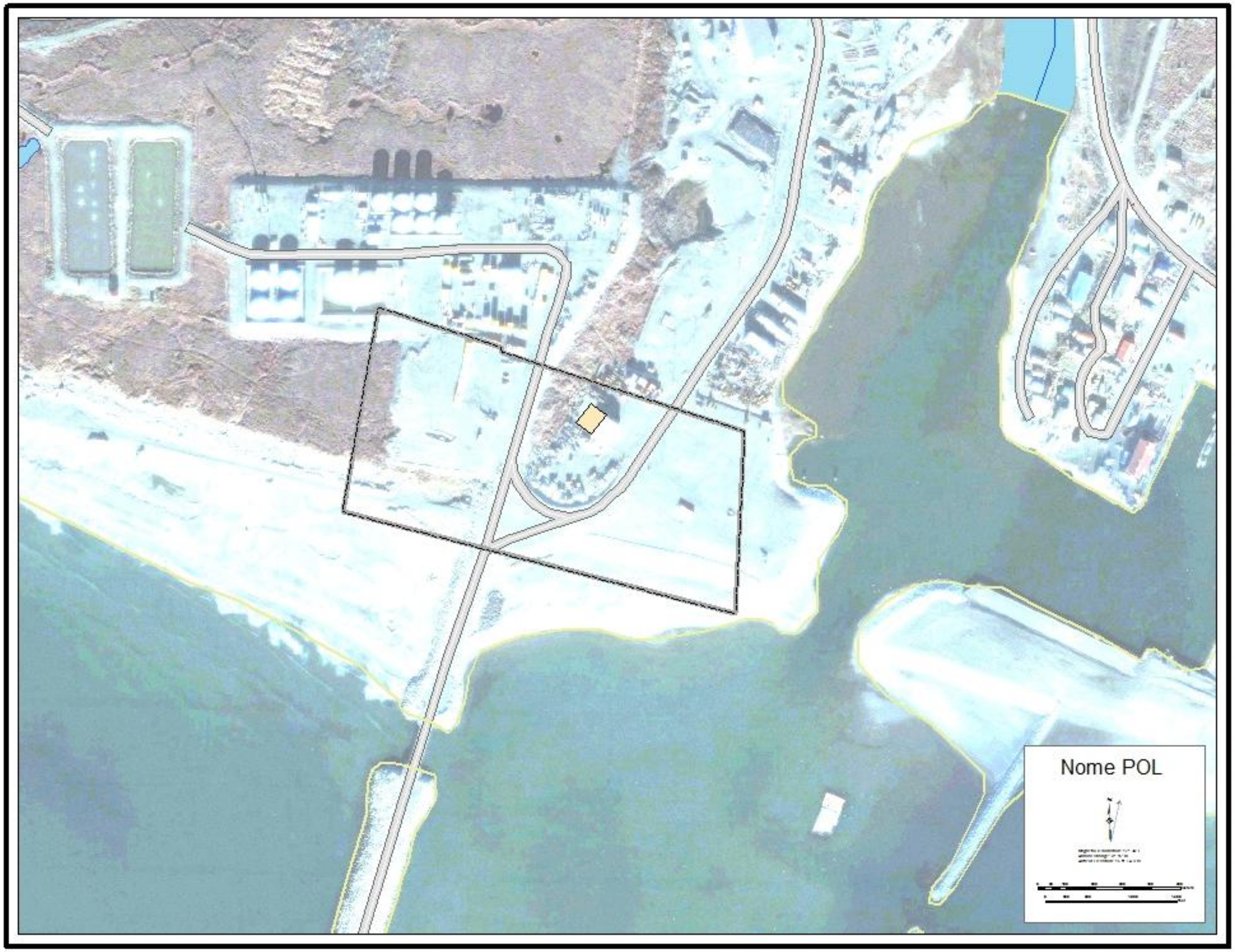
3.2 Installation History

West Nome Tank Farm (as it has been commonly called) was established as a POL storage facility in 1944 to support the former Marks AFB, which was decommissioned in the 1950s. West Nome Tank Farm was leased to various companies for commercial use from 1957 to 1991. The site was partially dismantled, primarily the tanks, and demolished in 1992. Some underground piping and the pumphouse were not removed. The POL pipeline over the Snake River was removed in 1994. The property was declared surplus in 1974; however, the Air Force still retains ownership.

3.3 Surrounding Communities

Nome has a population of 3,598 (2010) consisting of 54.8 percent Alaska Native or American Indian. Nome is the supply, service, and transportation center of the Bering Strait region. Government services provide most employment. In 2010, 43 residents held commercial fishing permits. Retail services, transportation, mining, medical and other businesses provide year-round employment. Nome has facilities common to most contemporary communities, such as a library, museum, visitor's center, recreation center, two radio stations, a fire department, two meeting/conference facilities, a hospital, and about 200 businesses. Several small gold mines continue to provide some employment, and NovaGold Resources,

Figure 3.1 Nome Field POL Site



Inc., a large gold mining operation, is developing a mine eight miles north of Nome. Subsistence activities contribute to the local diet (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Gold first brought people, in large numbers, to the Nome area. Gold was discovered in Anvil Creek in 1898. Almost overnight an isolated stretch of tundra fronting the beach was transformed into a tent-and-log cabin city of 20,000 (www.dced.state.ak.us 2012). Nome suffered major fires in 1905 and 1934 and violent storms in 1900, 1913, 1945, and 1974, which left little of Nome's gold rush architecture. Nome was the last stop on the ferry system for planes flying to the U.S.S.R. for the Lend/Lease program during World War II. The current airstrip was built, and many troops were stationed in Nome (www.dced.state.ak.us 2000).

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Nome site.

4.0 Physical Environment

4.1 Climate

January temperatures range from -3 to 11 °F; July temperatures are typically 44 to 65° F. Average annual precipitation is 18 inches, with 56 inches of snowfall (www.dced.state.ak.us 2012). Mean summer temperatures range from 39° to 56°F, while mean winter temperatures range from -3° to 14°F. Maximum and minimum temperatures of 86°F and -46°F have been recorded (Arctic Environmental Information and Data Center [AEIDC] 1989).

The Nome Field POL site has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. The area receives relatively little precipitation compared to other parts of Alaska. Annual precipitation averages 15.6 inches, with 10.5 inches of rain falling during summer and 54.8 inches of snow falling during winter (AEIDC 1989). Prevailing winds are from the north and average nearly 11 miles per hour.

4.2 Landforms

The primary topographical features of the Nome area are beaches, coastal plains, high hills, and water courses. The Nome site lies at the base of a bluff along the Snake River in the coastal plain area, which extends from Cape Nome to the hills west of the Cripple River (Hart Crowser, Inc. 1997e). Land surrounding the facility is typically less than 100 feet above msl. The property consists of level ground dissected by several earth dikes.

4.3 Geology and Soils

Coastal lowlands geology of the Nome area consists of unconsolidated Quaternary deposits of glacial, glaciofluvial, and alluvial deposits over metamorphosed quartz and calcareous schists. The Nome area geology is dominated by structural faulting, thrusting, and thermal intrusions, which have contributed to thermal and dynamic metamorphic structures in the area. These processes have produced rich deposits of placer gold on the Seward Peninsula and in the immediate vicinity of the Nome site (Hart Crowser, Inc. 1997e).

Soils in the vicinity of the West Nome Tank Farm site are poorly drained silts overlain with thick mats of organic material. The region is underlain by continuous permafrost at shallow depths. Soils are perennially frozen near the base of the organic mat. The area has many thaw lakes and drained thaw lake scars. Peat ridges, frost mounds, and frost boils are common. A common surface soil type of the Nome area and in the vicinity of the Nome POL site is coarse rubble along small streams and old beach lines from extensive mining in the area (Hart Crowser, Inc. 1997e).

4.4 Hydrology

The primary surface water feature near the Nome site is the Snake River, which discharges into Norton Sound near the site. The Nome River is the second major surface water feature occurring in the vicinity of the site, and it discharges into Norton Sound about four miles east of the City of Nome. Surface water in the area generally contains low amounts of dissolved solids, probably due to relatively low rates of annual stream runoff, low relief in the area, and the lack of glaciers (Hart Crowser, Inc. 1997e). The site's several earthen dikes designed for spill abatement have created three small, shallow depressions, which hold ponded water during periods of high precipitation. These ponds are the only surface water features on the site.

Groundwater in the area is available in small amounts in permafrost thaw-bulbs beneath channels of larger streams. Regional permafrost is generally prohibitive of productive groundwater sources. The City of Nome obtains most of its potable water from Moonlight Spring, and residents outside of the city obtain potable water from rivers, water impoundments, and local wells (Hart Crowser, Inc. 1997e).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Nome Field POL site. Much information included in INRMP Chapter 5.0 that includes Nome Field POL site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Nome Field POL site and the surrounding area. ***Appendix 3.0-Anvil***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Nome Field POL site. Fish and mammal species on Nome Field POL site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Nome Field POL site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: M120 Tundra Division – Mountain Provinces
Province: M125 Seward Peninsula Tundra-Meadow Province
Description: The landscape of this province contains broad convex hills and flat divides cut by sharp V-shaped valleys. Rising above coastal lowlands and interior basins are isolated groups of rugged glaciated mountains with elevations of 2,500-4,700 feet. Winters are long and cold followed by short, cool summers. Average precipitation is 18 inches with heavy snowfall in winter and heavier concentrations of rain in summer. At lower elevations are moist and wet tundra communities; alpine tundra communities are found in high mountains. The vegetation is mostly sedge tussocks with scatterings of willows and birches; isolated spruce-hardwood forests also exist. Dominant soils for the province are Inceptisols; permafrost can be found throughout the province.

5.2 Vegetation

A vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001c) identified 31 species during a 1999 site visit. Much of the previously cleared areas of the Nome POL site is revegetating to a cover of shrubby willows, dominated by *Salix alexensis*, *S. planifolia* ssp. *pulchra*, and *S. glauca*. More open areas, such as the footprint of buildings or fuel tank bases, are revegetating with an herbaceous cover of grasses, such as

Poa sp., *Festuca* sp., and *Trisetum spicatum*. Small segments of the bluff and hillslope on the site were never cleared and retain natural tundra and riparian vegetation. The three shallow ponded depressions harbor patches of open mud and shallow water and are partially vegetated with wetland species, such as *Eriophorum angustifolium*, *Juncus arcticus*, *Equisetum arvense*, and several species of *Carex*.

A general vegetation map of the Nome Field POL has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Nome Field POL site.

5.3 Fish and Wildlife

5.3.1 Fish and Aquatic Invertebrates

A variety of fish inhabit coastal waters near the Nome POL site, including all five species of Pacific salmon (king, sockeye, coho, chum, and pink), Pacific cod, Arctic char, and halibut. Freshwater fish habitat in the area near the site includes primarily the Nome and Snake rivers and their tributaries. Freshwater fish include Arctic grayling, rainbow trout, whitefish, and northern pike. Marine invertebrates are abundant in Norton Sound and clams and crabs, particularly king crabs, are commonly harvested by subsistence and commercial users (CH2M Hill 1994a).

5.3.2 Mammals

Terrestrial mammals inhabiting the Seward Peninsula area are found in or around Nome Field POL site (Bee and Hall 1956). The site also is near to coastal waters of Norton Sound with its marine mammals.

5.3.3 Birds

The moist tundra and brush environment within and adjacent to the site provides nesting and foraging habitat for a wide variety of bird species. Bird species found breeding on the Nome Field POL site are characteristic of arctic/alpine sites in Alaska and include the Yellow Warbler, Yellow Wagtail, White-crowned Sparrow, and Fox Sparrow in the shrub willow community and the Savannah Sparrow and Semipalmated Plover on gravel pads.

The USFWS breeding bird survey (Andres and Brann 1997) on Army National Guard training areas at Teller, White Mountain, and Elim, Alaska is an applicable addition to the database for southern Seward Peninsula. The 1997 survey occurred over three to four days at each site, confirming 12, 25, and 26 species, respectively.

5.4 Threatened and Endangered Species

No known threatened or endangered species occur on the site with exception of the threatened polar bear, which is known in the area. However, the potential exists for some federally-listed threatened or endangered species to occur in the Nome area, including the threatened Spectacled Eider and Steller's Eider; endangered Steller sea lion and bowhead, fin, and humpback whales; candidate Yellow-billed Loon; and threatened ringed and bearded seals (USFWS 2011). There is low potential for either the threatened Spectacled or Steller's Eider to nest or visit the Nome Field POL site since there is no suitable habitat.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Nome Field POL site.

5.6 Other Natural Resources Information

5.6.1 Subsistence

The City of Nome is associated with the Nome Field POL site. Regardless of the ethnic background or employment status, subsistence plays an important role in Nome. Ninety-five% of residents in 1995 used at least one subsistence resource, and 65% used at least six different wild resources. Harvest estimates are exclusively for birds and eggs. A large portion of the bird and egg harvest in 1995 consisted primarily of migratory birds, upland birds, and sea bird and loon eggs. Fish harvest includes salmon, Dolly Varden, grayling, and whitefish. Nome residents harvest marine mammals such as bearded, ringed, and spotted seals. In general, Nome residents use an area that consists of Norton Sound, west to Bering Strait, and all watersheds draining the southern portion of the Seward Peninsula between Golovin Bay and Port Clarence (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreation opportunities available at the Nome POL site are limited due to its small acreage and the industrial nature of the area surrounding the site. Activities, such ATV riding and bird watching, can occur on the site. Limited subsistence-related collection of vegetation for greens and berries could occur on the site. These activities are not recommended due to the extensive contamination with unknown concentrations on site.

Appendix 3.0 – North. North River Radio Relay Site

3.0 Installation Overview

Figure 3.0 Ground Level View of North River Former RRS

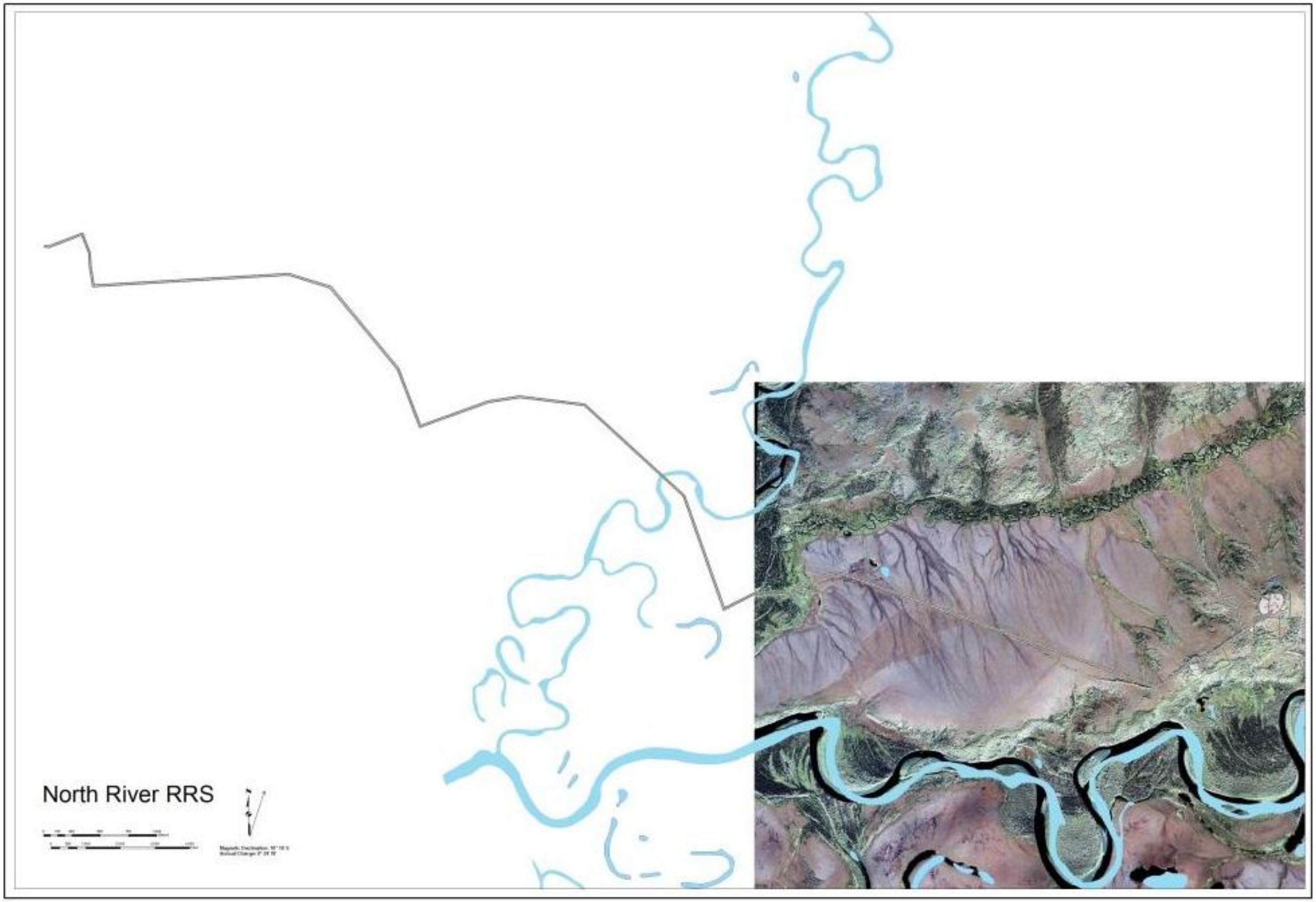
3.1 Location and Area

The North River excess site is inland eight miles east (12 road miles) of the village of Unalakleet, Alaska on Norton Sound (INRMP Figure 3.1). The site encompasses 144 acres on a hilltop above the north bank of the Unalakleet River (Figure 3.1), including a North River Expansion Area, access roads, communication lines, etc.

3.2 Installation History

North River WACS facilities were constructed in 1956 and 1957. The North River site is one of the 31 original WACS sites. USAF real estate records indicate it first was the North River Communications Station, renamed North River Air Force Station in 1958, then in 1961 became the North River Radio Relay Station. North River operated as a combined tropospheric scatter/TD-2 microwave station, which relayed radio information to and from the Granite Mountain and Kalakaket Creek WACS sites (Reynolds 1988). North River became active in 1957 and was abandoned in 1978. The site was operated remotely by Radio Corporation of America/Alascom from the early 1960s until 1978. The facility was typical of WACS sites with a composite building, a barracks, four antenna structures, POL storage, a water tower, and a temporary garage. The North River site included a water pumphouse located near the Little North River. All structures were demolished and removed from the site in 1996 (Hart Crowser, Inc. 1997f). The future plan is to transfer the property to the appropriate adjudicating agency. A PCB soil removal project was completed in 2005. In 2006 a remedial investigation was performed. In 2010-2012 POL remediation occurred. Additional PCB and POL removals were conducted in 2011 and 2012, and further removals are planned for 2013.

Figure 3.1 North River Former RRS



3.3 Surrounding Communities

The population of Unalakleet is 688 (2010) consisting of 77.3% Alaska Native or American Indian. Commercial fishing for herring, herring roe and subsistence activities are major components of Unalakleet's economy. Commercial fishing permits are held by 101 residents. The Norton Sound Economic Development Council operates a fish processing plant, and government and school positions are relatively numerous. Tourism is becoming increasingly important; there is world-class silver salmon fishing in the area. There is a school in the community attended by 188 students, and the Euksavik Clinic provides medical services (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Access to the North River site is via a gravel road from Unalakleet. Unalakleet is at the mouth of the Unalakleet River on Norton Sound, 148 miles southeast of Nome and 395 miles from Anchorage. House remnants along Unalakleet's beach ridge have been dated from 200 B.C. to 300 A.D. Unalakleet has long been a major trade center as the terminus for the Kaltag Portage, an important winter travel route connecting to the Yukon River. The Russian-American Company built a post at Unalakleet in the 1830s. In 1901 the Army Signal Corps connected Unalakleet, via telegraph, to St. Michael, Kaltag, and Fort Gibbon (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas

There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the North River site.

4.0 Physical Environment

4.1 Climate

The North River site has a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain and snow. Unalakleet has a subarctic climate with considerable maritime influences when Norton Sound is ice-free, usually from May to October. Winters are cold and dry. Average summer temperatures range 47 to 6 °F; winter temperatures average -4 to 11°F. Extremes have been measured from -50 to 87°F. Precipitation averages 14 inches annually, with 41 inches of snow (www.dced.state.ak.us 2012). Prevailing winds are from the east-northeast. The average annual wind speed is about 12 miles per hour (Hart Crowser, Inc. 1997f).

4.2 Landforms

The North River site is on a topographic high point at about 500 feet above msl. The surrounding terrain is hilly alpine tundra, but the facilities were situated mostly on gravel fill.

4.3 Geology and Soils

The North River site is in the Lower Yukon Subregion. This coastal area is underlain by Cenozoic gravel and silts and basalts; the northern part may be underlain by granodiorite. The Nulato Hills consist of folded Cretaceous greywacke and slate with Mesozoic and Paleozoic volcanics at the eastern and southern ends. These rocks are locally intruded by stocks and dikes ranging in composition from monzonite to diabase. The subregion is transected by the Kaltag Fault, a major structural feature that trends north northwest between Unalakleet and Kaltag. Most rocks are intensely folded and faulted (Aman Environmental Construction, Inc. 1995).

The North River site is on the Norton Sound Highlands, an area generally characterized by soils of the Histic Pergelic Cryaquepts and Pergelic Cryunbrepts associations (Soil Conservation Service 1979). The Unalakleet River basin is underlain by sedimentary bedrock consisting of graywacke, shale, grit, and conglomerate. Coarse clastic rocks form rubble-covered ridges and hills; shale underlies slopes and valleys (Hart Crowser, Inc. 1997f). Soil at the North River site is poorly developed, consisting of a thin layer of topsoil over crystalline bedrock. Topsoil thickness varies from less than one inch on the hilltop to 10 inches on the hillside. Permafrost is discontinuous in the Unalakleet area. Permafrost is not expected to be present at the North River site due to the shallow depth to bedrock (U.S. Army Corps of Engineers 1991).

4.4 Hydrology

Major surface water features in the immediate area of the North River site are Unalakleet and North rivers. North River is a tributary of the Unalakleet River, which discharges into Norton Sound at Unalakleet. Unalakleet River is about ½ mile south, and Little North River, a tributary of North River, is about one mile north of the site. Developed drainages are not present on the site, and precipitation runs off by sheetflow.

Permafrost is present in most of the Unalakleet River basin, but its extent and thickness have not been determined. Unfrozen zones occur in alluvium underlying and adjacent to the streams, and certain types of vegetation, such as aspen trees, indicate that some of the well-drained, south-facing slopes also may be free of permafrost. Groundwater can be found in unfrozen alluvium in stream valleys. Because of the presence of permafrost and low-permeability bedrock in most of the basin, groundwater is both recharged and discharged principally along stream courses in the alluvium (CH2M Hill 1994d). The water table is expected to be greater than 10 feet deep at the North River site (U.S. Army Corps of Engineers 1991). Groundwater resources within the basin are virtually unused for water supply. A well near the Little North River was once used to supply the North River site. Unalakleet pipes water from a developed collection gallery and well under a small stream north of the village, outside of the Unalakleet River basin (Sloan *et al*. 1986).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to North River site. Much information included in INRMP Chapter 5.0 that includes North River site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on North River site and the surrounding area. ***Appendix 3.0-Anvil***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on North River site. Fish and mammal species on North River site and the surrounding area are in ***Appendix 3.0-Lay***, Appendix A, Table A2 and A3, respectively. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at North River site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 125 Bering Tundra (Northern) Province
Description: As a western extension of the arctic coastal plain, the Bering Tundra is a broad lowland area rising gradually to the east. Winters are cold, and summers are generally cool. Annual precipitation is 17 inches. Along coastal areas the vegetation is mainly sedge and cottongrass; on higher sites are woody plants. In transition areas between beach and forest are birch-willow-alder thickets. Inceptisols over silt, sand, and marine sediments are found along the coast; in the lower Yukon and Kuskokwim Valley bottoms are pockets of Entisols. In most of the area, the permafrost is continuous.

5.2 Vegetation

Vegetation types in western Alaska form a mosaic of patterns related to slope and aspect and the presence or absence of permafrost. Vegetation includes alpine tundra, small willows, lichens, and mosses found at the other three, higher elevation sites (Hart Crowser, Inc. 1997f).

Gravel pads of the North River site are revegetating to grasses, primarily *Festuca rubra*, *Trisetum spicatum*, and *Poa* sp., and various forb species. Short, steep slopes of the gravel pads are nearly 100 percent revegetated with *Alnus crispa*. Surrounding undisturbed terrain on the hilltop is primarily moist to wet tussock tundra with some small patches of open rock (frost-heaved talus) and small riparian drainages lined with shrub-sized willow and alder. The tundra is dominated by large tussocks of *Eriophorum vaginatum* with associated species, such as *Betula nana*, *Vaccinium vitis-idea*, *V. uliginosum*, and *Ledum palustre*.

Some well drained portions of the hilltop support arctic/alpine vegetation. Slopes and broad valley bottoms in the area are dominated by expansive stands of *E. vaginatum* tussocks with intermingled and stunted *Picea mariana*. Along larger riparian sites are localized stands of *Picea glauca*, *Populus balsamifera*, and *P. tremuloides* with shrub-sized willow and alder. Herbaceous vegetation in these areas is more typical of boreal forest taxa with such species as *Cornus canadensis*, *Galium boreale*, *Orthilia secunda*, and *Pyrola chlorantha*.

A vegetation survey performed in association with development of a previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001c) identified 70 species during a 1999 site visit. A general vegetation map of the North River site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for North River site.

5.3 Fish and Wildlife

5.3.1 Fish

The Unalakleet River supports spawning runs of all five species of Pacific salmon. Dolly varden, Arctic char, tomcod, herring, whitefish, king crab, and marine invertebrates are also present in the area. The Unalakleet River has been identified as a critical environment for anadromous fish species (CH2M Hill 1994d).

5.3.2 Mammals

The area is inhabited by brown/grizzly bears, moose, caribou, wolves, ground squirrels, hares, red foxes, mink, martens, beavers, muskrats, weasels, etc. No mammals were observed during a 1999 site visit (Universe Technologies, Inc. and Gene Stout and Associates 2001c).

5.3.3 Birds

Habitats of the Nulato Hills provide nesting and foraging opportunities for a wide variety of bird species. Common terrestrial birds of the area include Spruce Grouse, Rock and Willow Ptarmigan, Common Raven, Parasitic Jaeger, Savannah Sparrow, Lapland Longspur, Snow Bunting, and raptors, such as Gyrfalcon, Northern Harrier, Merlin, Snowy Owl, Rough-legged Hawk, and Golden Eagle (Hart Crowser, Inc. 1997f).

The following species can be observed nesting on the site and in the area: American Robin, Varied Thrush, Swainson’s Thrush, Ruby-crowned Kinglet, Yellow Warbler, Yellow-rumped Warbler, Wilson’s Warbler, Alder Flycatcher, Olive-sided Flycatcher, Dark-eyed Junco, White-crowned Sparrow, Fox Sparrow, Savannah Sparrow, and American Tree Sparrow.

The USFWS breeding bird survey (Andres and Brann 1997) on Army National Guard training areas in the Nome region, including Unalakleet, is an applicable addition to the database for the Seward Peninsula. This survey identified 21 species at the Unalakleet training area.

5.4 Threatened and Endangered Species

No known threatened or endangered species are known to occur on the North River site. However, the potential exists for federally-listed threatened or endangered species to occur in the Unalakleet area, including the endangered Steller sea lion and bowhead, fin, north Pacific right, blue, sperm, and humpback whales and threatened Spectacled Eider and Steller's Eider (USFWS 2004b, 2011). There is low potential for either the Spectacled or Steller's Eider to nest at the North River site.

5.5 Wetlands

A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for North River site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

Unalakleet is about eight miles west of the North River site. Subsistence resource harvesting plays a significant role in supporting the community and is a primary occupation of the village. The limited number of wage jobs, cultural preferences and the expense and difficulty in procuring imported foods are important factors. More important is the integration of subsistence resource harvesting into the web of social relations, not only in Unalakleet but also among other coastal villages of Norton Sound. A system of reciprocity helps insulate people from local shortages as well as support those who cannot harvest resources for various reasons (Braund and Associates 2004).

Harvest data for the village of Unalakleet are limited to birds and eggs, and in 1995, 56% of sampled households harvested birds and eggs. Marine mammals are harvested offshore and on islands in Norton Sound near St. Michael and in Golovin Bay. Walrus tend to haul out or swim near haulout spots, either on islands or ice shelves. Beluga whales are generally harvested near beaches along the coast. Caribou are hunted in the Andreafsky Mountains and along McDonald Creek to the south and in the environs of Debauch Mountain north through the Seward Peninsula towards Buckland. Moose are taken along rivers from the Golsovia River north to Egavik, and along tributaries of Unalakleet River. These areas are also used to harvest rabbits, fox, mink, otters and bears. Large birds are taken near Shaktoolik, along the Unalakleet and Golsovia rivers, and southwest of St.Michael and Stebbins (Braund and Associates 2004).

5.6.2 Outdoor Recreation

North River site and the surrounding area are used primarily by residents of Unalakleet for hunting, fishing, trapping, and gathering (berry picking). The road and rivers in the area allow for access to the site and the surrounding area. Unalakleet is a departure point for recreational fishing in Norton Sound and the Unalakleet and North rivers. A commercial fishing lodge operates on the Unalakleet River about eight miles above Unalakleet. Other recreation activities include camping, hiking, and wildlife viewing.

Appendix 3.0 – Heiden. Port Heiden Radio Relay Site

3.0 Installation Overview

3.1 Location and Area

The Port Heiden excess site is on the west coast of the Alaska Peninsula in southwestern Alaska. The site encompasses 171 acres, is about four miles northwest of the community of Port Heiden (Figure 3.1), and about 400 miles southwest of Anchorage, Alaska (INRMP Figure 3.1).

3.2 Installation History

The Aleutian Segment of the DEW Line was completed in 1958 and Port Heiden's WACS became operational in 1961 to provide reliable communications for the DEW Line station. The WACS site consisted of four tropospheric antennas; a composite building with dormitories, office space, storage, a garage, and standby power generation equipment; a heliport; septic system; waste POL collection pits; and three underground fuel storage tanks. A POL tank farm was located on the coast, about four miles southwest of the site. The tank farm consisted of two large aboveground tanks, a pumphouse, and piping, which distributed fuel to the site. The DEW Line station closed in 1969. Port Heiden RRS was deactivated in 1978, and demolition of facilities occurred in 1990. The site has POL- and PCB-contaminated soil and POL- and TCE-contaminated groundwater. The installation has been in active remediation since 2008, and that is anticipated to continue for several years.

3.3 Surrounding Communities

The Port Heiden site is in a remote area of the Alaska Peninsula. The community of Port Heiden is about four miles southeast of the site. The old village of Meshik was located on the coast near the current site of the community of Port Heiden. Influenza epidemics during the early 1900s forced residents to relocate to other villages. During World War II, Fort Morrow was built near Meshik, and 5,000 personnel were stationed at the base. The base was closed after the war. A school was established in the early 1950s, which attracted people from surrounding communities. The community relocated inland due to storm waves eroding much of the old town site and threatening to destroy community buildings. The population of Port Heiden is 102 (2010) consisting of 83.3% Alaska Native or American Indian (www.dced.state.ak.us 2012).

3.4 Regional Land Use

Commercial fishing and government jobs provide the majority of cash income. In 2010, 11 residents held commercial fishing permits. Subsistence harvests of salmon, other fish, and marine mammals are important subsistence food resources. Game, birds, plants, and berries are also an important part of villagers' diets (www.dced.state.ak.us 2012).

3.5 Local and Regional Natural Areas

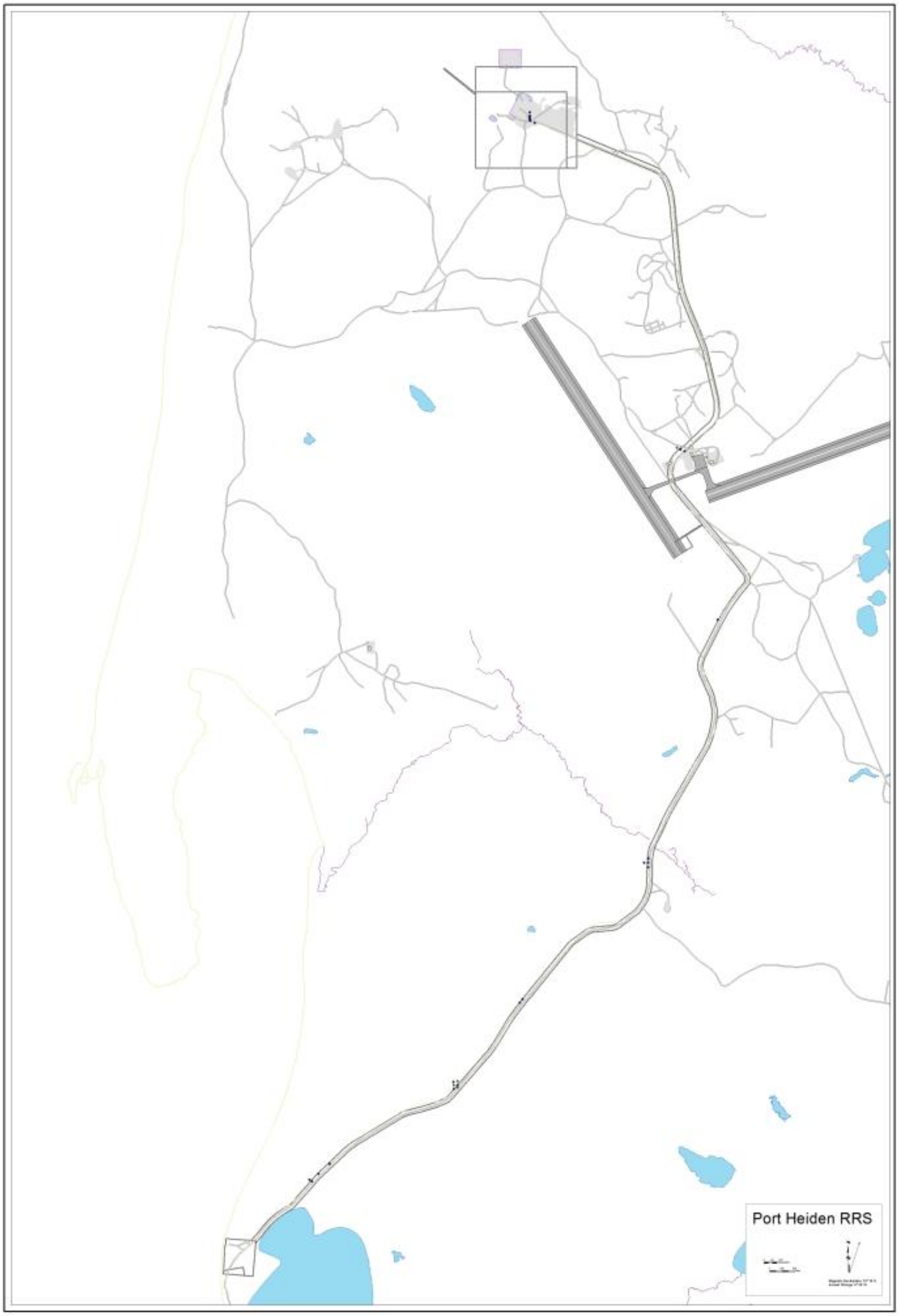
There are no significant (*e.g.*, wildlife refuges, parks, reserves) local or regional natural areas near the Port Heiden site.

4.0 Physical Environment

4.1 Climate

The climate of the Port Heiden region is classified as a cold maritime climate characterized by high humidity, considerable cloudiness, frequent fog, and light rain or snow. Port Heiden has cool summers,

Figure 3.1 Port Heiden Former RRS



relatively warm winters, and rain. Snowfall averages 58 inches per year. January temperatures average 25°F, and July temperatures average 50°F (www.dced.state.ak.us 2012). The mean annual precipitation is 15.5 inches with 8.3 inches of rain between July and October Extreme temperatures of -26°F and 87°F have been recorded (CH2M Hill 1994e).

4.2 Landforms

The Port Heiden site is adjacent to a large shallow bay on a relatively flat coastal plain that slopes gently toward Bristol Bay. The area exhibits lateral and terminal moraines, evidence of past glaciation. The site was constructed on a glacial moraine at about 140 feet above msl. The most significant topographic feature in the area is Aniakchak Crater, about 20 miles east of the site. Ponds, lakes, and wetlands are numerous in the vicinity of the site (EMCON Alaska, Inc. 1996b).

4.3 Geology and Soils

The Alaska Peninsula is composed mainly of volcanic rocks, volcaniclastic sedimentary rocks, and occasional plutons. Two volcanoes in the Port Heiden area, Aniakchak Crater and Mount Veniaminof, form the major geologic features. The most recent ash producing eruption from Anaikchak took place in 1931. Mount Veniaminof is not known to produce large ash eruptions. The area also exhibits glacial features, including moraines and paraglacial lakes, and evidence of fluvial surface processes that have produced outwash, floodplains, alluvial fans, beaches, spits, and deltas (EMCON Alaska, Inc. 1996b).

Bristol Bay Coastal Plain soils are generally characterized as soils of the Typic Cryandepts association. These soils occupy coastal plains and mountain footslopes and occur where thick layers of volcanic ash and cinder overlay glacial till or outwash. Soils at the Port Heiden site are primarily volcanic in origin. Upland soils are composed of volcanic ash interspersed with rocks, rubble, or cinders and are typically silty or sandy. Soils in the lowland areas are thicker and consist of ash with a loamy texture with high organic content (CH2M Hill 1994e).

4.4 Hydrology

The prominent surface water features in the area include Reindeer Creek and an unnamed tributary about one mile north of the site. A lowland area with small shallow ponds begins about one mile south of the site and extends south another mile to Abbott Creek. The lowland drains to Bristol Bay and Port Heiden through unnamed streams and Abbott Creek. The overall surface water drainage of the area is to the west and Bristol Bay. The area surrounding the site consists of undulating moist tundra with no defined drainage patterns (CH2M Hill 1994e).

The Port Heiden site is in a permafrost free area. Groundwater beneath the site occurs in unconsolidated sediments at a depth of 20-35 feet. Groundwater is believed to recharge shallow ponds, lakes, and creeks in the area (CH2M Hill 1994e).

5.0 Ecosystem and the Biotic Environment Information

INRMP Chapter 5.0, *Ecosystems and the Biotic Environment* provides general information on biological resources on and near 611 ASG sites, which should be consulted with regard to Port Heiden site. Much information included in INRMP Chapter 5.0 that includes Port Heiden site is not repeated in this section.

The following subsections provide brief summaries of natural resources occurring on Port Heiden site and the surrounding area. ***Appendix 3.0-Driftwood***, Appendix A contains lists of vascular plants (Table A1) and birds (Table A2) on Port Heiden site. ***Appendix 3.0-Campion***, Appendix A contains lists of fish (Table A2) and mammals (Table A3) on Nikolski site. These species lists have been combined for brevity purposes. Threatened or Endangered Species that may occur at Port Heiden site are in INRMP Section 5.4, Table 5.4).

5.1 Ecosystem Classification

Domain: 100 Polar Domain
Division: 120 Tundra Division
Province: 126 Bering Tundra (Southern) Province
Description: This is a moraine- and outwash-mantled lowland province that rises from sea level to heights of 300-500 feet. Winters are cold, and summers are cool and short. Average precipitation is 13-34 inches. Dominant vegetation is moist and wet tundra communities. Inceptisols are dominant soils of the province; permafrost is sporadic or absent.

5.2 Vegetation

The Port Heiden site is primarily open, low shrub, and ericaceous tundra dominated by substantial areas of low willow scrub. Some natural patches of bare ground and previously disturbed areas covered with grass, are dominated by festuca species and herbs. Several small shallow ponds, small lakes, and creeks occur in the immediate area of the site and support various aquatic plant species.

The vegetation survey performed in association with development of the previous INRMP (Universe Technologies, Inc. and Gene Stout and Associates 2001e) identified 43 species during a 2000 site visit. A general vegetation map of the Port Heiden site has not been prepared. A NWI map (produced during 2000-2005) provides vegetation occurrence information and is on file in the 611 CES office. NWI wetland data are available for 2011 but have not been mapped for Port Heiden site.

5.3 Fish and Wildlife

5.3.1 Fish

Freshwater resources in the area of the Port Heiden site include Reindeer Creek (about one mile north), Barbara Creek (about five miles southeast), and Birthday Creek (about eight miles south). Reindeer Creek is used by sockeye salmon as a spawning area, and Barbara and Birthday creeks are used by chum salmon for spawning grounds. The streams and interconnected ponds and lakes provide habitat for pink, chum, and coho salmon, and Dolly varden trout. Coastal areas provide feeding areas for Pacific herring and habitat for chum, king, coho, and sockeye salmon (CH2M Hill 1994e).

5.3.2 Mammals

The Port Heiden area is used seasonally by brown bear, moose, and caribou. Caribou use calving grounds primarily south of Port Heiden on a plain between Bear River and Port Heiden Bay. Red fox, wolves, wolverine, river otter, mink, least weasel, ermine, muskrat, beaver, lemmings, porcupine, Arctic ground squirrel, and occasionally Arctic fox and lynx inhabit the area (EMCON Alaska, Inc. 1996b).

The Port Heiden area provides important habitat for harbor seals, sea otter, sea lions, and whales. These marine mammals are attracted by the large influx of salmon into the Meshik River system (CH2M Hill 1994e).

5.3.3 Birds

The Port Heiden area supports diverse and abundant marine species, including waterfowl and seabirds, that use marine waters for feeding and resting. Waterfowl and shorebirds also use numerous ponds and lakes in the area during yearly migrations. The Alaska Peninsula supports raptors, such as the Bald Eagle, Rough-legged Hawk, Harrier, Osprey, Merlin, Gyrfalcon, and Short-eared Owl. Willow and Rock Ptarmigan are abundant, and passerine species pass through in large numbers during seasonal migrations.

Bird species common to the site area include Semipalmated Plover, Pacific-Golden Plover, Lapland Longspur, Golden-crowned Sparrow, Common Redpoll, Yellow Warbler, Orange-crowned Warbler, Rock Sandpiper, Arctic Tern, Parasitic Jaeger, and Mew Gull.

5.4 Threatened and Endangered Species

Threatened Steller's and Spectacled Eiders and candidate Yellow-billed Loon are potentially on or near Port Heiden site. Known Steller's Eider winter and molting distribution (USFWS 2004a) includes areas near Port Heiden site. Steller's Eiders do not occur on the site proper; rather, they may occur in marine waters near the site. Endangered marine mammals that may be near the site include North Pacific right, bowhead, and fin whales and Steller sea lions. The threatened northern sea otter in southwest Alaska may be in waters near the site (USFWS 2011).

5.5 Wetlands

A substantial amount of wetland area is evident in the area surrounding the site. A NWI map specific to the site, completed during 2000-2005, provides wetlands information. NWI wetland data are available for 2011 but have not been mapped for Port Heiden site.

5.6 Other Natural Resource Information

5.6.1 Subsistence

The community of Port Heiden is about four miles southeast of the Port Heiden site. Due to cultural preferences and because of the expense of importing food, subsistence is a particularly important component of the Port Heiden economy. Participation in the subsistence harvest is nearly 100% and an integral part of intercommunity relations on the Alaska Peninsula. Port Heiden residents' subsistence harvests range from the Lower Cinder River in the north to the Ocean River drainage to the south. This area includes portions of the King Salmon River drainage and areas of the Cinder River drainage that overlap with harvest areas used by people from Pilot Point and Ugashik. Port Heiden residents also use areas on the Pacific Ocean side of the peninsula, including Aniakchak Bay and parts of the Chignik River system. Port Heiden has the least amount of resource area overlap of all communities in Southwest Alaska. Port Heiden Native Council members indicated to Air Force personnel in 2003 that the area of the former WACS site is used for berry picking and hunting of geese, caribou, porcupine and rabbit (Braund and Associates 2004).

5.6.2 Outdoor Recreation

Outdoor recreational activities are limited due to the location of the Port Heiden site. Access is limited with aircraft providing the only year-round access. Residents of Port Heiden use roads associated with the site to traverse the area and access other nearby areas. Recreational fishermen and hunters may access the Port Heiden area via the Port Heiden airfield.