U.S. Fish & Wildlife Service

Alaska Peninsula and Becharof National Wildlife Refuges

Contaminant Assessment

Cover Photo by Donna Dewhurst/USFWS

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Preface

Acknowledgements
Several people have contributed to this assessment. Their continual advice and support were essential for the completion of this project. I extend a special thanks to the personnel at the Alaska Peninsula and Becharof National Wildlife Refuges, especially Daryle Lons, Mark Koepsel, Gary Melvin, Darlene Melvin, Dave Cox, and Susan Savage. Additionally, I would like to acknowledge Philip Johnson for providing invaluable feedback throughout the development of this document. Other people I would like to thank include the following: Mike Boylan, Catherine Berg, Lenny Corin, Richard Hannan, Danielle Jerry, Warren Keogh, Andrea Medeiros, Rick Poetter, Ann Rappoport, LaVerne Smith, Jordan Stout, Kim Trust, and Laura Whitehouse.

Author's Notes

■Numerous sources were reviewed to create this document. Some of these sources include the following: Alaska Peninsula and Becharof National Wildlife Refuge Annual Refuge Narrative reports, Refuge contaminants files at the Anchorage Fish and Wildlife Field Office and the Fisheries and Habitat Conservation Regional Office, consulting firm documents, internal U.S. Fish and Wildlife Service documents, and various Internet sources. Additionally, a refuge visit was conducted from August 21–August 25, 2000.

■Some parts of this document have been duplicated in their entirety from other Service sources as needed. Special care has been taken to cite these sources when large portions of them have been incorporated into this document. Some of these sources include the Refuge annual narratives (various authors).

■All available Refuge narratives were reviewed extensively from a contaminants standpoint. The years reviewed for Becharof Refuge were 1979, 1981–1985 (1980 was missing). The years reviewed for Alaska Peninsula Refuge were 1981–1986. Starting in 1987, the Alaska Peninsula and Becharof Refuge annual narratives were combined into one comprehensive annual narrative. The years reviewed for this comprehensive narrative were 1987–1997 (1996 was missing). The narratives from 1998–2002 had yet to be completed upon compiling this assessment.

■Even though the Alaska Peninsula and Becharof are separate refuges, they are managed essentially as one comprehensive unit. In October 1982, Becharof and Alaska Peninsula Refuges were administratively combined. Throughout this document the Refuges will be referred to in the singular as the "Refuge."

Executive Summary

National Wildlife Refuges are typically envisioned as pristine havens for wildlife, and while these refuges provide vitally important habitat, many refuges also have contaminant issues. One aspect of maintaining environmental health on refuges is to assess contaminant threats to refuge lands and resources. The U.S. Fish and Wildlife Service (Service) utilizes the Contaminant Assessment Process (CAP) to document existing and potential contamination issues affecting refuges by assessing several factors including known/suspected contaminant sources, contaminated areas, contaminant transport pathways, and areas vulnerable to spills/contamination. By utilizing the CAP, a comprehensive inventory of known and potential contamination threats is developed. Assessment results allow Service personnel to understand contaminant issues affecting trust resources, prioritize necessary sampling and/or cleanup actions, develop proposals for future investigations, initiate pollution prevention activities, and incorporate contaminant issues into refuge Comprehensive Conservation Plans. The CAP was initiated for the 16 National Wildlife Refuges in Alaska in 1999.

Although many people think of Alaska as an untouched wilderness—the last frontier—Alaska is not immune to contaminant problems. In fact, its remoteness has contributed to its contaminant burden. Even the National Wildlife Refuges in Alaska are not impervious to contaminant threats, and many of them have significant contaminant histories. Past and current uses on refuge lands in Alaska have included a variety of activities including oil exploration and drilling, mining, military activities, and even nuclear weapons testing. After operations ceased, many sites were abandoned. Because costs to transport wastes and debris from remote Alaskan sites were considerable, entire facilities were commonly left intact or minimally cleaned. At some sites, hazardous materials were spilled with little or no subsequent cleanup. On many refuges in Alaska, abandoned 55-gallon drums dot the landscape. These abandoned drums rust through with time, releasing any contents to the surrounding environment.

Additionally, the physical transport of environmental contaminants in air and water currents and by migratory species from areas outside of Alaska may be a potential issue. Arctic and sub-arctic environments are especially vulnerable to long-range air and water transport of environmental contaminants. When contaminants reach Arctic regions, they have a tendency to "settle" due to decreased volatilization in colder climates. Additionally, these chemicals break down at a slower rate in colder climates. The Arctic regions essentially serve as a sink for these chemicals. Some environmental contaminants of particular concern within the Arctic are persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), dioxins, dichlorodiphenyl-trichloroethane (DDT), hexachlorocyclohexane (HCH), chlordane, toxaphene, mirex, and dieldrin; heavy metals, such as cadmium, mercury, and lead; polycyclic aromatic hydrocarbons (PAHs); and radionuclides.

This contaminant assessment report documents known and suspected contaminant threats to the Alaska Peninsula and Becharof National Wildlife Refuges (Refuge). Prior to and since its establishment, the Refuge has experienced a variety of activities that have introduced contaminants into the environment. This contaminant assessment report documents the main potential contamination sources and issues for the Refuge including oil and gas exploration, remote cabin sites, mining, marine spills, Formerly

Used Defense Sites (FUDS), development potential, recreational activities, wildlife die-off, biotic sources, and physical transport of contaminants. Primary sources of contamination identified by this assessment are past oil and gas exploration activities, remote cabin sites, and the *Exxon Valdez* oil spill.

Areas of concern, future sampling needs, and potentially contaminated areas have been identified in this report. The Refuge also could greatly benefit from more baseline studies, which assess contaminant levels in air, soil, sediment, water, and biota. Little data exist for establishing contaminant baseline levels on the Refuge. Baseline data would be helpful in assessing the impacts from potential contamination events on and near the Refuge. These data also could be used to establish the contaminant contribution from off-refuge sources, including biotic and physical transport mechanisms. Ideally, contaminant baseline studies would be conducted on all of the National Wildlife Refuges in Alaska, followed by periodic trend monitoring.

Several potentially contaminated areas exist on the Refuge. Some of these areas have documented contaminant issues, and cleanups have occurred in some areas; however, it may be beneficial to conduct additional sampling at these locations to determine if residual contamination is an issue. Other potentially contaminated areas have yet to be examined for contaminants. As a direct result of this contaminant assessment, six areas (denoted with * asterisks) were funded for further evaluation as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process. The following issues/areas/species are recommended for future inspection and/or sampling:

1) Oil Exploration Sites:

- Grammer No. 1 (page 11)
- Pacific Oil and Commercial Co. No. 1 and No. 2 (page 11)
- J.H. Costello No. 1 and No. 2 (page 11)
- Lathrop No. 1, McNally No. 1, Lee No. 1, Alaska Well No. 1, and Finnegan No. 1 (page 11)
- Island Bay/Jute Bay (page 12)
- Kanatak Village (page 16)

2) Remote Cabin Sites and Associated Debris:

- *Lower Ugashik Lake Cabin (page 24)
- *Egegik River Fisheries Cabin (page 26)
- *Trade and Manufacturing Site (page 28)
- *Subsistence Cabin (page 29)
- *Bible Camp (page 31)
- Scotty's Island (pages 33, 35)

3) Mining Sites:

- *Braided Creek Mining Site (page 36)

4) Coastal Areas:

- Potential residual contamination and effects from the *Exxon Valdez* oil spill and other marine spills (page 41)

5) Biotic Sources:

- Anadromous, migratory, and resident species to determine baseline contaminant concentrations and determine if biotic transport of contaminants is a concern (page 51)

6) Physical Transport:

- POPs, heavy metals, PAHs, and radionuclides transported atmospherically and by ocean currents (page 51)

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Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
AFWFO	Anchorage Fish and Wildlife Field Office
APBNWR	Alaska Peninsula and Becharof National Wildlife Refuge
ANILCA	Alaska National Interest Lands Conservation Act
ANCSA	Alaska Native Claims Settlement Act
AWQS	Alaska Water Quality Standards
BEST	Biomonitoring of Environmental Status and Trends
bgs	Below Ground Surface
BLM	Bureau of Land Management
BRD	Biological Resources Division
Bristol	Bristol Environmental and Engineering Services Corporation
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAP	Contaminant Assessment Process
CCP	Comprehensive Conservation Plan
cPAHs	Carcinogenic Polynuclear Aromatic Hydrocarbons
DDT	Dichlorodiphenyltrichloroethane
DEQ	Division of Environmental Quality
dry wt	Dry Weight
EC	Environmental Contaminant
EPA	Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
EVOS	*Exxon Valdez* Oil Spill
FUDS	Formerly Used Defense Sites
FY	Fiscal Year
HC	Hydrocarbons
HCH	Hexachlorocyclohexane
HLA	Harding Lawson and Associates
KNWR	Kenai National Wildlife Refuge
MAYSAP	May Shoreline Survey Assessment Program
mg/kg	Milligram/Kilogram
NPS	National Park Service

NOx	Nitrogen Oxides
NWR	National Wildlife Refuge
OCs	Organochlorines
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
ppb	Parts per Billion
ppm	Parts per Million
POP	Persistent Organic Pollutants
RCRA	Resource Conservation and Recovery Act
SUP	Special Use Permit
System	National Wildlife Refuge System
T&M	Trade and Manufacturing
TEPH	Total Extractable Petroleum Hydrocarbons
TPH	Total Petroleum Hydrocarbons
Service	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
WACS	White Alice Communication System

Contaminant Assessment Process

This blue goose, designed by J.N. "Ding" Darling, has become a symbol of the National Wildlife Refuge System.

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

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

National Wildlife Refuge System Improvement Act of 1997

The United States Fish and Wildlife Service (Service) is the only federal government agency whose primary mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. A primary way that the Service fulfills this important mission is to manage the country's National Wildlife Refuges, which encompass over 94 million acres. The mission of the National Wildlife Refuge System (System) "is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" [16 USC § 668dd(a)(2) (1998)]. It is the responsibility of the Service to "ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of the present and future generations of Americans" [16 USC § 668dd(a)(4)(B)].

One aspect of maintaining the environmental health of National Wildlife Refuges is to assess contaminant threats to refuge lands and resources by utilizing the Contaminant Assessment Process (CAP). Although many people envision wildlife refuges as pristine havens for wildlife, many refuges also have contaminant issues. The Contaminant Assessment Process was developed by the United States Geological Survey Biological Resources Division's (USGS/BRD) Biomonitoring of Environmental Status and Trends (BEST) Program and the Service's Division of Environmental Quality (DEQ). The Service utilizes the CAP to document existing and potential contamination issues affecting refuges by assessing several factors including known/suspected contaminant sources, known/suspected contaminated areas, contaminant transport pathways, and areas vulnerable to spills/contamination. By utilizing the CAP, a comprehensive inventory of actual and potential contamination threats is developed and entered into CAP's national database. Assessment results allow Service personnel to understand contaminant issues affecting trust resources, prioritize necessary sampling and/or cleanup actions, develop proposals for future investigations, initiate pollution prevention activities, and incorporate contaminant issues into refuge Comprehensive Conservation Plans (CCP). The CAP was initiated nationally on refuges in 1995–1996.

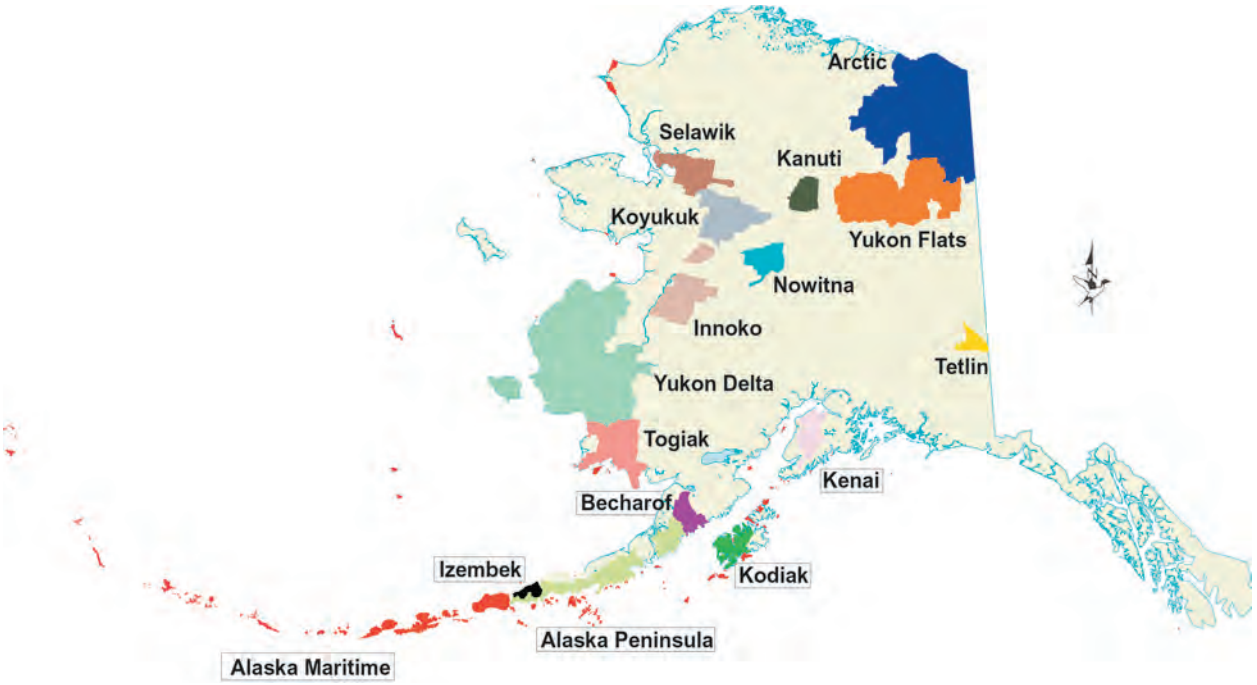
Utilizing the Contaminant Assessment Process in Alaska

In 1999, the CAP was initiated to evaluate contaminant issues for the 16 National Wildlife Refuges in Alaska (Figure 1). Most of the refuge lands in Alaska were established with the passage of the 1980 Alaska National Interest Lands Conservation Act (ANILCA). Section 304 (g)(1) (1980) of ANILCA mandates that a CCP be developed for each refuge, which includes identification and description of "significant problems which may adversely affect the populations and habitats of fish and wildlife" [ANILCA Section 304 (g)(2E) (1980)].

Approximately 82% of the National Wildlife Refuge (NWR) lands are in Alaska, totaling nearly 77 million acres. While the large size and remoteness of the refuges in Alaska present special challenges for utilizing and applying the CAP, valuable information about potential contaminant threats still can be gained by using this process.

Although many people think of Alaska as an untouched wilderness—the last frontier—Alaska is not immune to contaminant problems. In fact, its remoteness has contributed to its contaminant burden. Even the National Wildlife Refuges in Alaska are not impervious to contaminant threats, and many of them have significant contaminant histories. Past and current uses of refuge lands in Alaska have included a variety of activities including oil exploration and drilling, mining, military activities, and even nuclear weapons testing. After operations ceased, many sites were abandoned. Because of the high cost to transport wastes and debris from remote Alaskan sites, entire facilities were commonly left intact or minimally cleaned. At some sites, hazardous materials were spilled with little or no subsequent cleanup. On many refuges in Alaska, abandoned 55-gallon drums dot the landscape. These abandoned drums rust through with time, releasing any contents to the surrounding environment.

Figure 1. The 16 National Wildlife Refuges in Alaska



Graphics by USFWS.

The first refuge in Alaska to receive a contaminant assessment was the two million-acre Kenai National Wildlife Refuge (KNWR). A comprehensive report detailing contaminant issues on the Refuge was completed in January 2001. As a direct result of the KNWR assessment, a proposal for further site evaluation was submitted and funded as part of the fiscal year 2002 Refuge Cleanup Project Proposal process, and other investigations may be developed in the future. This report is available in hard copy, compact disc, and via the internet at http://alaska.fws.gov/fisheries/contaminants/process.htm. For further information about this report, please contact the Regional Office in Anchorage, Alaska at 907/786 3520.

Alaska Peninsula and Becharof National Wildlife Refuges

The next refuges in Alaska to receive a contaminant assessment were the Alaska Peninsula and Becharof National Wildlife Refuges (Figure 2). Throughout this document, these refuges will be referred to as the "Refuge." The generalized land status for the Refuge is depicted in Figure 3. The results of the contaminant assessment for the Refuge are presented in this report. In addition to this report, contaminant assessment data were entered into CAP's national database.

Figure 2. Approximate Location of the Alaska Peninsula and Becharof National Wildlife Refuges

Graphics by USFWS.

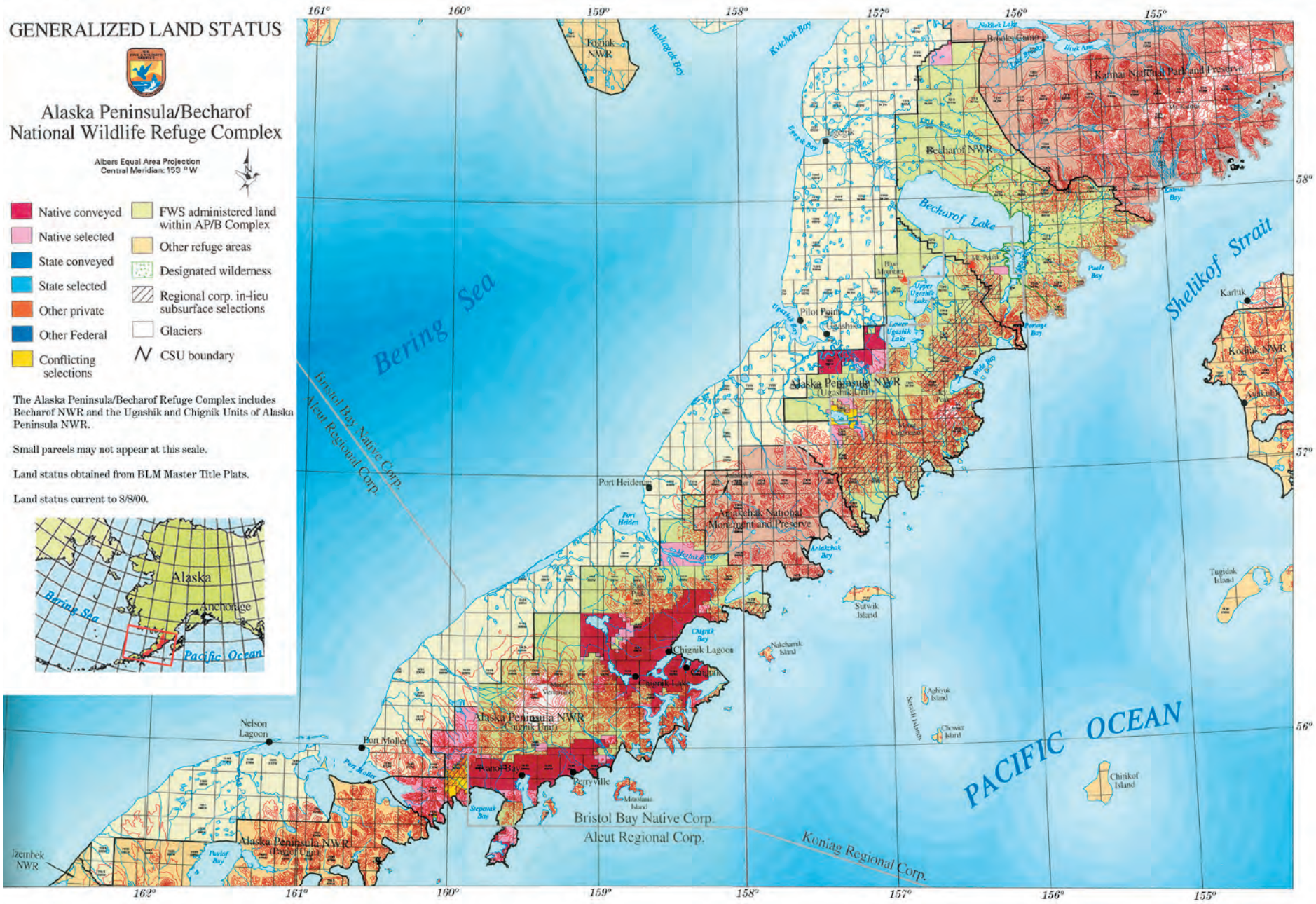
The following sections describing the Alaska Peninsula and Becharof Refuges are from the Alaska Peninsula/Becharof National Wildlife Refuge Annual Narratives:

Becharof National Wildlife Refuge

On December 1, 1978, President Jimmy Carter established the 1.2 million acre Becharof National Wildlife Monument by Proclamation 4613. The President established this monument due to the Alaska Peninsula supporting one of the densest known populations of the great Alaska brown bear and the area's unique volcanic activity and geology.

With the passage of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, Becharof National Wildlife Refuge was established. The Becharof National Wildlife Refuge is located 10 miles south of King Salmon and 295 miles southwest of Anchorage. The Refuge lies between Katmai National Park and the Alaska Peninsula

Figure 3. Generalized Land Status of Alaska Peninsula and Becharof National Wildlife Refuges



Region 7 Division of Realty/USFWS.

National Wildlife Refuge. Of the 1.2 million acres, approximately 400,000 acres is designated the Becharof Wilderness. The Refuge landscape consists of tundra, lakes, wetlands, and volcanic peaks. Becharof Lake, the second largest lake in Alaska, is nestled between the low tundra wetlands to the north and west and the Aleutian Mountain Range to the east and south. Mount Peulik drops to the edge of the lake about midway along its southern shore. The geologically active Ukinrek (Ookeenuk) Maars bares scars of the eruption that took place in 1977.

The lowest elevation on the west side of the Refuge is about 50 feet above sea level. The highest elevations on the Refuge are about 5,000 feet where the northern boundary crosses the Kejulik Mountains. The Kejulik River Valley, about six miles wide at Becharof Lake, splits the main trend of the Aleutian Range, separating the rugged Kejulik Mountains from the coastal range. A few glaciers are on slopes and upper valleys of higher peaks on the northeast boundary of the refuge.

Alaska Peninsula National Wildlife Refuge

With the passage of ANILCA in 1980, Alaska Peninsula National Wildlife Refuge was established. The Alaska Peninsula National Wildlife Refuge boundaries encompass about 4.3 million acres of land—an area bigger than the state of Connecticut. Stretching for nearly 340 miles along the Alaska Peninsula, the Refuge is subdivided into four units: the Ugashik, Chignik, Pavlof and North Creek units.

The Alaska Peninsula National Wildlife Refuge boundaries encompass about 4.3 million acres of land—an area bigger than the state of Connecticut.

The Ugashik Unit's northeastern boundary is about 60 miles south of the Refuge headquarters at King Salmon and 360 air miles southwest of Anchorage. It is bounded on the north by the Becharof National Wildlife Refuge and on the south by the Aniakchak National Monument and Preserve. The Chignik Unit bounds the Monument's southern boundary with the Pavlof Unit occupying the southwestern end of the Alaska Peninsula crescent. Izembek Refuge adjoins the unit's southwest corner.

Landforms of the Alaska Peninsula NWR include rugged mountain crests, rounded sub-summits, U-shaped valleys with sheer walls, sea cliffs and fjords, low tundra wetlands, glacial lakes, and moraines. The dominant geographical feature is the rugged Aleutian Range. Eleven major volcanoes, including seven that are active, are inside refuge boundaries. They range from 4,400 feet to 8,300 feet in elevation. Cinder beds radiate from eruptive centers in the volcanic systems, and the volcano slopes are covered with glaciers and summit ice fields.

The Refuge lands on the Bristol Bay side of the Range gradually slope toward the Bristol Bay coastal plain northwest of the mountains. The coastal plain terrain is flat, with lakes, and meandering streams. Remnants of glacial moraines provide the only local relief. Toward the tip of the Peninsula the southwestern half of the Refuge has fewer lakes and assumes a progressively narrower slope.

Alaska Peninsula and Becharof National Wildlife Refuges

The Refuge are an undisturbed continuum of sub-arctic ecosystems. A mission of the Refuge is to preserve and maintain these systems in their original state, allowing for natural processes to continue with minimal disturbance. Management is responsible for protecting and enhancing fish and wildlife and habitat resources, and for assuring that objectives and policies are met through program planning, evaluation, supervision and coordination.

Caribou on the Alaska Peninsula/Becharof National Wildlife Refuge. Donna Dewhurst/USFWS.

The Refuge's purposes were established by ANILCA. Becharof NWR purposes [ANILCA 302(2)(B)] include:

(i) "to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, brown bears, salmon, migratory birds, the Alaska Peninsula caribou herd and marine birds and mammals;

(ii) to fulfill international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; and

(iv) to insure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the refuge."

The Alaska Peninsula Refuge purposes [ANILCA 302(1)(B)] add, "moose, sea otters and other marine mammals, shorebirds and other

migratory birds, raptors, including bald eagles and peregrine falcons, and salmonids and other fish."

Becharof Lake and its tributary streams, the Ugashik Lakes, Black Lake, King Salmon Rivers (2), Dog Salmon River, Meshik River and Chignik River provide nursery habitat necessary for the five species of salmon that spawn in the Refuge. A major portion of the multi-million dollar salmon industry in Bristol Bay originates in Refuge waters. Dolly Varden, Arctic grayling, rainbow trout, five species of Pacific salmon and other fish are found in refuge streams.

The Refuge's fauna includes a large population of approximately 3,000 brown bears. Moose inhabit the area in moderate numbers and caribou use refuge lands for calving, insect escape habitat, migration and wintering. Other animals found include wolves, foxes, wolverines, and lynx. Sea otters, sea lions and harbor seals inhabit the shorelines, and nesting bald eagles, peregrine falcons, and thousands of seabirds inhabit the rocky sea cliffs of the Pacific coast.

The most prevalent nesting, migrating, and wintering waterfowl found on wetlands, lakes, and streams throughout the refuges include tundra swans, greater white-fronted geese, emperor geese, mallards, northern pintails, American widgeons, greater scaup, and harlequin ducks.

Winter conditions along the Pacific Coast of the Alaska Peninsula. Donna Dewhurst/USFWS.

The Refuge is superimposed over the rugged Aleutian Mountain Range. This volcanic mountain range contains numerous peaks that rise above 6,000 feet elevation. This creates a coast on the Pacific side that is rocky and heavily fjorded. The Refuge contains numerous volcanoes known to have erupted since 1760. They are part of a chain of volcanoes that rim the Pacific Ocean known as the "Ring of Fire." Mt. Veniaminof in the Chignik Unit is a designated National Natural Landmark.

The Alaska Peninsula is world famous for big game hunting. The Refuge is sub-divided into 23 big game guide-outfitter use areas with 29 special use permits issued for conducting big game guiding activities within these areas. The Refuge staff manages a large sport hunting program that balances the needs of unguided and guided sport hunters with the needs of subsistence users.

Approximately 2,000 local residents live in 12 villages within or immediately adjacent to the Refuge. The day-to-day human activities on the Refuge, many of which have deep cultural traditions, pose issues and demands that require sensitive considerations and innovative approaches to refuge administration.

Contaminant Sources and Issues

Prior to and since its establishment, the Refuge has experienced a variety of activities which have introduced contaminants into the environment.

This contaminant assessment report documents numerous potential contamination sources and issues for the Refuge including oil and gas exploration, remote cabin sites, mining, marine spills, Formerly Used Defense Sites (FUDS), development potential, recreational activities, wildlife die-off, biotic sources, and physical transport of contaminants.

Big game guide-outfitter camp on the Refuge prior to the "Take Pride in America" cleanup effort. Angela Terrell-Wagner/USFWS.

Oil and Gas Exploration

Natural oil seeps like this attracted oil prospectors to the Alaska Peninsula. Ronald E. Hood/USFWS.

Oil and gas exploration activities have occurred on the Refuge since the early 1900s, including gravimetric surveys, surface geology studies, and seismic exploration. These exploration activities resulted in the drilling of 27 oil and gas wells on the Alaska Peninsula, with 15 of these wells within the Refuge boundaries. All well holes from historical development are capped and sealed. The exploration companies, well names, well locations, well completion dates, total well depths, and Refuge unit where wells are located are presented in Table 1. Also, the locations of the wells are depicted in Figures 4 and 6. Currently, there is no oil or gas development on the Refuge. Additionally, there is no offshore oil and gas development off the coast of the Refuge and no on-shore support facilities. However, oil and gas development on the outer continental shelf of the Bristol Bay lowlands is a potential future issue.

An oil and gas assessment by BLM received on June 24, 1987, identified two areas of high oil and gas potential. According to the 1987 Refuge Annual Narrative, "One area of high potential extends along the Pacific Ocean coast from the northern boundary of Becharof Refuge to Ivanof Bay in the Chignik Unit of Alaska Peninsula Refuge. It extends inland to a line running southwestward through the middle of Becharof Lake to just southeast of Black Lake (Chignik Unit) and then swings eastward to the coast. The other area of high potential runs along the Bristol Bay/Bering Sea coast from approximately 20 miles southwest of Port Heiden (Chignik Unit) to Moffet Lagoon on Izembek Refuge."

Rolligons used to transport drilling rigs to seismic exploration sites in 1983. Glenn Elison/USFWS.

In the 1980s and 1990s, special use permits (SUPs) for oil and gas exploration activities were issued to various oil and gas exploration companies including Arco, Amoco, Exxon, Mobil, and Chevron. These companies surveyed surface geology, collected samples, and mapped results. In the summer of 1983 for example, an Amoco geologist was issued a SUP to collect a seep sample from Oil Creek on the Refuge's Pacific side.

During some of these oil exploration activities, Service personnel monitored on-the-ground activities and conducted baseline vegetation studies in an attempt to quantify habitat alteration by crews. One example of a biomonitoring effort occurred on an unnamed lake about 5 miles south of Jensen Strip. Prior to issuing Amoco a permit to use water for drilling and domestic purposes at their camp, four minnow traps were deployed to determine if anadromous fish used the lake and streams flowing into the lake.

Prior to 1987, Refuge staff had little opportunity to conduct on-the-ground site inspections at well sites; only limited aerial reconnaissance had been conducted over some of the well locations. During these overflight inspections, physical debris, such as collapsed buildings and 55-gallon drums, was discovered at some of the sites. The presence of this debris, along with the knowledge that most of these exploration activities occurred prior to enactment of many current environmental laws and regulations, prompted a contaminants investigation by the Service at several well sites in 1988. Some common contaminants associated with oil and gas

Table 1. Exploration Companies, Well Names, Well Locations, Well Completion Dates, and Total Well Depths for Alaska Peninsula and Becharof National Wildlife Refuges

Company	*Well*	*Location*	*Completed*	*Total Depth (feet)*	*Refuge Unit*
J.H. Costello	No. 1	Sec 10 NW 1/4, T29S, R40W	1903	728	Becharof
Pacific Oil and Commercial Co.	No. 1	Sec 3/36 NW 1/4, T28/29S, R40W	1903/1904	1,421	Becharof
Pacific Oil and Commercial Co.	No. 2	Sec 2/3 SE 1/4, T29S, R40W	1904	1,542	Becharof
J.H. Costello	No. 2	Sec 10 SE 1/4, T29S, R40W	1904	Unknown	Becharof
Tidewater Associated Oil Co.	Finnegan No. 1	Sec 30 NE 1/4, T29S, R40W	30 June 1923	569	Ugashik, Koniag Subsurface Selection
Standard Oil Co. of California	Lathrop No. 1	Sec 17 SE 1/4, T29S, R43W Latitude 57°40'34" Longitude 156°17'44"	1923/1925	500	Becharof, Koniag Subsurface Selection
Standard Oil Co. of California	McNally No. 1	Sec 29 NW 1/4, T29S, R43W Latitude 57°38'57" Longitude 156°18'24"	1925	510	Becharof, Koniag Subsurface Selection
Standard Oil Co. of California	Lee No. 1	Sec 20 SW 1/4, T29S, R43W Latitude 57°39'01.6" Longitude 149°18'09.5"	16 January 1926	5,034	Becharof, Koniag Subsurface Selection
Tidewater Associated Oil Co.	Alaska Well No. 1	Sec 20 SW 1/4, T29S, R43W	16 January 1926	3,033	Becharof, Koniag Subsurface Selection
Standard Oil Co. of California	Grammer No. 1	Sec 10 SE 1/4, T30S, R41/43W Latitude 57°35'57" Longitude 155°54'54"	30 March 1940	7,596	Becharof
Humble Oil and Refining Co.	Bear Creek Unit No. 1	Sec 36 NE 1/4, T29S, R41W	4 March 1959	14,375	Becharof
Pure Oil Co.	Canoe Bay No. 1	Sec 8 NE 1/4, T54S, R78W	27 October 1961/1963	6,642	Pavlof
Richfield Oil Co.	Wide Bay No. 1	Sec 5, T33S, R43/44W	24 October 1963	12,566	Ugashik
Phillips Petroleum Co.	Big River No. 1	Sec 15/8 SW 1/4, T49/54S, R68/78W	10 January 1976/1977	11,371	Chignik
Chevron Oil Co.	Koniag No. 1	Sec 2 SW 1/4, T38S, R49W Latitude 56°54'57" Longitude 157°02'43"	9 July 1981	10,907	Ugashik

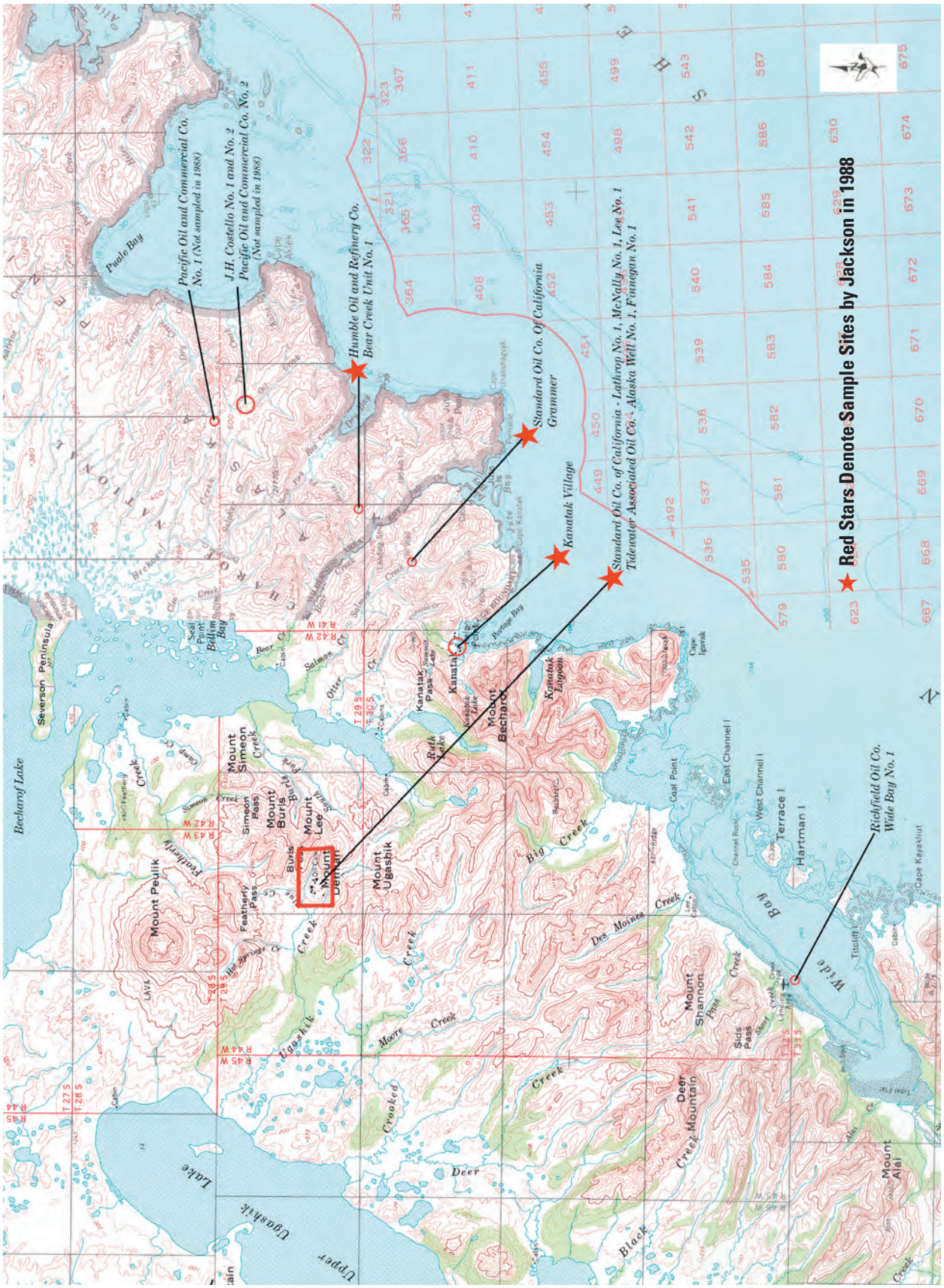


Figure 4. Approximate Locations of Wells Drilled on the Refuge

U.S. Geological Survey. Alaska Topographic Series. Ugashik and Karluk, 1:250 000.

The first comprehensive on-the-ground survey of oil and gas exploration sites conducted by Service personnel occurred in 1988.

exploration and development include petroleum hydrocarbons, pesticides, polychlorinated biphenyls (PCBs), and heavy metals.

1988 Oil and Gas Study

In coordination with Refuge staff, a 1988 oil and gas study was conducted by Rodney Jackson, a Service Contaminants Specialist. Jackson examined six locations (12 wells) where oil and gas exploration occurred on the Refuge. The objective of the study was to inspect as many well sites as possible and collect samples for contaminant analyses based on the conditions at each site. The locations examined are depicted in Figure 4. Soil and/or sediment samples were taken at four of the locations depicted by the red stars in Figure 4. Samples were analyzed for potential contaminants associated with oil and gas development, including organochlorines (OCs), polycyclic aromatic hydrocarbons (PAHs), trace elements, and metals. A complete listing of the analytes tested are presented in Appendix A.

Organochlorines were not detected in any of the samples and PAHs were undetectable or negligible from samples taken at Kanatak Village. However, some PAHs were found at 10 times the detection limit in samples from the Bear Creek site, with 2-methyl-napthalene and 2,6-dimethylnaphthalene being detected in three out of four samples. All metal samples were within normal ranges except for barium and silver, however, the quality assurance report from the laboratory indicated the silver results should not be used. All samples from Grammer and Bear Creek had elevated barium levels ranging from 618 parts per million (ppm) dry weight (dry wt) to 9,840 ppm dry wt. Jackson's 1991 report stated that high barium levels were found in the samples from Kanatak Village. The data presented in Jackson's report showed elevated barium in samples from Grammer and Bear Creek, however. The action level for barium was determined by Jackson (based on literature references at the time the study was conducted) to be 430 ppm in soil/sediment. The current Alaska Department of Environmental Conservation (ADEC) soil cleanup level for barium is 982 ppm for migration to groundwater. This is the most conservative, or protective, value based on the "Over 40 inch Zone" (an area that receives on average at least 40 inches of precipitation per year). For a summary on barium toxicity, please see http://risk.lsd.ornl.gov/tox/profiles/barium_f_V1.shtml.

The analytical results from these four sample locations indicate that some chemical contamination may have occurred at some well sites as a result of exploration activities. The actual risk, if any, to the environment is difficult to determine based on these limited samples. Perhaps most notable were other items discovered at these sites, which included collapsed buildings, hardened sacks of drill mud components, 55-gallon drums, and a landfill. Contaminants may be released to the environment from these and other possible sources at the well sites. Additionally, it may be beneficial to sample at the other two oil and gas exploration locations, which were not sampled in 1988, Pacific Oil and Commercial Co. No. 1 and No. 2 and J.H. Costello No. 1 and No. 2 (Figure 4, without red stars) and further characterize the area with the largest concentration of wells (Lathrop No. 1, McNally No. 1, Lee No. 1, Alaska Well No. 1, and Finnegan No. 1).

Unearthed 55-gallon drums at Island Bay, 1992. Ronald E. Hood/USFWS.

Island/Jute Bay Drum Cache

In 1988, during Jackson's contaminants investigation in locations where oil and gas exploration had occurred on the Refuge (see above), two caches of 55-gallon drums were discovered near the mouth of Jute Creek (Figure

Figure 5. Approximate Location of the Island Bay Drum Cache

U.S. Geological Survey. Karluk (C-6) Quadrangle, Alaska, 1: 63 360 series (Topographic).

5). The caches contained approximately 1,700 55-gallon drums; many were buried beneath the ground. A hydrocarbon sheen was apparent on the surface water in and around the area where the mostly empty drums were located. General Petroleum Corporation (a subsidiary of Mobil) built a dock and a road in the area to conduct oil exploration in the late 1950s, and Mobil agreed to remove the drum cache in June 1992. The cleanup was performed by Northern Exploration Services. During drum removal, Service personnel sampled soil and groundwater from and around the site to establish if residual contamination was an issue.

Crushing the drums from the cache, 1992. Ronald E. Hood/USFWS.

While the majority of the drums were empty, approximately 50 drums had minimal contents. When residues were found in the old rusty drums, they were transferred into new drums to prevent spillage. In June 1992 after the drum removal, Service personnel took 28 soil and 12 groundwater samples from 14 excavated pits where the drums had been stacked and in the general vicinity of the drum cache to determine if residual contamination could be detected. During a reconnaissance of this area prior to sample collection, a petroleum seep away from the cache area was discovered adjacent to the mouth of Jute Creek where it enters Island Bay. As a result of this discovery, three of the sampling pits were dug near the seep, and six soil samples and one water sample were collected. Two of these pits had a strong hydrocarbon smell, and the sand and gravel within the pits were gray and greasy up to six feet below the ground surface (bgs). All samples taken from the 14 pits were analyzed for aliphatic hydrocarbons, PAHs, and OCs; a complete listing of the analytes tested can be found in Appendix B.

Aerial view of the Island Bay drum cache and excavation. Ronald E. Hood/USFWS.

The results of the June 1992 sampling effort were summarized by Sonce de Vries and Mark Giger in a July 1998 Service Technical Report (WAES-TR-98-02) titled, *Contaminants Survey: Island Bay Barrel Cache, Alaska Peninsula and Becharof Refuge*. None of the analytes were detected in any of the groundwater samples. Petroleum hydrocarbons were detected in all of the soil samples, and estimated total petroleum hydrocarbon (TPH, measured as aliphatics, aromatics, and unresolved complex mixture) concentrations ranged from approximately 9 to 879 ppm dry wt. Additionally, organochlorines were detected in low concentrations in six of the soil samples.

While investigating the petroleum seep on the banks of Jute Creek, it was discovered that this site was also a helicopter refueling site during the *Exxon Valdez* oil spill cleanup. Fuel contamination was detected at the site during decommissioning, so it is plausible that the high TPH concentrations (123 to 879 ppm dry wt) discovered at this location are attributable to spillage while the site was used as a refueling station. Although Exxon performed some soil excavation at this site in 1991 and concluded in January 1992 that the site required no further action, the detection of high TPH in June 1992 suggested that more hydrocarbon contamination may be present than previously discovered. The Exxon refueling site is discussed in greater detail below.

Exxon's helicopter refueling site.
Ronald E. Hood/USFWS.

The Jute Creek/Island Bay areas provide essential habitat for numerous species including pink and chum salmon, brown bears, harbor seals, tufted puffins, horned puffins, harlequin ducks, surf scoters, black scoters, black turnstones, and water pipits.

Exxon Refueling Site

The helicopter refueling site was established by Exxon in May 1990 in Becharof National Wildlife Refuge in association with the *Exxon Valdez* oil spill cleanup. The refueling site was in the same area as the petroleum seep. In addition, Exxon stored some 55-gallon fuel drums on site during the 1989–1990 winter season without secondary containment. In May 1990, Exxon constructed the fuel storage and pumphouse containment areas on a gravel pad approximately 100 yards east of Jute Creek. The refueling site was demobilized by Exxon on August 27, 1990. The site contained a fuel storage containment area with two 850-gallon jet A fuel storage tanks, a pumphouse, and waste fuel drum within their own containment area. The containment areas were made with prefabricated pipe trusses and timbers and lined with Shelterite.

As part of their closeout procedure, Exxon hired Harding Lawson Associates (HLA) to conduct a site visit and collect soil samples at the site on August 28, 1990. According to Greg Hillyer, an Exxon fuel site consultant, no holes were discovered in the containment area liners during demobilization; however, minor leaks occurred during the demobilization process, and up to a quart of jet fuel may have been spilled inadvertently. HLA collected four soil samples at a depth of up to two inches bgs for total petroleum hydrocarbons analysis. Locations and sample results are displayed in Table 2. Only one sample, from beneath the pumphouse, had an elevated TPH concentration of 303 milligram/kilogram (mg/kg) dry wt. The ADEC soil cleanup level was calculated to be 100 mg/kg TPH for diesel and jet fuel based on ADEC guidance.

Table 2. Total Petroleum Hydrocarbon Results from August 28, 1990, at the Island Bay Fuel Cache/Helicopter Refueling Site Prior to Soil Excavation

Sample Number	*Location*	*TPH (mg/kg) dry weight*
RF3A	South end of containment area	20.0
RF3B	North end of containment area	14.3
RF3C	Beneath pumphouse	303
RF3D	Background sample	11.1

Due to the elevated petroleum levels, Exxon and HLA returned to the site on July 30, 1991, to determine the extent of contamination. A photoionization detector (PID) was utilized to screen soil for volatile organic compounds (VOCs). Based on the screening results, Exxon removed contaminated soils in an area approximately 5 feet by 5 feet by 3 feet deep. Water was encountered at 38 inches below ground surface, so removal activities ceased at the water level. The contaminated soil was placed in Geo-bags and transported off site for proper disposal. During this site visit, three samples were collected by HLA within the pumphouse containment area and analyzed for extractable petroleum hydrocarbons (EPH) as diesel (Table 3). One sample exceeded the calculated ADEC cleanup level of 200 mg/kg EPH, with an EPH concentration of 2,020 mg/kg.

Table 3. Extractable Petroleum Hydrocarbon Results from July 30, 1991, at the Island Bay Fuel Cache/Helicopter Refueling Site after First Soil Excavation

Sample Number	*Depth (inches)*	*EPH (mg/kg) dry weight*
IB1	36	143
IB2	6	2,020
IB3	6	33.2

Table 4. Extractable Petroleum Hydrocarbon Results from August 24, 1991, at the Island Bay Fuel Cache/Helicopter Refueling Site After Second Soil Excavation

Sample Number	*Depth (inches)*	*Description*	*EPH (mg/kg) dry weight*
IB4	31	Sand North Wall	ND
IB5	31	Sand Southwest Wall	ND
IB6	31	Sand Southeast Wall	ND
IB7	32	Sand Bottom	5,290

Exxon and HLA returned to the site on August 24, 1991, and excavation continued until the PID no longer detected VOCs along all four side walls of the excavation area. However, excavation stopped at a depth of only 32 inches bgs when water was encountered. Four soil samples were taken and analyzed for EPH as diesel (Table 4). One sample exceeded the calculated ADEC cleanup level of 200 mg/kg EPH, with an EPH concentration of 5,290 mg/kg. After collecting the samples, Exxon filled the excavation area with native soil from the western side of the site.

In January 1992, Exxon issued a letter to the ADEC and Service that recommended no further remediation or soil removal activities be conducted at the site. The Service issued a letter to Exxon dated February 1999 inquiring about further cleanup at this site. Currently, contaminant issues at this site remain unresolved.

Kanatak Village first appeared on a Russian map in 1849. However, archaeological evidence suggests the original inhabitants occupied the area around 500 to 900 years ago.

Kanatak Village

The historic Aleut village, Kanatak, is located at the head of Portage Bay on the Becharof National Wildlife Refuge (Figure 4). Historic Kanatak, known to Russian explorers as Kanatnoi, was established in the late 1890s. The 1890 census documented 26 Natives in seven families sharing two houses. Kanatak Village first appeared on a Russian map in 1849. However, archaeological evidence suggests the original inhabitants occupied the area approximately 500 to 900 years ago.

As a result of the passage of a 1920 Congressional oil leasing bill and a corresponding oil boom, Kanatak became the nearest town to oil exploration locations on the Alaska Peninsula (see Figure 4 for wells drilled in the vicinity of Kanatak Village). Due to oil exploration in the area, the village population increased to nearly 200 people between 1920 and 1922. The portage trail ran from Kanatak to Egegik, traversing the land on

which the Refuge now lies, connecting the East and West coasts of the Alaska Peninsula. In the 1940s, due to the lack of commercial quantities of oil and the subsequent departure of oil companies from Kanatak, many people started leaving the area. When the school and post office closed in the late 1940s and mid-1950s, respectively, Kanatak Village was abandoned. Most of the buildings were burned in the 1970s and 1980s, most likely due to arson. The Koniag Regional Corporation has selected most of the lands within Kanatak under Sec. 14(h)(1) of the Alaska Native Claims Settlement Act (ANSCA).

In June 1993, Service Environmental Contaminant (EC) staff conducted a contaminants survey at Kanatak Village to evaluate potential chemical contamination from historic oil exploration activities that were staged at the village. The investigation focused on areas within the village that were visibly disturbed. Thirty-four soil samples were collected in visibly disturbed and undisturbed (control) areas. Samples were analyzed for OCs (HCB, alpha BHC, alpha-chlordane, beta-BHC, dieldrin, endrin, gamma BHC, gamma chlordane, heptachlor epoxide, mirex, o,p'DDD, o,p'DDE, o,p'DDT, oxychlordane, p,p'DDD, p,p'DDE, p,p'DDT, toxaphene, trans-nonochlor, and aroclors 1242, 1248, 1254, 1260) and metals (Al, As, B, Ba, Be, Cd, Cr, Fe, Hg, Mg, Mn, Mo, Ni, Pb, Se, Sr, V, Zn). It does not appear that samples were analyzed for petroleum hydrocarbons.

For all samples, OCs were below the detection limit and metals were within the normal metal background range for Alaska (Gough et al. 1988). Based on the sample results from 1993, it was concluded that contamination did not appear to be an issue at this site. According to a May 1999 technical report by the Service based upon the 1993 data titled, *Further Investigation of Kanatak Village, Alaska Peninsula/Becharof National Wildlife Refuge,* "If the land is selected for conveyance to the Koniag Corporation, it may be transferred without prejudice due to contaminants." Hydrocarbon contamination may be an issue at this site.

1991 Reserve Pit Assessment

Historically at drill sites, unlined reserve pits typically served as storage for drilling muds, fluids, cuttings, and produced waters. Regulations adopted by ADEC in 1996 require formal closure of inactive reserve pits (also known as monofills). According to Underwood (1998), "monofills are single-use waste disposal sites that are permitted with the intent of disposing of solid wastes which are not regulated under the Resource Conservation and Recovery Act (RCRA) as a hazardous waste." According to the EPA's RCRA Orientation Manual (http://www.epa.gov/epaoswer/general/orientat/) under Subtitle C, "Certain wastes from the exploration and production of oil, gas, and geothermal energy are excluded from the definition of hazardous waste. These wastes include those that have been brought to the surface during oil and gas exploration and production operations, and other wastes that have come into contact with the oil and gas production stream (e.g., during removal of waters injected into the drill well to cool the drill bit)."

Numerous unlined reserve pits were utilized historically on the Refuge, all of which were backfilled, and today are difficult to locate.

Numerous unlined reserve pits were utilized historically on the Refuge, all of which were backfilled, and today are difficult to locate. A Service study conducted by Rodney Jackson (1990) on Kenai National Wildlife Refuge titled, *Report of Findings: Kenai National Wildlife Refuge Drill Mud Pilot Study*, assessed the migration potential of drill mud pit materials to surrounding soils. Jackson discovered elevated trace metal concentrations in some samples, but concluded that overall there was no

gross contamination. However, drilling-related materials buried in reserve pits still may be a potential contamination source.

In 1991, Woodward-Clyde Consultants conducted an assessment of reserve pit sites at Grammer No. 1, Koniag No. 1, McNally No. 1, Lee No. 1, and Lathrop No. 1. The scope of the assessment was limited to determining potential environmental risks associated with inactive reserve pits. Results from this study are summarized in Table 5. All of the well sites were located by Woodward-Clyde Consultants except for Lathrop No. 1. The actual reserve pits were not located at any of the well sites.

Table 5. Reserve Pit Results by Woodward-Clyde Consultants (1991)

Well Name	*Reserve Pit Found*	*Debris/Drums Observed*	*Samples Taken*	*Significant Sample Results*	*Reserve Pit Risk Conclusions by Woodward-Clyde Consultants*
Grammer No. 1	No	Small amount of wood and metal debris	1 background water sample and 1 well pad water sample	Total Ba 3.8 mg/L and Al 0.56 mg/L in well pad water sample	Basis of concern established. Risk is negligible.
Koniag No. 1	No	One bag of trash	None collected. No visual evidence of contamination.		No basis of concern. Risk is negligible.
McNally No. 1	No	Steam engine, some black solid material around the steam engine with a petroleum odor, collasped steel tank, tubulars, drill line, drilling machine and tools, lumber, metal sheeting, 16 55-gal drums (most empty, several with solidified material), collapsed wooden buildings	1 background soil sample, 1 soil sample from a downstream drainage ditch and 1 soil sample from black material at the steam engine	Total extractable hydrocarbons in black material was 46,000 mg/kg	No basis of concern. Risk is negligible.
Lee No. 1	No	Well cellars, collapsed wood building, stack of drill pipe, 30 55-gal drums, drill line, wood and metal debris, collapsed tank	None collected. No visual evidence of contamination.		No basis of concern. Risk is negligible.

Samples were taken only at Grammer No. 1 and McNally No. 1. Samples were analyzed for a variety of chemicals including PCBs, heavy metals, and total extractable petroleum hydrocarbons (TEPH). PCBs were not detected in any samples. Elevated total barium (3.8 mg/L) and aluminum (1.2 mg/L) were detected in the water sample from Grammer No. 1. The National Primary Drinking Water Standard Maximum Contaminant Level for barium is 2.0 mg/L (National Recommended Water Quality Criteria do not exist for barium). The National Secondary Drinking Water Standard for aluminum is 0.05 to 0.2 mg/L. The National Recommended Water Quality Criteria Maximum and Continuous Concentrations for aluminum are 0.75 mg/L and 0.087 mg/L, respectively. Elevated TEPH (46,000 mg/kg) was detected in the soil sample taken from some black material found at the steam engine at McNally No. 1. The ADEC Soil Cleanup Standard for TEPH is 100 to 2,000 mg/kg (based on cleanup thresholds for diesel, gasoline, and residual range petroleum hydrocarbons).

Although these assessments only evaluated risks associated with inactive reserve pits, Woodward-Clyde Consultants recommended further cleanup/investigation at some sites. For example, further investigation of the black material at McNally No. 1 was recommended. Additionally, they suggested removal of debris and drums at Grammer No. 1, McNally No. 1, and Lee No. 1.

Bear Creek Well Number 1 and Reserve Pit

Bear Creek Well Number 1 is located in the Becharof National Wildlife Refuge (Figure 4). This 14,474-foot exploratory well was drilled by Humble Oil and Refinery Company (now Exxon) in 1957 and was abandoned in 1959 because the well did not produce commercial quantities of oil. In addition to the well, a housing pad, shop pad, reserve pit, and pipe storage area were erected at this site.

During a site visit in 1988, it appeared that the remains of a reserve pit and debris were eroding into a stream flowing into Bear Creek, which is an important salmon spawning area.

1988 Site Visit

During the 1988 oil and gas study by Rodney Jackson, it appeared that the remains of a reserve pit and debris were eroding into a stream flowing into Bear Creek, which is an important salmon spawning area. Some of the items observed eroding into the stream were drill muds, 55-gallon drums, plastic, and other debris. Three soil samples were taken from the reserve pit. Samples were analyzed for organics and metals. No OCs were identified, but PAHs were detected (at levels below the control value). Elevated concentrations of barium (up to 4,420 ppm dry wt) were noted. Exxon removed debris and culverts from the site in 1990 and 1991.

1993 Site Visit

In 1993, Service personnel collected soil and sediment samples at the site, including two sediment samples within the reserve pit area noted in the 1988 site visit, to determine if residual contamination existed from past exploration activities. A total of 122 soil samples were taken from four areas, including the well, housing and shop pads, and an up-slope control site. A total of 15 sediment samples were taken from Bear Creek and the drainages beside the pads. It was noted that the two sediment samples taken from the stream cutbank, which intersected the reserve pit, were noticeably different than the other samples. The sediment in this area was pinkish in color, greasy, and smelled of hydrocarbons. A compilation of hardhats, cans, boots, and other debris were mixed in with this sediment material. Soil and sediment samples were analyzed for organochlorine pesticides, PCBs, PAHs, and metals.

Bear Creek, part of the Egegik River watershed, flows northwest into the Island Arm of Becharof Lake. Becharof Lake's Island Arm is rated among the highest quality fish and wildlife habitats on the Alaska Peninsula, and it has been identified as having "special value" to the Refuge under Section 304(g) of ANILCA.

1993 Soil Sample Results
Concentrations of total PAHs in soil samples were higher at the pads (0.07 ppm to 4.89 ppm) than at the control site (0.02 ppm to 0.59 ppm). All metal concentrations from the pad soil samples were within the range of the control sample concentrations or within documented background levels (Gough 1988), except for lead. Samples from the well pad had lead concentrations ranging from 10.93 to 181.97 ppm. The ADEC soil cleanup level for lead in soils in a residential area is 400 ppm. PCBs and organochlorine pesticides were not detected in any soil samples.

1993 Sediment Sample Results
Total PAH concentrations in sediment ranged from 1.66 ppm to 153.47 ppm. All metals analyzed were within normal background levels with the possible exception of zinc in two samples. These samples had zinc concentrations of 354.1 ppm and 361.1 ppm; values three times higher than the other samples, but considerably lower than the maximum background concentration of 2,700 ppm reported for Alaska. Only one sediment sample had detectable levels of total PCBs at 0.05 ppm. Organochlorine pesticides were not detected in any of the sediment samples. Two of the samples with the highest total PAH concentrations were taken from the reserve pit area and these samples also had the highest zinc concentrations. Additionally, one of these samples had the only detectable concentration of PCBs.

The results of the 1993 study were summarized by Service personnel, Sonce de Vries and Mark Giger, in a July 1998 report titled *Contaminants Survey: Bear Creek Well Number 1*. According to their report, further investigation should occur at this site to determine if there is a contaminant risk to wildlife.

1999 Reconnaissance
A reconnaissance of this site occurred on June 10, 1999, by Refuge, ADEC, and Exxon personnel. Shallow water (6 to 12 inches deep) covered about two-thirds of the reserve pit observed during previous site visits. Drilling wastes, such as lumber, plastic and metal debris, were exposed in several areas within the pit and sediment along the east edge of the pit created a sheen and odor when disturbed. It appeared that the reserve pit had been backfilled and graded, but a depression had formed due to the settling of the backfilled material, exposing the drilling wastes. The debris seen eroding into the stream during the 1988 and 1993 site visits could not be located. Four surface water samples were collected from the reserve pit (two samples total, one for quality control), down gradient from a channel at the east edge of the pad, and a background sample from a drainage creek north of the pad. Samples were analyzed for diesel range organics (DRO), benzene, toluene, ethylbenzene and xylene (BTEX), carcinogenic polynuclear aromatic hydrocarbons (cPAHs), and inorganics (As, Ba, Ca, Cr, Pb, Mg, Ni, Na, and Zn). DRO, BTEX, and cPAHs were not detected at or above the method detection limits. However, two samples collected at the reserve pit exceeded the Alaska Water Quality Standard (AWQS) for lead. The AWQS for lead is based on water hardness, and the standard for this site was calculated to be 0.54 parts per billion (ppb). The lead concentrations of the samples were 1.58 and 1.61 ppb. All other metal concentrations were below the AWQS.

Reconnaissance to Bear Creek Well Number 1 in June 1999. USFWS.

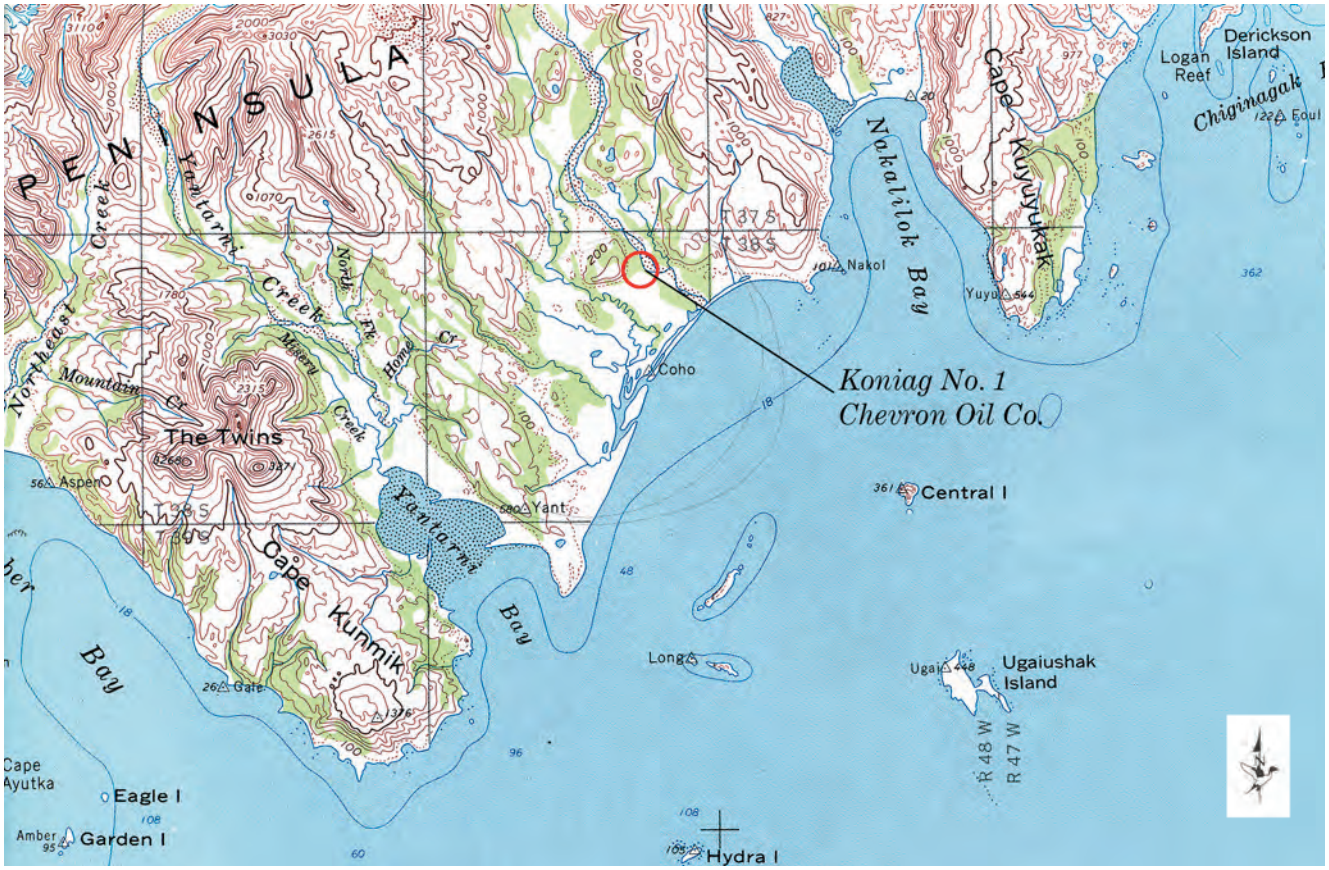
The closure plan by Exxon's consultant, Harding Lawson Associates, *Closure Plan Exxon Inactive Reserve Pit Bear Creek Unit 1 Near King Salmon, Alaska (January 2000)*, proposed further site characterization with additional sampling (a risk assessment may be necessary) and removal of solid waste from the site. The plan also stated that further

corrective action may be necessary depending on the risk assessment results. Exxon's consultant, ENSR, conducted a risk assessment in 2001 evaluating the lead concentrations and hydrocarbon sheening at the site and determined they did not pose a risk to wildlife. The ADEC and Service have approved the closure plan for this site, but the Service reserved the right to have Exxon re-initiate cleanup activities if site conditions change.

Koniag Number 1

On May 27, 1992, a Level II contaminants survey was conducted by Service EC staff at the abandoned oil exploration well, Koniag Number No. 1, at the Yantarni airstrip (Figure 6). The well was drilled by Chevron in 1981 while the land was conveyed to Afognak Native Corporation and Koniag Inc. Apparently, commercial quantities of oil were not discovered and the well was abandoned by Chevron in late 1981.

Figure 6. Approximate Location of Koniag Number 1



U.S. Geological Survey. Alaska Topographic Series. Sutwick Island. 1: 250 000.

Due to the history of the site and the presence of a drill mud pit, a Level II survey was necessary to determine if contaminants were an issue at the site prior to acquisition (Secretarial Order #3127, December 15, 1988). The mud used onsite was chromium lignosulfate-based, so barium and chromium were the primary contaminants of concern. Service EC staff took five soil and four surface water samples at the site on May 27, 1992. Soil samples were taken from an area determined to be the mud pit up to a depth of 12 feet below ground level and water samples were taken down slope from the well site. Samples were analyzed for barium, chromium, and a suite of other metals. It was difficult to discern from the literature concerning this site other contaminants that were analyzed. Barium and chromium detected in soil samples were all below existing state and federal criteria. Barium and chromium were not detected in the surface water samples. Other metals were not detected at a level of concern.

Summary: Oil and Gas Exploration

Oil and gas exploration activities have occurred on the Refuge since the early 1900s. These exploration activities resulted in the drilling of 15 wells within the Refuge boundaries. Due to contamination associated with exploration activities, site assessments and cleanup activities have occurred at some of these sites. Because few on-the-ground surveys have been conducted, it is recommended that further evaluation occur at the following locations:

- Grammer No. 1 (page 11)
- Pacific Oil and Commercial Co. No. 1 and No. 2 (page 11)
- J.H. Costello No. 1 and No. 2 (page 11)
- Lathrop No. 1, McNally No. 1, Lee No. 1, Alaska Well No. 1 and Finnegan No. 1 (page 11)
- Island Bay/Jute Bay (page 12)
- Kanatak Village (page 16).

Remote Cabin Sites and Associated Debris

Prior to Refuge establishment and throughout the history of the Refuge, over one hundred permanent cabins and temporary structures, usually associated with game hunting, fishing, and guiding, have been established on Refuge lands. Some of these structures are inholdings, others are permitted structures on Refuge lands, and others are illegal non-permitted structures. Due to the remoteness of these structures and the logistics/cost of removal, debris has accumulated at many of these locations. Some of the debris found at these cabin and tent sites include old cars, refrigerators, 55-gallon drums, 5-gallon gas cans, batteries, and other assorted trash. Additionally, landfills often are located onsite. Due to the extensiveness of the problem, Refuge staff initiated helicopter and on-the-ground cabin surveys and inspections in the 1980s. Cabin locations, cabin dimensions, land ownership, site conditions, special use permit compliance, etc., are maintained in a database at the Refuge headquarters in King Salmon, Alaska. Because cabin and tent sites are numerous, and tent site locations (temporary/seasonal camps) change frequently, it is beyond the scope of this contaminant assessment to detail information about each site. This assessment focuses on sites that required extensive cleanup activities and sites sites that should be cleaned up in the future.

Cleanup at Mother Goose Lake in 1989.
Ronald E. Hood/USFWS.

A program established in the 1980s called "Take Pride in America/Alaska" resulted in cleanup at several of these debris-ridden sites. The Refuge greatly benefited from this program, which was discontinued in 1993 and subsequently reinstated in 2003. Some of the past cleanups at cabin sites have included:

- 1989—Excavation and removal of in excess of 900 5-gallon fuel cans, 40 55-gallon drums, one game observation tower, and other assorted trash in the Mother Goose Lake area.

- 1992—Removal of 1,344 5-gallon cans at a base camp on the upper reaches of Dog Salmon River.

- 1992—Removal of 800 pounds of trash and debris from a site nine miles west of Mother Goose cabin at the west end of a 300+ acre unnamed lake.

Historic and current cabin and tent sites located throughout the Refuge remain potential contamination sources. The most likely sources of contamination are motor fuels (gas and diesel), heating fuels (kerosene and fuel oil), lubricants, and lead and acid from batteries.

During a Refuge visit in conjunction with the CAP, several sites with potential contamination were visited by Service staff from the Refuge and Regional Office on August 22, 2000. Service personnel visited a cabin on Lower Ugashik Lake; the Egegik River Fisheries Cabin; a Trade and Manufacturing site adjacent to Becharof Lake and the Egegik River; a subsistence cabin on the Egegik River and the surrounding area; and Bible Camp on Becharof Lake. A description of potential contaminant issues discovered during the visits, photos, and maps of each site are presented below and in Appendix C. As a result of this contaminant assessment, a fiscal year 2002 Refuge Cleanup project proposal for more

detailed sampling and assessment work was submitted and funded for these sites. During summer 2002, Platt Environmental conducted a Phase II Environmental Due Diligence Audit (EDDA) at each location. Specific cleanup actions at these sites will be determined in the future. Future actions will depend upon site history, land status, degree of contamination, funding availability, and other factors.

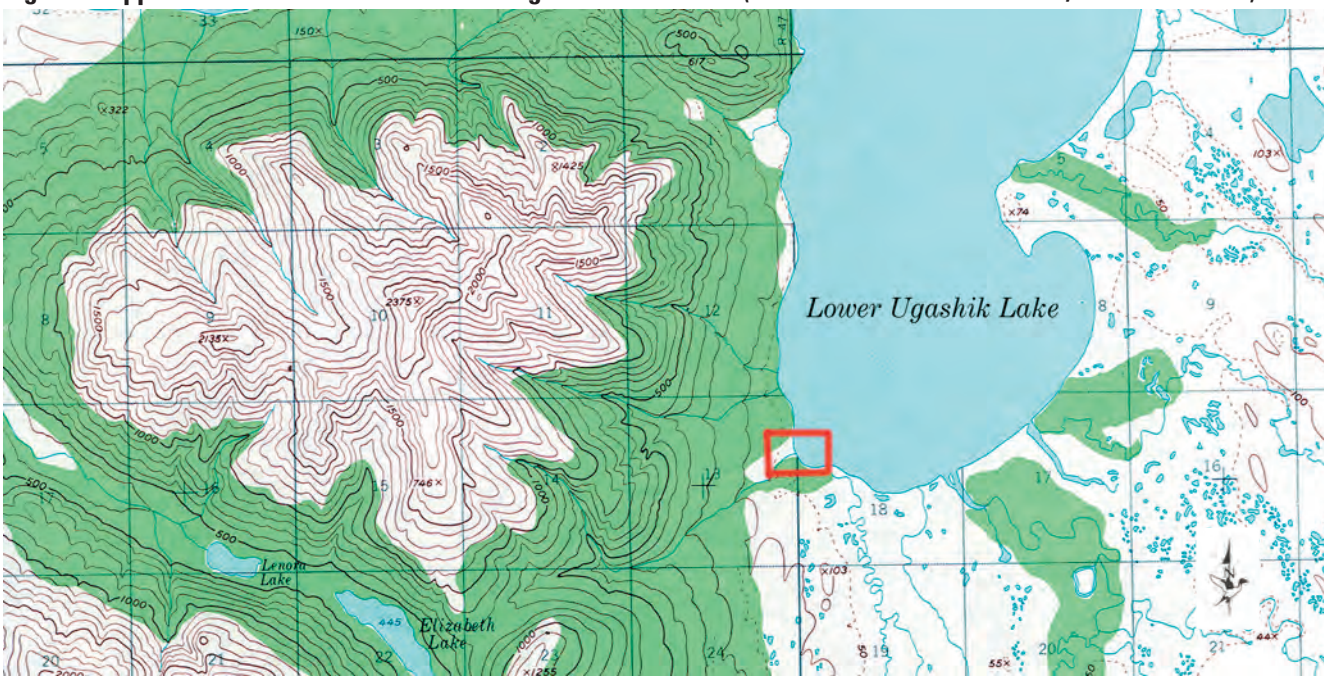
Spill area at Lower Ugashik Lake cabin (approximately 2 feet by 2 feet). Gary Melvin/USFWS.

Lower Ugashik Lake Cabin

The cabin complex, acquired by the Service in 1998, is near Lower Ugashik Lake, approximately 88 miles south of King Salmon on the Alaska Peninsula NWR (Figure 7). On July 24, 1997, a Level I Preacquisition Survey was conducted at the site, and while abandoned drums were observed, no spills were noted. Refuge and EC staff visited this site in August 2000 during investigations associated with the Contaminant Assessment Process.

During the August 2000 visit (Appendix C), a small petroleum spill was observed at the watchtower, accompanied by a strong hydrocarbon smell. A pronounced hydrocarbon smell was also noted at the generator shed, indicating the possible presence of spilled petroleum products. Most of the structures are located away from the lake, but the generator shed is within a few feet from the Lower Ugashik Lake shoreline. Numerous drums were scattered throughout the property, but it was unknown if any had contents. A workshop/parts room contained various materials, including paint, engine oil, etc., that need to be removed and disposed of properly. The fuel and storage areas, as well as the main cabin, may also contain items requiring proper disposal. The buildings had never been evaluated for lead paint or asbestos containing materials (ACM). Extensive vegetation and limited time precluded a more comprehensive investigation.

Figure 7. Approximate Location of the Lower Ugashik Lake Cabin (N 57°25.18.63 W 156°49.18.01, Datum WGS-84)



U.S. Geological Survey. Ugashik (D-1) Quadrangle, Alaska, 1: 63 360 Series (Topographic).

As a result of the CAP, a proposal for a more extensive site characterization was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

During summer 2002, Platt Environmental conducted a Phase II EDDA at the site. Platt Environmental assessed several potential contaminant sources including hydrocarbons, lead-based paint, metals, asbestos, household and workbench hazardous wastes, and non-regulated wastes. The findings by Platt Environmental (2002) were:

Fuel shed at Lower Ugashik Lake cabin. Gary Melvin/USFWS.

Hydrocarbons: No hydrocarbon releases were found at the site, although several sources for potential releases were investigated. There were 20+ 55-gallon drums scattered around the cabin area. Some drums contained up to 90% liquid, including 55 gallons of leaded fuel and 250 gallons of old watery fuel mixed with oil. Other liquids tested were determined to be gasoline, heating fuel, and camp stove oil. There were 57 discarded 5-gallon gas cans and nine discarded 5-gallon cans of Blazo fuel scattered throughout the various structures and on the property. Many of these had been placed inside the generator shed. Also, the fittings to the oil heaters that heat the cabin were determined to be possible sources of hydrocarbon contamination. Eleven soil samples were screened for hydrocarbons including GRO, DRO, RRO, and BTEX. DRO was detected in two samples, RRO was detected in every sample, and xylenes were detected in one sample. However, all soil hydrocarbons concentrations were below ADEC cleanup levels.

Lead-Based Paint: The main cabin and the surrounding structures (bunkhouse, outhouses, generator shed, and boat storage shed) were painted with lead-based paint. Additionally, two 55-gallon drums of lead-based paint cans were found. Two paint samples, one from the interior walls and one from the exterior walls of the main cabin, were tested for lead. Lead was detected in both of the paint samples, which exceeded the ADEC "presence/absence" standard for lead. The white interior paint of the main cabin contained lead at 130 mg/kg, and the brown and green exterior paint of the main cabin contained lead at 131 mg/kg.

Metals: Eight metals (Hg, As, Ba, Cd, Cr, Pb, Se, and Ag) regulated under the Resource Conservation and Recovery Act (RCRA), were analyzed in one soil sample and lead was analyzed in two additional soil samples. All soil samples for metals were below ADEC cleanup levels.

Asbestos: Five samples were taken for asbestos analysis from the main cabin. Samples were taken from linoleum, black roofing paper, ballast caulk on the windows, and the ballast of the fluorescent lights. The kitchen linoleum had 30% asbestos containing material (ACM); the other four asbestos samples did not have ACM. The EPA threshold level for asbestos is 1%.

Household and Workbench Hazardous Wastes: Insect repellent, rat poison, outboard oil, paint, paint thinner, marine resin, fuel, antifreeze, caulk, and batteries were found at the site. These items must be properly disposed of as wastes when no longer in use.

Non-Regulated Wastes: Items found were the remains of wooden (2), fiberglass (2), and aluminum (2) skiffs, boat trailers (2), outboard motors (4), fishing gear, empty 55-gallon burn barrel, miscellaneous food items, bags of household trash, beds/bedding, old chairs, and other household fixtures.

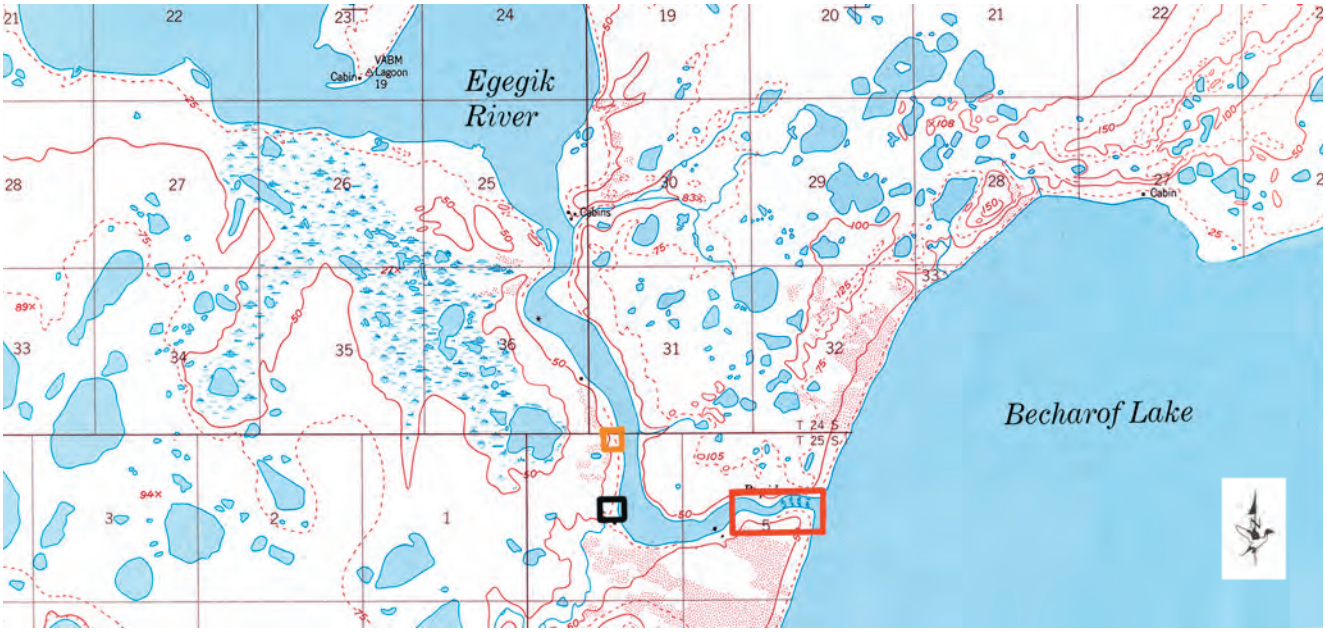
Egegik River Fisheries Cabin

The cabin is located on the Egegik River downstream of Becharof Lake, approximately 47 miles south of King Salmon (in orange, Figure 8). The Bureau of Commercial Fisheries built the wood frame weir cabin in 1932, and an addition was constructed in 1952. The cabin was transferred from the Bureau of Commercial Fisheries to the Alaska Department of Fish and Game (ADF&G) on February 28, 1961. The ADF&G is the current owner of the cabin, while the Service manages the land where the cabin is located. Throughout the 1990s, the Service issued ADF&G SUPs to use the site. ADF&G staff has used the cabin for approximately the last 40 years to conduct fisheries management and research activities from May until July.

While the cabin is owned and operated by ADF&G, Service personnel also have used the cabin on limited occasions. From August to September 1993, Service staff from the Fisheries Office in King Salmon used the cabin to conduct a salmon count and creel survey. During the summers of 1994 and 1995, ADF&G and Service staff from the Fisheries Office in King Salmon were co-located in the cabin, conducting fisheries studies. The ADF&G provided equipment, gear and support services for the studies. From late July through the middle of September in 1999 and 2000, Service staff from the Refuge used the cabin to conduct a public use study.

While conducting the public use survey in July 1999, Service staff noticed a strong fuel oil smell at the cabin. However, it was not until July 2000, when Service staff were trying to level the addition of the cabin and perform some foundation work, that an extensive fuel oil leak was discovered. While digging under the addition, it was discovered that fuel oil had saturated and penetrated the ground for at least four feet below the cabin. Service staff disconnected the 55-gallon fuel oil tank on July 24, 2000 and replaced

Figure 8. Approximate Location of the Egegik River Fisheries Cabin (orange box; N 58º02.56.90 W 156º52.42.29, Datum WGS-84), Trade and Manufacturing Site (red box; N 58º02.00.48 W 156º52.05.79, Datum WGS-84), Egegik River Subsistence Cabin (black box; N 58º02.17.48 W 156º52.35.11, Datum WGS-84)



U.S. Geological Survey. Ugashik (D-1) Quadrangle, Alaska, 1: 63 360 Series (Topographic).

it with a propane fuel supply. The fuel leak appears to be quite extensive and likely has occurred for an unknown number of years.

The cabin and associated fuel leak are located on a bluff approximately 50 feet from the Egegik River, the most important river for salmon migration on the Refuge, with 1 to 2.5 million sockeye salmon migrating upriver each year. Additionally, the Egegik River is the second most extensively fished river on the Refuge. Depending on the hydrology of the area and the depth of the fuel contamination, it is possible that fuel already has or eventually may enter the river via groundwater or stormwater runoff. Additionally, this could be a human health and safety issue for cabin occupants.

Refuge and EC staff also visited this site in August 2000 during investigations associated with the CAP (Appendix C). Soil staining was observed at the site, but it was difficult to determine the total impact area because the cabin is situated over the spill area, and the depth of the spill was unknown. As a result of the CAP, a proposal for further site evaluation was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

During summer 2002, Platt Environmental conducted an Environmental Phase II EDDA at the site. Platt Environmental assessed several potential

Location of fuel spill at Egegik River Fisheries cabin. Gary Melvin/USFWS.

The Egegik River is the most important river for salmon migration on the Refuge, with 1 to 2.5 million sockeye salmon migrating upriver each year.

contaminant sources including hydrocarbons, lead, asbestos, workbench hazardous wastes, and non-regulated wastes. Summary by Platt Environmental (2002) follows:

Hydrocarbons: It is unclear whether ADF&G still uses fuel oil heating at this site. During the Environmental Phase II EDDA in summer 2002, Platt Environmental noted that the cabin was heated with heating fuel, contained in a 55-gallon heating fuel drum. Although a release was previously documented at this site, Platt's field screening and analytical results, further confirmed this release. Four soil samples were collected three feet bgs at the fuel release next to the cabin and analyzed for GRO, DRO, RRO, and BTEX. All of the soil samples had detectable levels of DRO and RRO, and three samples exceeded the ADEC cleanup level of 100 ppm for DRO at 285, 1,310, and 1,930 ppm. Approximately 200 cubic yards of soil have been contaminated by the spill.

Lead: The cabin's tongue and groove exterior and its plywood interior were painted with lead-based paint. A wooden fishing skiff painted with lead-based paint is located within 20 feet of the main cabin. The paint has chipped off from the boat and now is a contaminant in the soils around the skiff, resulting in approximately 2.5 cubic yards of lead contaminated soils. Four paint samples were tested for lead-based paint including the exterior brown paint on the bunkhouse, interior white paint on the bunkhouse, exterior red paint on the outhouse, and exterior tan over white paint on the bunkhouse door. All samples exceeded the ADEC "presence/absence" standard for lead, with the following lead concentrations: exterior brown paint on the bunkhouse (2,900 mg/kg), interior white paint on the bunkhouse (7,800 mg/kg), exterior red paint on the outhouse (3,500 mg/kg), and exterior tan over white paint on the bunkhouse door (1,600 mg/kg). Four soil samples were collected to test for lead next to the main cabin, outhouse, storage shed, and wooden boat. Although lead was detected in all the soil samples, only the sample collected next to the wooden boat (1,870 mg/kg lead) exceeded the ADEC lead level for soils of 400 mg/kg.

Asbestos: Three samples were collected to test for ACM. Sample locations included insulation on the electrical wires, backsplash against the kitchen wall, and roofing from the bunkhouse. No ACM were found in the three samples.

Workbench Hazardous Wastes: Spray paint and outboard oil were observed at the cabin. These items must be properly disposed of as wastes when no longer in use.

Non-Regulated Wastes: These wastes included various wood debris, remains of an old wooden boat, mechanical hoist, empty 55-gallon burn drum, and fishing gear.

Cabin at the Trade and Manufacturing site. Tiffany Parson/ USFWS.

Trade and Manufacturing Site

The Trade and Manufacturing (T&M) site is located in the Becharof Refuge, approximately 47 miles south of King Salmon (in red, Figure 8). It borders Becharof Lake, the second largest lake in Alaska, and the Egegik River. This site was established in 1977 as an unguided hunting/fishing camp. Improvements included a small cabin, garage, tent sites, and outhouse. The site was not used during 1978, and it appears not to have been used since then. A patent application for a trade and manufacturing operation at this site was submitted to the Bureau of Land Management (BLM) in 1973. There is a subsequent long history of judicial cases and

appeals regarding this application. The T&M application was approved by the BLM, but the U.S. Department of the Interior's Board of Land Appeals overturned this decision in 1998. The same Board denied a petition for reconsideration in 1999.

Refuge and EC staff visited this site in August 2000 during investigations associated with the Contaminant Assessment Process (Appendix C). Debris at the site included old building remains, containers in a wooden garage structure, and an abandoned four-wheel drive vehicle. Some scattered fuel cans and other miscellaneous items also were located in the area. As a result of the CAP, a proposal for further site evaluation was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

During summer 2002, Platt Environmental conducted an Environmental Phase II EDDA at the site. Platt Environmental assessed several potential contaminant sources including hydrocarbons and vehicles, lead, asbestos, household and workbench hazardous wastes, and non-regulated wastes. The results by Platt Environmental (2002) are as follows:

Abandoned vehicle near the Trade and Manufacturing Site. Gary Melvin/ USFWS.

Hydrocarbons and Vehicles: The remains of a vehicle can be found approximately 30 yards upriver from the site. The vehicle's oil pan appears to be intact and likely contains oil. A battery is located inside the vehicle. An abandoned three-wheeler with gasoline in its tank is located between the T&M site and the subsistence cabin. One soil sample was collected 6 inches bgs under the vehicle to test for hydrocarbons, including GRO, DRO, RRO, and BTEX. Only RRO (38.8 mg/kg) was detected in this sample and was far below the ADEC RRO cleanup level of 2,000 mg/kg.

Lead: One paint sample was collected from the blue over white paint on the cabin door to test for lead. This sample contained 1,000 mg/kg lead, which exceeded the ADEC "presence/absence" standard for lead. One soil sample was collected under the cabin door to test for lead, and although lead was detected in this sample (3.81 mg/kg), it was far below the ADEC lead level in soils of 400 mg/kg.

Asbestos: Because there was no indication of ACM, no asbestos samples were taken.

Household and Workbench Hazardous Wastes: Coleman fuel, miscellaneous household wastes, and an auto battery were found. These items must be properly disposed of as wastes when no longer in use.

Non-Regulated Wastes: Wood debris, empty white gas cans, and vehicle remains were present.

Subsistence Cabin

This subsistence cabin, located along the banks of the Egegik River, was built in 1967 (in black, Figure 8) and adjoins the T&M site and the Egegik River Fisheries cabin approximately 47 miles south of King Salmon. When the Refuge was created in 1980, this cabin was originally believed to be outside the Refuge boundary. However, it was discovered in 1995 that this property was actually inside the boundary. Upon discovery, the Refuge manager contacted the cabin owner and explained that the cabin was located on the Refuge and its continued use would require a SUP. The cabin is currently used for subsistence activities under a SUP.

Subsistence cabin along the banks of the Egegik River. Tiffany Parson/ USFWS.

In the 1990s, the Refuge apparently cleaned up a large number of old fuel cans and drums at this site. Refuge and EC staff visited this site in August 2000 during investigations associated with the CAP (Appendix C). A few scattered drums and 5-gallon fuel cans were located at the cabin along with miscellaneous debris, including an old snow machine. Contents (if any) of these drums and cans were unknown. As a result of the CAP, a proposal for further site evaluation was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

During summer 2002, Platt Environmental conducted an Environmental Phase II EDDA at the site. Platt Environmental assessed several potential contaminant sources including hydrocarbons, lead-based paint, asbestos, vehicles, and non-regulated wastes. The findings by Platt Environmental (2002) include:

Hydrocarbons: Several 55-gallon drums are scattered throughout the property; some contained approximately 4" of rusty water and hydrocarbon residue. Several 5-gallon cans were scattered throughout the area. These cans have no liquid, but have possible hydrocarbon residue. A 55-gallon drum of heating fuel is used for heating the cabin. Field screening and sampling results indicate a fuel release around the heating fuel drum storage area, resulting in approximately 200 cubic yards of hydrocarbon contaminated soil. Six soil samples were collected and analyzed for hydrocarbons, including GRO, DRO, RRO, and BTEX. Although GRO, DRO, RRO, and/or toluene, ethylbenzene, and xylenes were detected in all of the samples, four out of the six soil samples exceeded the ADEC cleanup levels for GRO, DRO, and/or RRO (Table 6).

Table 6. Selected Hydrocarbon Results at the Subsistence Cabin from Platt Environmental (2002)

Soil Sample Number	*Sample Location*	*GRO (mg/kg)*	*DRO (mg/kg)*	*RRO (mg/kg)*
ADEC Cleanup Level A		50	100	2,000
02USFWSMC-0731-02	8" bgs under the heating fuel drum	263*	25,550*	2,190*
02USFWSMC-0731-03	2' from the heating fuel valve at 4' bgs	242*	11,300*	1,140
02USFWSMC-0731-04	6' from the heating fuel valve at 4' bgs	187*	16,300*	1,270
02USFWSMC-0731-05	12' from the heating fuel drum at 4' bgs	ND	285	995

**Exceeds ADEC Cleanup Level A Standards.*

Lead-Based Paint: The cabin has corrugated metal siding painted with black lead-based paint. One sample of black paint from the corrugated metal siding was tested for lead. This sample contained 4,500 mg/kg lead, which exceeded the ADEC "presence/absence" standard for lead.

Asbestos: Three samples were taken for asbestos, one each from the sauna exterior roofing paper, sauna interior roofing paper, and sauna linoleum flooring. No ACM was found in any of these samples.

Vehicles: There is a vehicle located 20 feet from the cabin; the gas tank and hydraulic hoses are intact.

Non-Regulated Wastes: Remains of a snow machine, chair, wood debris, rusted oil drip stove, rusty woodstove, empty drums and gas cans, miscellaneous household wastes, and burn debris were found.

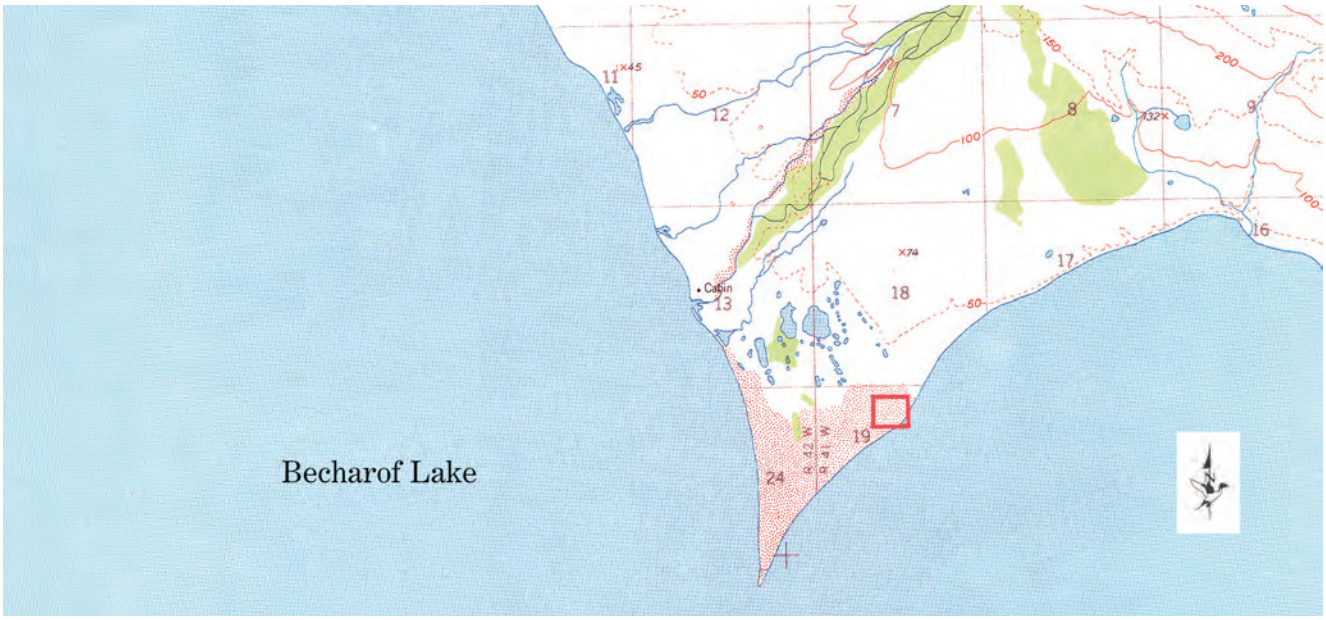
Bible Camp

In 1966, Becharof Bible Conference Grounds, Inc. (BBCG) applied to the BLM for a Recreation and Public Purposes application to establish a youth camp on 615 acres at Becharof Lake. At that time, the BLM encouraged BBCG to initiate construction of the camp to demonstrate their commitment to establishing this camp. Originally, BBCG had plans to develop the site to include a golf course, water sports area, landing strip, archery and rifle range, baseball diamonds, and horseshoe, badminton and volleyball courts. However, actual construction only included a dining hall, washhouse, and six cabins located along a spit in the northeast portion of Becharof Lake (Figure 9). Due to a land freeze in 1968 issued by the Department of Interior, a lease was never issued to BBCG. Throughout the years, BBCG used this site for a few weeks each summer for youth education. With the passage of ANILCA in 1980, the land became part of the Becharof National Wildlife Refuge and BLM forwarded the Recreation and Public Purposes application to the Service. Upon Refuge establishment, the Service issued BBCG a SUP to continue the youth education camps on this site. BBCG stopped using the site in the early 1990s. The Refuge manager indicates that this site is currently permitted to an individual for subsistence use. The Refuge also has had Science Camps at the facility during the summer.

Becharof Lake produces over 6 million salmon per year.

Refuge and EC staff visited this site in August 2000 during investigations associated with the CAP (Appendix C). At least 40 abandoned drums (some partially buried), with contents undetermined, were on the property.

Figure 9. Approximate Location of Bible Camp (N 57°55.18.09 W 156°04.47.26, Datum WGS-84)



U.S. Geological Survey. Ugashik (D-1) Quadrangle, Alaska, 1: 63 360 Series (Topographic).

Bible Camp. Philip Johnson/USFWS.

Other debris included generators and an abandoned vehicle. As a result of the CAP, a proposal for further site evaluation was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

During summer 2002, Platt Environmental conducted an Environmental Phase II EDDA at the site. Platt Environmental assessed several potential contaminant sources including hydrocarbons, lead, asbestos, creosote, workbench hazardous wastes, and non-regulated wastes. The findings by Platt Environmental (2002) follow:

Hydrocarbons: Surface staining was noted in several areas including near the mess hall, behind the bunkhouse, and around the steam bath. There are more than 20 55-gallon drums scattered at the site, containing various amounts of fuel. Numerous fuels cans were found in and around the structures including Coleman fuel, kerosene, Avgas, and Blazo containers. The contents of these containers total approximately 250 gallons of watery heating fuel and Avgas. A heating fuel release from the 55-gallon drum used to store heating fuel adjacent to the large bunk house has resulted in approximately 200 cubic yards of hydrocarbon contaminated soil. Six soil samples were analyzed for hydrocarbons, including GRO, DRO, RRO, and BTEX. One sample collected from the soil beneath the fuel drum at the mess hall exceeded the ADEC cleanup level for DRO (Table 7). Three soil samples around the drum cradle at the bunkhouse exceeded ADEC levels for GRO and/or DRO, and one sample approached the ADEC cleanup level for xylenes (Table 7).

Lead: Nine out of the eleven structures were painted with lead-based paint; only the water tank and large bunkhouse were not painted with lead-based paint. Twelve paint samples were analyzed for lead. Lead was detected in eleven samples with concentrations ranging from 530 to 47,000 mg/kg. These eleven samples exceeded the ADEC "presence/absence" standard for lead. Six soils samples were collected for lead analysis. Lead was detected in all the soil samples, however, all samples were below the ADEC cleanup level for lead in soils.

Debris and drums at Bible Camp.
Gary Melvin/USFWS.

Asbestos: One sample was collected for asbestos analysis from the outhouse roofing paper. This sample did not have any ACM.

Creosote: The foundations of the structures are constructed with creosote treated pilings, resulting in 82 6-foot creosote logs at the site.

Workbench Hazardous Wastes: Paint thinner, latex paint, Coleman fuel, kerosene, Avgas, Blazo, and lime were found. These items must be properly disposed of as wastes when no longer in use.

Non-Regulated Wastes: A galvanized steel compactor, wood debris, propane heaters (2), refrigerators with freon intact (2), generator, mattress, fuel burning heaters, cook stove, water lines, empty drums, electric range and dryer, toilets, jeep parts, and various other items were noted.

Table 7. Selected Hydrocarbon Results at Bible Camp from Platt Environmental (2002)

Soil Sample #	*Sample Location*	*GRO (mg/kg)*	*DRO (mg/kg)*	*Xylenes (mg/kg)*
ADEC Cleanup Level A		50	100	78
02USFWSBC-0807-19	beneath the fuel drum at the mess hall	ND	131*	ND
02USFWSBC-0807-21	beneath the drum cradle at the bunkhouse	ND	2,730*	ND
02USFWSBC-0807-22	4' to the right of the drum cradle at the bunkhouse	ND	208*	ND
02USFWSBC-0807-23	4' to the right of the drum cradle at the bunkhouse	111*	8,730*	55.34

**Exceeds ADEC Cleanup Level A Standards.*

Solid waste problems always have been an issue for the Refuge.

Solid Waste Removal at Sites within the Refuge

The Service contracted with Bristol Environmental and Engineering Services Corporation (Bristol) to remove abandoned drums and non-hazardous solid wastes from the Refuge in 1998 and 1999. In 1998, debris was removed from several areas within the Becharof NWR including a site on Shelikof Strait called Bear Bay; the north side of Becharof Lake; and the south side of Becharof Lake at Gas Rocks (Figures 10-13). In 1999, debris was removed from one site within the Alaska Peninsula NWR, Scotty's Island (Figure 13).

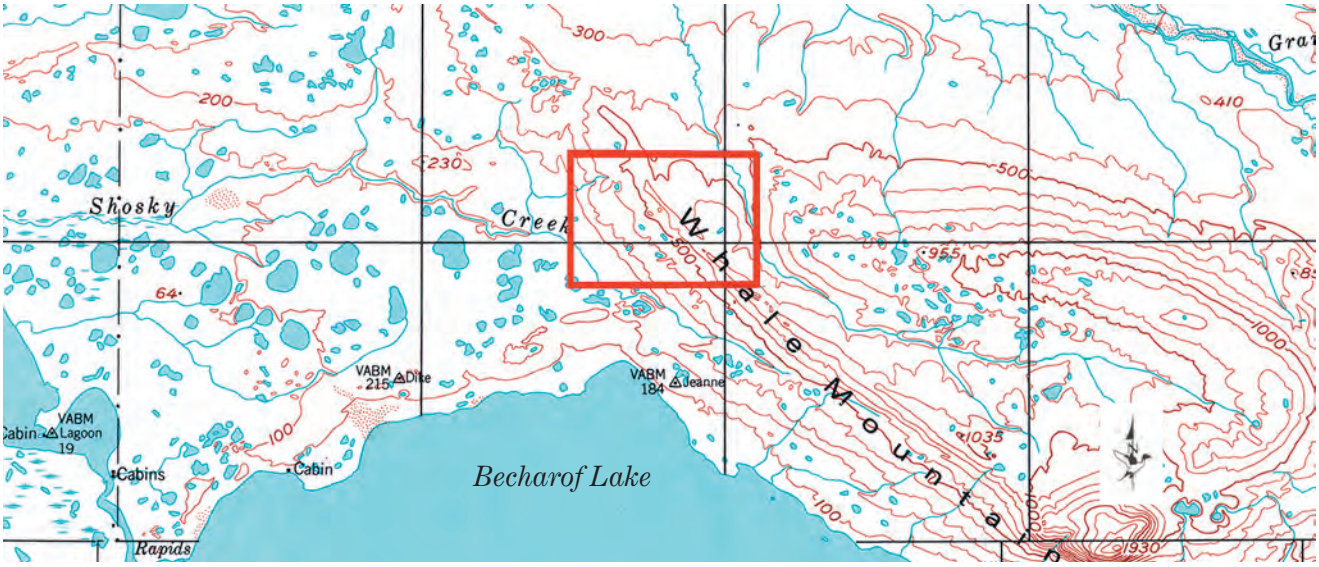
Figure 10. Approximate Location of the Bear Bay Solid Waste Removal Site

U.S. Geological Survey. Karluk, 1:250 000, Alaska, Topographic Series.

Some of the items removed from the Bear Bay site included 5-gallon Blazo cans, 1-gallon gas cans, wood debris, and 1-quart oil cans. Some of the items removed from the north side of Becharof Lake included 5-gallon Blazo cans, propane gas stoves, propane canisters, wood debris, and plastic crates. The items removed from the Gas Rocks site included batteries, wire, and wood debris. Items removed from Scotty's Island included buoys, plastic gas containers, over 100 5-gallon square gas cans, nearly 80 5-gallon round cans, 12-volt batteries, wringer washing machine, seven 55-gallon drums, stove

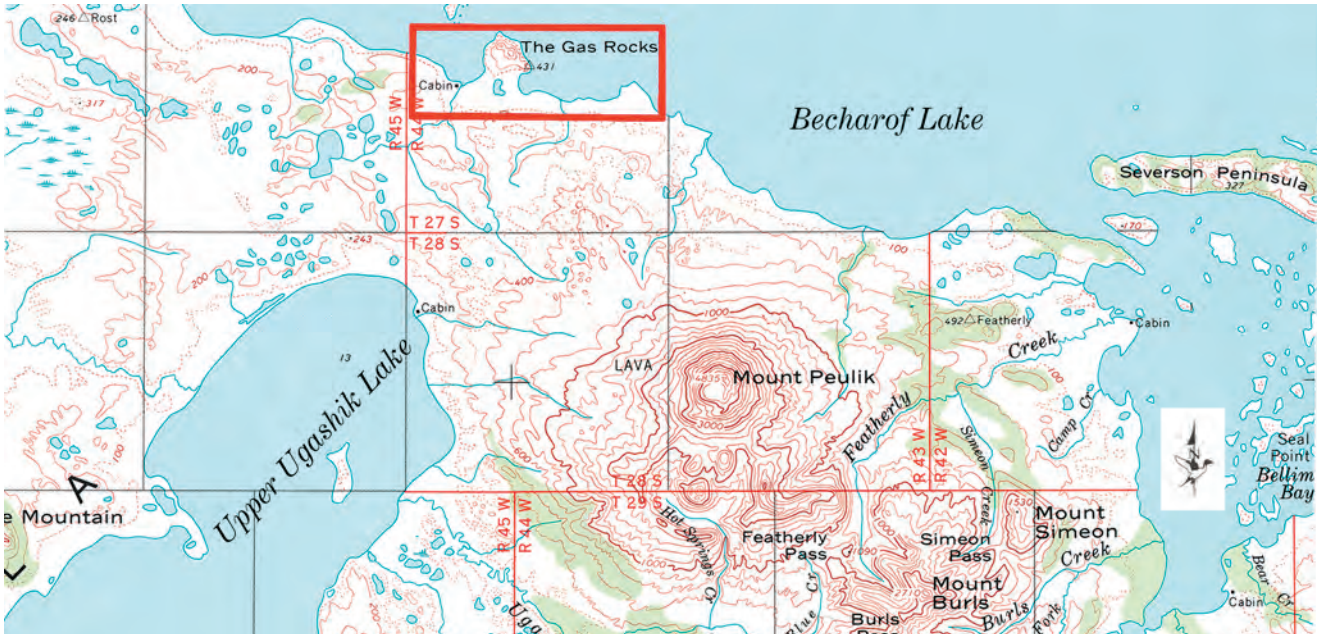
parts, metal siding, sheet metal, oil heater, chicken wire, and tarps. Even though a large amount of solid waste was removed from this site, the contractor noted that numerous aluminum and tin cans and glass bottles and jars were left onsite because the contractor was not aware that these items were to be removed and hence made no preparations for their removal. The contractor also noted that three contiguous trash pits were located at this site.

Figure 11. Approximate Location of the North Side Becharof Lake Solid Waste Removal Site



U.S. Geological Survey. Naknek, 1:250 000, Alaska, Topographic Series.

Figure 12. Approximate Location of the Gas Rocks Solid Waste Removal Site



U.S. Geological Survey. Ugaskik, 1:250 000, Alaska Topographic Series.

Problem Areas for Solid Waste

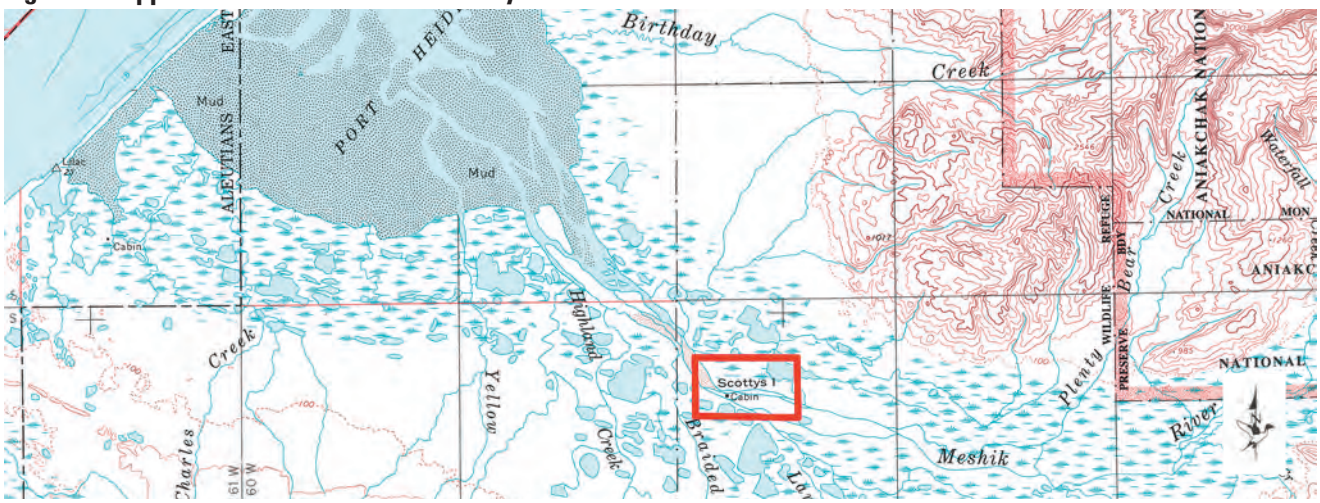
Potential dumping areas can occur at aircraft landing sites located throughout the Refuge or on the Pacific Coast beaches from fishing boats. According to Refuge staff, there are significant litter problems in these areas; however, there are no known locations where serious dumping of hazardous waste has occurred. Solid waste problems have been, and continue to be, an issue for the Refuge.

Summary: Remote Cabin Sites and Associated Debris

Several cabin sites on the Refuge may require cleanup. Three of the five cabin sites have hydrocarbon contamination associated with leaking fuel oil. At one of the cabins, asbestos containing materials were discovered. Also, all of the sites have structures painted with lead-based paint and have miscellaneous debris that should be removed. Specific cleanup actions at these sites will be determined. Future actions will depend upon site history, land status, degree of contamination, funding availability, and other factors.

Many of the cabin sites have contaminant issues including hydrocarbon contamination, lead-based paint, and asbestos.

Figure 13. Approximate Location of the Scotty's Island Solid Waste Removal Site



U.S. Geological Survey. Chignik, 1:250 000, Alaska, Topographic Series.

Mining

Placer–A deposit of earth, sand, or gravel, containing valuable minerals, like gold, in particles.

According to the BLM's Alaska Land Information System, which includes all mining claims that were active as of 1976, only one placer claim existed on Becharof NWR, and 116 lode claims existed on Alaska Peninsula NWR. Placer mining involves removing the top layer of dirt and rocks (overburden) to expose mineral-bearing gravel deposits. Lode mining is also called hard rock mining and involves removing minerals from solid rock in either an open pit or an underground mine.

Lode–A mineral deposit, like gold, in solid rock.

In the 1980s, mining in the Chignik and Herendeen Bay areas loomed as major potential resource development projects. In response to proposals for hard rock mining exploration of gold, silver, lead, and zinc on upper Braided Creek of the Meshik River drainage, the Service conducted background analyses from 1989–1991 to document natural concentrations and variations of these metals in water and sediment prior to mining. The purpose of the study was to establish baseline data that could be used for comparative purposes should mining occur.

Due to more stringent regulations and higher claim maintenance/ assessment fees in the 1990s, all claims on the Refuge were abandoned, and hence declared "null and void" by the BLM. Currently, there are no active mining claims on the Refuge. While there is currently no mining activity on the Refuge, remnants from past mining operations exist.

Due to more stringent regulations and higher mining claim maintenance/ assessment fees in the 1990s, all claims on the Refuge were abandoned, and hence declared "null and void" by the BLM.

Braided Creek Mining Site

The Braided Creek mining site (also known as the Anaconda site, Anaconda Camp, Manhattan Project, and Manhattan Prospect) is located in the Alaska Peninsula National Wildlife Refuge in the Meshik Valley about 20 miles east of Port Heiden (Figure 14). Approximately 55 unpatented gold, silver, lead, and zinc mostly lode mining claims were located at this area in 1964 (with nearly 30 more claims in the surrounding area). Since 1964, several companies explored the area's mining potential. According to Giger (1994), these companies include Pan American Oil (1965–1967), Bear Creek Mining Company (1975), Anaconda Minerals Company (1984–1985), Pangea Explorations, Inc. (1987), Global Pacific Mineral Services (1989), and Sierra Nevada Mining & Engineering, Inc. (1993).

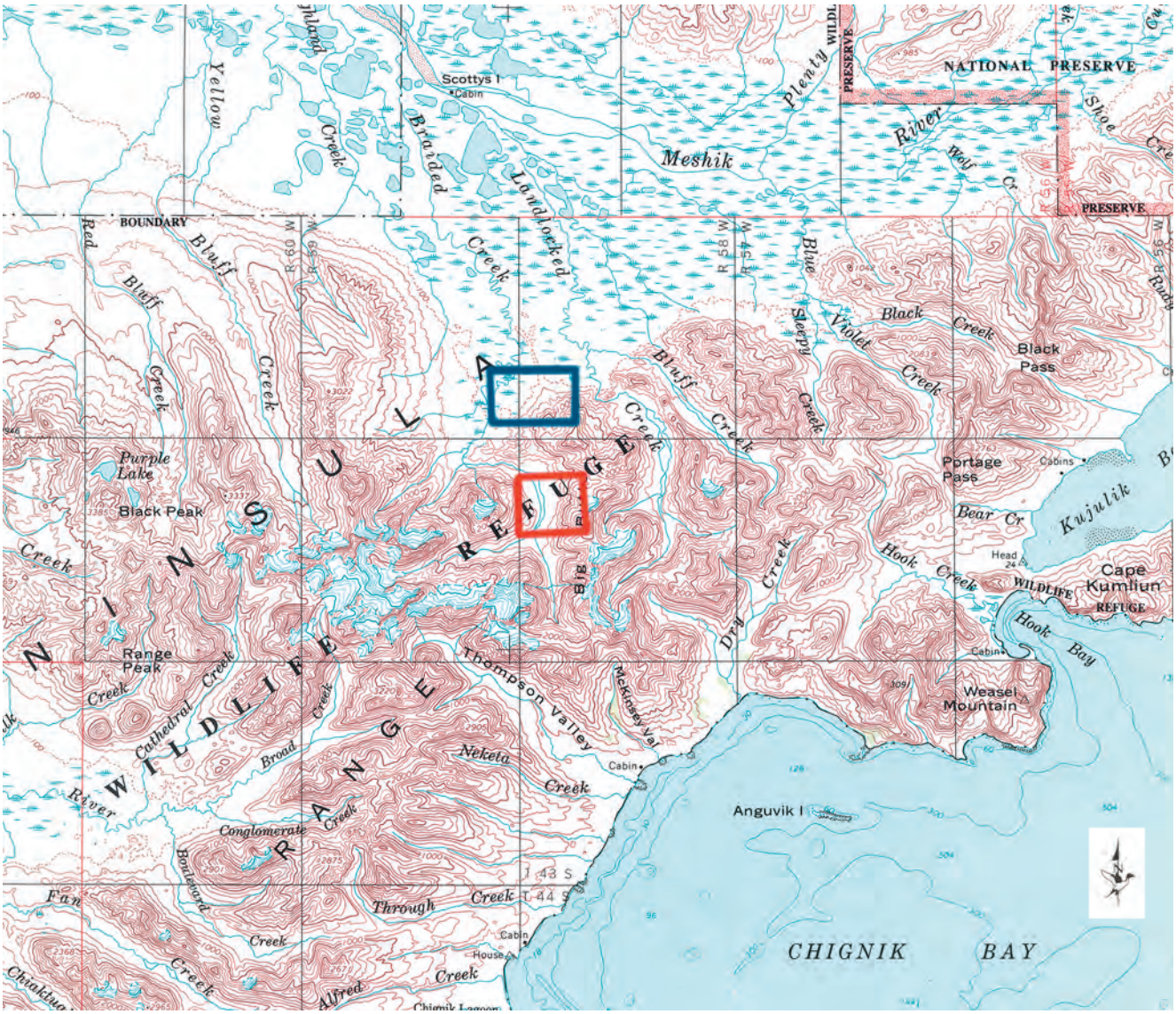
A July 1996 memorandum from the Service to the BLM stated that a cabin structure built by Pan American Oil in 1964 was filled with several hundred boxes of core samples, and the area in which the structure was located contained a large fuel tank, possible hydrocarbon contamination, and debris. A different memo also suggested that Pan American Oil abandoned these core samples, which were labeled "Manhattan Project."

Service staff have not visited this site for several years. The two most recent visits occurred in 1985 and 1989.

1985 Site Visit

From July 27–28, 1985, volunteers with the Service conducted a site visit. To access the site, the volunteers hiked along the base of the foothills to Braided Creek. They crossed a main tributary before reaching Braided Creek, and a few feet beyond the crossing, located several old 55-gallon

Figure 14. Approximate Location of Braided Creek Mining Claims (red) and Mining Cabin (blue)



U.S. Geological Survey. Chignik, Alaska Topographic Series, 1:250 000.

drums. At the camp they found the following (direct excerpt from their field notes):

> *Three 16' X 20' weather port frames, two smaller weather port frames (8' X 10' and 8' X 6'), two complete canvas frame tents (one with camp gear including cots, pad, stoves, heaters, lanterns, cooking gear, chairs, tables, etc. and one with empty 55-gallon drums), partially constructed or collapsed tent frames, lumber, PVC pipe, several full 55-gallon fuel drums (without a liner or berm area to capture fuel if a leak would occur), wood shack with several hundreds of boxes of core samples, collapsed cabin with old bed frames, broken glass, clothes dryer, and two large red fuel tanks (one intact and one smashed).*

The Braided Creek mining site has several contaminant issues including hydrocarbon contamination, lead-based paint, and asbestos.

> *Two landing strips also are located in the vicinity. On the runways and in the surrounding brush, extensive equipment, garbage and debris were found. Some of the items included a metal housing trailer, wooden outhouse, gas heater, flatbed trailer, plywood and other scrap wood, wooden crates, bulldozer, sheet metal, steel cables, metal bed frames, metal chairs, metal buckets, steel trash can, rope, (3) 10-gallon fuel cans, (28) 5-gallon Avgas fuel cans, (42) 55-gallon drums (mostly Avgas).*

As a result of the 1985 site assessment, on August 4, 1986, Refuge staff impounded mining camp equipment and supplies apparently abandoned by Anaconda Minerals Co. at their Braided Creek campsite (SUP AP-114-84 and AP-104-85).

1989 Site Visit
A former Deputy Refuge Manager, Rick Poetter, recalls his 1989 visit to the site (September 6, 2000):

> *A cabin was there the last time I visited in about 1989. Numerous core samples from drilling were present. We used to do cabin inspections, and that was one of them. Most of the others were guide cabins. Of course, it was common to have "landfill" dump sites at each cabin, piles of discarded (usually empty) metal 5-gallon and sometimes 55-gallon fuel containers, and abandoned equipment with batteries, oil, etc. left behind. We did a significant amount of cleanup during the "Take Pride In America" campaign during the early 1990s. We did not do any cleanup at the Braided Creek cabin. The drilling occurred long before 1989, but I do not remember when.*

2002 Environmental Phase II Environmental Due Diligence Audit
As a result of the CAP a proposal for further site evaluation was submitted and funded as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process.

The Braided Creek area provides essential habitat to harlequin ducks, Canada geese, bald eagles, brown bears, and coho, chum, and king salmon.

During summer and fall 2002, Platt Environmental conducted an Environmental Phase II EDDA at the site. Platt Environmental assessed several potential contaminant sources including hydrocarbons, lead-based paint, lead in soil, asbestos, and non-regulated wastes. Findings by Platt Environmental (2002) include:

Hydrocarbons: Drums occur in several locations throughout this site. Some drums are conglomerated in certain areas, while others are scattered. It is estimated that there is a total of about 250 gallons of rusty water with fuel residue and 55 gallons of kerosene in these drums. Additionally, it is estimated that there is a total of approximately 50 cubic yards of hydrocarbon contaminated soil at these drum sites. Three areas have a high density of drums. These drum areas include a location approximately 20 yards from the core shed (debris dump one), 250 yards north of the mining camp (debris dump two), and King's Camp airstrip (debris dump three). Additionally, one 55-gallon drum was located at the former living quarters, and analytical results indicated that a fuel release occurred at this site (Table 8).

- *Debris Dump One*: A debris dump was located approximately 20 yards from the core shed. This dump included 40 55-gallon drums, a 10,000-gallon tank, several propane bottles, fuel cans, fuel lines, and

Table 8. Selected Hydrocarbon Results at Braided Creek Mining Site from Platt Environmental (2002)

Soil Sample Number	*Sample Location*	*DRO (mg/kg)*
ADEC Cleanup Level A		100
02USFWSBC-0727-05	Soil beneath drums 35, 36, 37 located at Debris Dump One	186*
02USFWSBC-0727-08	Soil beneath drum at Former Living Quarters	388*
02USFWSBC-1101-01	~6" under drum No. 50 located within the middle cluster of drums at Debris Dump Two	14,100*
02USFWSBC-1101-02	~18" under drum No. 50 located within the middle cluster of drums at Debris Dump Two	3,590*
02USFWSBC-1101-03	~18" under drum No. 54 located within the middle cluster of drums at Debris Dump Two	689*
02USFWSBC-1101-06	~18" under drum No. 84 located within the lower cluster of drums at Debris Dump Two	10,200*

**Exceeds ADEC Cleanup Level A Standards.*

an electrical switch. Three of the 55-gallon drums contained a small amount of rusty liquid. Analytical results associated with a group of drums at this site indicated that there was a hydrocarbon release (Table 8).

■*Debris Dump Two*: An extensive drum field was located 250 yards north of the mining camp. This drum field was comprised of three separate clusters of drums. Additionally, some drums were discovered off the bluff near Braided Creek approximately 300 yards southwest of the core sample shed. A total of 101 drums were documented and numbered at these locations. Nearly 30 of the drums contained three to six inches of rusty water with fuel residue, and three of the drums were 1/3 full of kerosene. Analytical results from soil beneath a group of drums at this site indicated that there was a hydrocarbon release (Table 8).

■*Debris Dump Three*: At "King's Camp" airstrip, there were several scattered empty rusted 55-gallon drums, empty 5-gallon Blazo cans, and various scattered metal debris. One 55-gallon drum was 3/4 full of kerosene.

■*Former Living Quarters*: The former living quarters are located roughly 10 yards west of the core shed. One 55-gallon drum was located at the former living quarters. Analytical results indicated a fuel release from the heating fuel drum occurred at this site (Table 8).

Sixteen samples were analyzed for hydrocarbons, including GRO, DRO, RRO, and BTEX. Six soil samples exceeded the ADEC cleanup levels for DRO (Table 8). GRO, RRO, and xylenes were detected in low concentrations in some samples, but were below the ADEC cleanup levels.

Lead-Based Paint: Two paint samples were analyzed for lead, one from paint on the wood debris of the former living quarters and one from paint on the wall of the core sample shed. Both samples exceeded the ADEC presence/absence standard for lead, with lead concentrations of 410 mg/kg

Braided Creek mining site, 2002. Platt Environmental.

lead from the former living quarters and 3,800 mg/kg lead from the core sample shed.

Lead in Soil: Six soil samples were tested for lead. Lead was detected in all samples, but concentrations were all well below the ADEC cleanup levels for lead.

Asbestos: Nine samples were analyzed for asbestos: three each from the roofing material on the core sample shed; linoleum on the floor of the former living quarters; and window caulk around the windows at the core sample shed. Two samples had ACM above the 1% EPA threshold level for asbestos. The roofing material on the core sample shed had 4% ACM. The black felt beneath the shingling on the core sample shed had 40% ACM. Two samples from the caulk around the window at the core sample shed had a trace of ACM (less than 1%).

Non-Regulated Wastes: Items found included the remains of two washing machines, remains of an industrial metal sink, remains of three hot water heaters, 80 sections of 10' long and 60 sections of 20' feet long galvanized steel pipe, 940 boxes of core samples, wood debris, rusted bed frames, over 35 empty 55-gallon drums, and two 10,000-gallon empty fuel tanks.

Site history, mining claim records, and findings of the 2002 Platt Environmental site assessment are being reviewed prior to determining a course of action for this site.

Marine Spills

One of the nearly three thousand dead sea otters from the Exxon Valdez oil spill. Gregory Thompson/ USFWS.

Due to ship traffic along the Refuge's coast and the likelihood of adverse weather, the potential for oil and fuel spills along coastal areas remains high. Some examples of documented spills are highlighted in this section.

- In January 1989, the US Coast Guard fired 1,500 rounds of 2 mm projectiles into a barge, UMTB 283, sinking it in 100 fathoms of water southwest of the Semidi Islands. Resource damage was expected to be negligible due to the nature of the diesel fuel, the rough weather at the time, and the depth of the water at the site.

- On March 24, 1989, the *Exxon Valdez* oil tanker ran aground on Bligh Reef in Prince William Sound spilling approximately 11 million gallons of crude oil into the Prince William Sound and the Gulf of Alaska, making it the largest spill ever in the United States (more details of this spill are presented below).

- In 1990, while conducting shoreline reconnaissance associated with determining *Exxon Valdez* oil spill (EVOS) impacts, a Refuge survey crew discovered a diesel spill from a fish processor in Ivanof Bay. The sheen was apparent over two kilometers away from the vessel. During these investigations, the crew observed other oil films or near shore sheen throughout the observation area, but they could not determine if the impacts were solely from EVOS. The crew suspected some of the sheen may have been from local fishing boats and/or processors.

- In the summer of 1991, the Jute Peak surveillance camp was established to determine impacts of commercial fishing vessels on seabird colonies. During the surveillance, several forms of disturbance were noted including numerous fuel spills and garbage thrown overboard from passing vessels.

Exxon Valdez Oil Spill

Within two months, prevailing currents carried oil into the Shelikof Strait impacting shorelines of Kodiak and the Alaska Peninsula. An estimated 3,200 miles of shoreline were oiled during the Exxon Valdez oil spill, including approximately 725 miles associated with the Alaska Peninsula and Becharof National Wildlife Refuges (the Refuges' entire Pacific coastline).

Refuge staff conducted pre-oil wildlife surveys, participated in containment/booming planning, conducted reconnaissance flights to track movement of oil onto the Refuge, participated in shoreline and wildlife impact assessments including animal carcass recovery, conducted oil degradation studies, and conducted winter monitoring studies in 1989. Some Refuge staff were detailed to Kodiak, where response operations for both Kodiak and the Alaska Peninsula were centered.

The ADEC rated Puale Bay, on the Becharof NWR, as the most heavily impacted area recorded outside of Prince William Sound. Oil on Puale Bay beaches was up to 12 inches deep. Exxon conducted cleanup activities in Puale Bay, Alinchak Bay, and Dry Bay from June-September 1989. According to the Refuge Narratives, cleanup involved removing surface oil

The Exxon Valdez oil spill killed an estimated 250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles, 22 killer whales, and billions of salmon and herring eggs.

mousse by hand from sandy shorelines using shovels, bagging the mousse, and removing it to waiting boats.

In 1989, a total of 4,718 migratory bird carcasses were recovered from the Refuge. This accounted for approximately 13% of the total number recovered in Alaska during the spill, with a majority (38%) of these carcasses from Puale Bay.

In spring 1990, Exxon helped organize interagency teams to survey beaches with known oil impacts. These teams began surveying Refuge beaches in April 1990. The Refuge also initiated an independent shoreline assessment program in spring 1990, utilizing the same standardized survey techniques. The primary purpose of the Service's project was to survey, on foot, as much of the 725 mile refuge coastline as possible and to determine the extent of visible oil impacts, survey impacts to local wildlife, and evaluate habitat impacts at treated and non-treated sites. Maps which summarize shoreline oil impacts observed on the Refuge are displayed in Appendix D. One year after the spill, approximately 25% of the Becharof NWR shoreline was still impacted by scattered bands of oil (primarily at Alinchak, Puale, Dry, and Island bays). Oil impacts were very light further down the Alaska Peninsula. Exxon conducted additional treatment at Puale and Alinchak bays in 1990 using hand techniques and bioremediation (fertilization). Wildlife population surveys related to the spill continued in 1990.

In 1991, Exxon conducted the May Shoreline Survey Assessment Program along the coast of the Becharof Refuge, from Cape Kubugakli to Cape Unalishagvak. The Service conducted a census of seabird colonies in the Becharof Refuge from July to August the same year to determine if numbers of colonial seabirds breeding in oiled areas had changed significantly from pre-spill surveys and to evaluate productivity at seabird colonies. Additionally, murre eggshells were collected for hydrocarbon analysis in 1991. Similar population census, productivity, and eggshell studies were conducted in 1992.

In a 1995 post-EVOS wildlife monitoring project, aerial bald eagle nesting surveys were conducted by helicopter. Eagle production appeared to be lower than last surveyed in 1990. From Cape Kubugakli to Cape Kunmik, 78 nests were observed in 1990, while only 65 were found in 1995. Nesting success also appeared to be lower with many abandoned nests, and most other nests yielding only one fledgling, despite laying of multiple eggs. The cause of reduced nesting and fledging success is unknown.

As described above, the Exxon Valdez oil spill impacted the Pacific coast of the Refuge, particularly several bays on Becharof NWR. Given the magnitude of the spill, many other Refuge projects were postponed or canceled during 1989. While post-spill assessment activities occurred for several years, relatively little is known about the magnitude and duration of oil impacts on the Refuge. This is in contrast to the much more extensive information gathered in Prince William Sound from 1989 to present.

While conducting shoreline reconnaissance in 1990 associated with the Exxon Valdez oil spill, a Refuge survey crew discovered this diesel spill from a fish processor in Ivanof Bay. Donna Dewhurst/USFWS.

Formerly Used Defense Sites

Ugashik Lake Recreation Annex

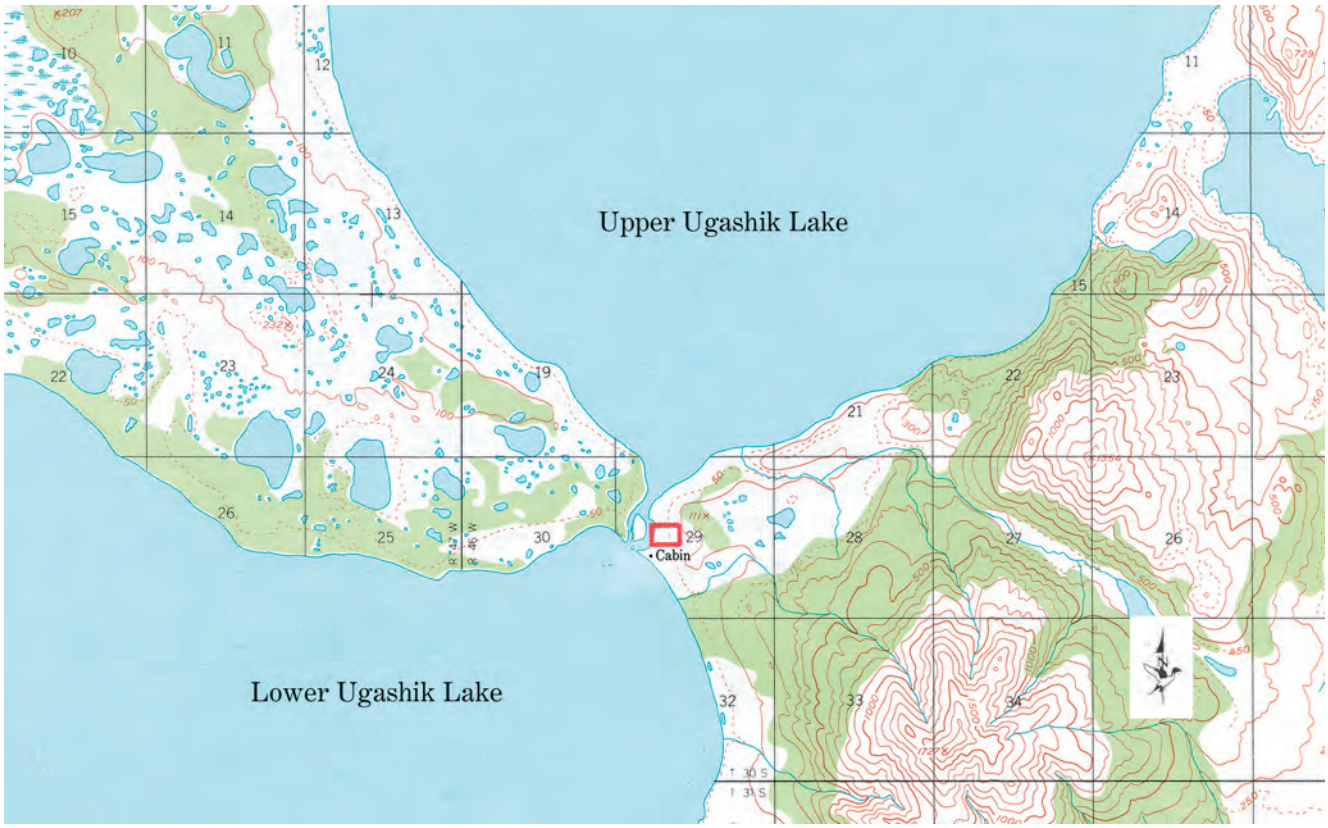
The Ugashik Lake Recreation Annex is the only Formerly Used Defense Site (FUDS) within the Refuge boundaries (Figure 15).

The following information about this site is from the Alaska District FUDS GIS Database, http://137.161.179.3/fuds/map/fud_index.html, 6 January 2004.

> *The Ugashik Lake Recreation Annex is located on the Alaska Peninsula of southwest Alaska, approximately 80 miles south of King Salmon and 160 miles west of Kodiak. The FUDS site number is FlOAK0242. This 3.10-acre site is on the southeast shore of the narrows between Upper and Lower Ugashik Lake within U.S. Survey No. 4799 (Figure 17). The property had been developed by private owners for hunting and fishing parties, prior to Air Force use, including four wood-frame cabins, a shed, and two outhouses. No utilities were available.*
>
> *This site was obtained for the Air Force from Maxine Madsen by lease dated 28 June 1968 through 31 August 1968, and continuing from 1 June through 31 August annually thereafter for a term not to exceed five years. The Air Force used the site as a summer recreation camp. The lease was terminated by Notice of Cancellation dated 20 February 1970, effective 31 August 1969. This site is within the SW1/4 of Section 29, T30S, R46W, Seward Meridian.*
>
> *As quoted from the Findings and Determination of Eligibility Report for this site: "Based upon the historical records however, there appears to be no reason to consider this site to contain hazardous/toxic waste, ordnance, or unsafe debris." It does not appear that a site visit was conducted.*
>
> *This information is based on the best available data and is believed to be accurate as of the last update of this web site. However, the information is subject to change if new information becomes available. For verification of the above information or additional information on Formerly Used Defense Sites please call the Corps of Engineers FUDS team at 907-753-5781.*

This site likely poses minor contaminant issues for the Refuge. According to Refuge staff, a dump with unknown contents may be associated with this site.

Figure 15. Approximate Location of Ugashik Lake Recreation Annex



U.S. Geological Survey. Ugashik (C-3) Quadrangle, Alaska, 1: 63 360 Series (Topographic).

Development Potential

Development near and within the Refuge boundaries has the potential to pose future contamination issues for the Refuge. Several development projects have been proposed including transpeninsula corridors and hydropower projects.

Transpeninsula Corridors

Three regional corporations, Bristol Bay, Koniag, Aleut, and their village corporations, have large Refuge inholdings (Figure 3). Transpeninsula corridors have been proposed for moving oil/gas from Bristol Bay to ice-free, deep water ports on the Pacific side of the Peninsula. One proposed area for oil/gas corridors is near the Meshik River. Additionally, two other potential transpeninsula pipeline corridors are in the Dog Salmon River and Figure Eight Creek areas. Transpeninsula road projects and Bristol Bay oil and gas exploration have also been proposed. Although these proposed projects primarily pose habitat disturbance issues due to construction of corridors and other infrastructure associated with the projects rather than contaminant issues, large construction projects may result in fuel spills or other unintended impacts.

Hydropower

In 1982, Service Ecological Services staff, Refuge staff, US Army Corps of Engineers staff, and ADF&G evaluated potential impacts of proposed hydropower development projects on Native lands near Perryville, Chignik, and Chignik Lagoon. The site in the Perryville area is located on an unnamed tributary of the Kametolook River. The sites in the Chignik area under consideration for development were Indian Creek, Mud Bay, and Packers Creek. These projects did not occur.

Although proposed projects, such as these, pose primarily habitat disturbance issues associated with construction of dams, power transmission lines, and other infrastructure, large construction projects may result in fuel spills or other unintended contaminant-related impacts.

Perryville, an Aleut village in the Chignik Unit of the Refuge. Note the 55-gallon drums in the foreground. Ronald E. Hood/USFWS.

Recreational Activities

A soda can left behind. Tiffany Parson/ USFWS.

The Refuge is used for a variety of recreational and subsistence purposes. Some of these uses may pose potential contaminant concerns for the Refuge. The topics addressed in this section include hunting, fishing, snowmobile use, boating, and aviation. Additionally, solid waste may be left behind as a result of recreational activities.

Hunting and Fishing—Lead Shot and Sinkers

Residual lead from shot and fishing weights/jigs may pose potential contamination issues, especially for waterfowl. Many species ingest small pebbles for use in their gizzards to help grind up food for digestion and small pieces of lead may be ingested and used as grit in the gizzard.

Lead Shot

The ingestion of lead shot is the main source of lead poisoning in waterfowl and other bird species (Scheuhammer and Norris 1996). Lead poisoning has affected every major species of waterfowl in North America and has been reported in a wide variety of other birds. Lead shot poisoning has been observed most frequently in mallards, northern pintails, redheads, scaups, Canada and snow geese, tundra swans, bald and golden eagles, coots, and rails (Friend 1999). In Alaska on the Yukon Delta National Wildlife Refuge, lead poisoning from shot was documented in spectacled eiders, a threatened species, and common eiders (Franson et al. 1995; Flint and Grand 1997; Franson et al. 1998). Lead exposure also has been observed in king eiders and threatened Steller's eiders in Alaska (Stout et al. 2002). No lead shot mortality events have been reported on the Refuge. It should also be noted, however, that given the large size of the Refuge and the lack of a systematic study, it is possible that lead toxicity in waterfowl may go undetected.

Lead poisoning has affected every major species of waterfowl in North America.

Although lead shot use by waterfowl hunters was banned in 1991, spent shot may persist in the environment. For example, studies cited in Scheuhammer and Norris (1996) estimated that lead shot in grassland soils would lose half their lead content within 54–63 years, and that total transformation of the lead pellet might take up to 100–300 years. Lead shot persistence is not well studied in cold climates like Alaska. Flint (1998) investigated lead shot settlement rates in tundra ponds on the Yukon Delta, where no detectable settlement or loss of lead shot was observed within the upper four centimeters of sediment during a three-year monitoring period. Environment Canada has summarized the environmental fate and chemistry of lead shot and sinkers (http://www.cws-scf.ec.gc.ca/publications/papers/88/chap2_e.cfm, January 6, 2004).

Fishing Weights and Jigs

Fishing weights and jigs also are potential sources of lead. Consumption of lead sinkers and jigs may account for 10 to 50 percent of adult loon mortality in the New England area and is the most common source of adult loon mortality (Service, http://contaminants.fws.gov/documents/leadpoisoning2.pdf, October 1999). Studies also indicate that the ingestion of just one lead sinker or jig can poison a water bird. Loons, swans, brown pelicans, Canada geese, and mallard ducks are the species most frequently

documented with lead poisoning attributable to ingestion of lead fishing weights (Friend 1999).

Ingestion of just one lead sinker or jig can poison waterfowl.

To help alleviate lead toxicity from fishing gear, some states have implemented restrictions on lead use for fishing. Additionally, the Service has established lead-free fishing areas in a number of National Wildlife Refuges and Waterfowl Production Areas in eight States, extending from Alaska to Florida (Service, http://policy.fws.gov/library/99fr43834.pdf, August 11, 1999). On the Refuge there are currently no bans on using lead fishing gear. However, intensive fishing occurs in several areas on the Refuge, especially at the Ugashik Narrows, Becharof Outlet/Egegik River, Gertrude Creek, and Island Arm.

Snowmobile Use

Snowmobile use and recreation have grown popular on the Refuge. Snowmobile use is heavier in good snow years. Most of the snowmobiling occurs closest to the villages and from Chignik Lake to Port Heiden. Recently, issues have arisen regarding air pollution and snowmobile emissions in other federally managed areas, such as Yellowstone National Park. Although the scale of snowmobile use is much greater in Yellowstone National Park and use is more concentrated, snowmobile emissions presumably could pose occasional air quality issues for the Refuge.

Many snowmobiles have two-stroke engines that emit more hydrocarbons (HC) and particulate matter (PM) than vehicles with four-stroke engines, such as automobiles (NPS 2000). Snowmobiles also emit other pollutants including VOCs, nitrogen oxides (NOx) and carbon monoxide (CO). According to a study by the NPS (2000), "[w]hen compared to various automobile emission estimates, a snowmobile operating for 4 hours, using a conventional 2-stroke engine, can emit between 10 and 70 times more CO and between 45 and 250 times more HC than an automobile driven 100 miles."

Airplane crash in 1988. John Payne/ USFWS.

Boating

Motorized boating occurs in several areas on the Refuge including the Egegik River, Big Creek, Meshik River, and King Salmon rivers (one in Becharof Refuge and one in Alaska Peninsula Refuge). Two-stroke motors, which emit contaminants to the environment by direct discharge of fuel and incomplete combustion of fuel, are a concern. Additionally, fuel caches and spills associated with boat refueling operations may pose a potential contaminant threat.

Aviation

Numerous aircraft accidents have occurred over the years on the Refuge. It appears that most of the aircraft have been removed from the Refuge. These crashed aircraft likely pose more of a solid waste issue than a contaminant issue to Refuge lands, however, spilled aircraft fuel and lead from unrecovered batteries could be a minor issue. Additionally, fuel caches may pose a potential contaminant issue.

Biotic Sources and Physical Transport of Contaminants

King eider. Donna Dewhurst/USFWS.

Biotic Sources

Anadromous fish, migratory birds, and other migratory species are possible biotic sources of contaminants. Because these species are highly mobile, they may be exposed to contaminants outside of the Refuge boundaries. When these species return to the Refuge, they may be vectors for contaminants and may impose contaminant-related risks to other Refuge resources and to humans.

A study conducted by Ewald et al. (1998) documented the biotransport of contaminants, such as DDT and PCBs, by a population of sockeye salmon in the Copper River, located in south central Alaska. The salmon accumulated relatively low levels of contaminants during their ocean life stage and transported contaminants to their freshwater spawning areas. The results of the study suggested that other species, like arctic grayling, may accumulate contaminants that are transported by sockeye salmon into freshwater ecosystems.

Currently, it is not known if biotic transport is a contaminant pathway affecting Refuge resources, and it should be studied in the future.

Migratory birds may be exposed to an array of potentially toxic chemicals on their wintering grounds outside Alaska, including chemicals that are banned or no longer used in the United States. During the spring migration, birds may transport these contaminants to their nesting grounds in Alaska. This migratory transport of contaminants provides a potential exposure pathway to other organisms which would otherwise likely not be exposed to these chemicals.

Physical Transport

Environmental contaminants from local and distant sources are subject to short- and long-range transport mechanisms. Arctic and sub-arctic environments are especially vulnerable to the long-range air and water transport of environmental contaminants. When chemicals reach Arctic regions, they have a tendency to "settle" due to decreased volatilization in colder climates. Additionally, these chemicals break down at a slower rate in colder climates. The Arctic regions essentially serve as a sink for these chemicals. Some environmental contaminants of particular concern within the Arctic are persistent organic pollutants (POPs) such as PCBs, dioxins, dichlorodiphenyl-trichloroethane (DDT), hexachlorocyclohexane (HCH), chlordane, toxaphene, mirex, and dieldrin; heavy metals, such as cadmium, mercury, and lead; polycyclic aromatic hydrocarbons (PAHs); and radionuclides.

Physical transport of contaminants may be impacting the Refuge, and this pathway should be studied in the future.

There is some evidence that at least one refuge in Alaska, the Kenai National Wildlife Refuge, may be exposed to contaminants from off-site sources. PCBs (Aroclor 1254 and/or 1260) have been detected in low concentrations in snowshoe hares, shrews, clams, slimy sculpins, rainbow trout, and arctic char on KNWR (Ecology and Environment, Inc. 1986). To date, there is no documentation that these aroclors were used on the Refuge. The most likely source of these aroclors is atmospheric deposition.

Biotic and physical transport mechanisms should be studied in the future to assess if these pathways pose contaminant issues for the Refuge.

Areas of Concern and Future Sampling Needs

Forget-me-nots. Donna Dewhurst/USFWS.

This contaminant assessment analyzed some of the past, present, and future contamination issues for the Alaska Peninsula and Becharof National Wildlife Refuges. It is the second assessment of its kind to be completed for the National Wildlife Refuges in Alaska. Prior to and since its establishment, the Refuge has experienced a variety of activities which have introduced contaminants into the environment. Various parties are responsible for these contamination events. This report documents numerous potential contamination sources and issues for the Refuge including oil and gas exploration, remote cabin sites, mining, marine spills, including the *Exxon Valdez* oil spill, FUDS, development potential, recreational activities, wildlife die-off, biotic sources, and physical transport of contaminants.

During the process of compiling the contaminant assessment data, it became apparent that the primary sources of contamination on the Refuge are past oil and gas exploration activities, remote cabin sites, and the *Exxon Valdez* oil spill.

Areas of concern, future sampling needs, and potentially contaminated areas have been identified in this report. The Refuge also could greatly benefit from more baseline studies, which assess contaminant levels in air, soil, sediment, water, and biota. Little data exist for establishing contaminant baseline levels on the Refuge. Baseline data would be helpful in assessing the impacts from future contamination events on and near the Refuge. These data also could be used to establish the contaminant contribution from off-refuge sources, including biotic and physical transport mechanisms. Ideally, contaminant baseline studies would be conducted on all of the National Wildlife Refuges in Alaska, followed by periodic trend monitoring.

As a result of this contaminant assessment several potentially contaminated areas were identified. Additionally, as a direct result of this assessment six areas (denoted with * an asterisk) were funded for further evaluation as part of the 2002 fiscal year Service Refuge Cleanup Project proposal process. The following issues/areas/species should undergo further investigation and/or cleanup:

1) Oil Exploration Sites:

- Grammer No. 1 (page 11)
- Pacific Oil and Commercial Co. No. 1 and No. 2 (page 11)
- J.H. Costello No. 1 and No. 2 (page 11)
- Lathrop No. 1, McNally No. 1, Lee No. 1, Alaska Well No. 1 and Finnegan No. 1 (page 11)
- Island Bay/Jute Bay (page 12)
- Kanatak Village (page 16)

2) Remote Cabin Sites and Associated Debris:

- *Lower Ugashik Lake Cabin (page 24)
- *Egegik River Fisheries Cabin (page 26)
- *Trade and Manufacturing Site (page 29)
- *Subsistence Cabin (page 30)
- *Bible Camp (page 31)
- Scotty's Island (page 33)

3) Mining Sites:

- *Braided Creek Mining Site (page 36)

4) Coastal Areas:

- Potential residual contamination and effects from the *Exxon Valdez* oil spill and other marine spills (page 41)

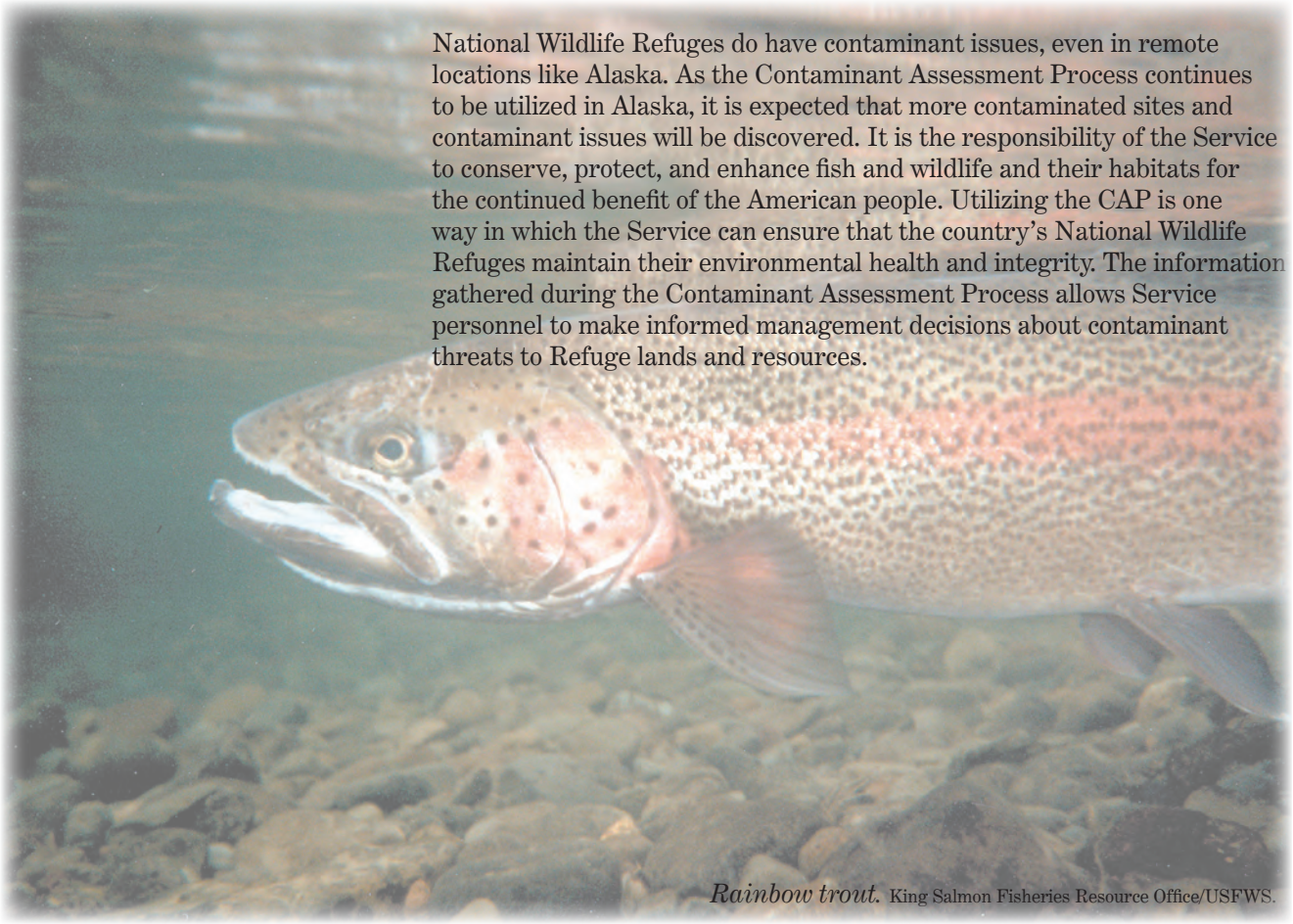
5) Biotic Sources:

- Anadromous, migratory, and resident species to determine baseline contaminant concentrations and determine if biotic transport of contaminants is a concern (page 51)

6) Physical Transport:

- POPs, heavy metals, PAHs, and radionuclides have a tendency to settle in Arctic regions (page 51)

Conclusion



National Wildlife Refuges do have contaminant issues, even in remote locations like Alaska. As the Contaminant Assessment Process continues to be utilized in Alaska, it is expected that more contaminated sites and contaminant issues will be discovered. It is the responsibility of the Service to conserve, protect, and enhance fish and wildlife and their habitats for the continued benefit of the American people. Utilizing the CAP is one way in which the Service can ensure that the country's National Wildlife Refuges maintain their environmental health and integrity. The information gathered during the Contaminant Assessment Process allows Service personnel to make informed management decisions about contaminant threats to Refuge lands and resources.

Rainbow trout. King Salmon Fisheries Resource Office/USFWS.

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Appendix A: Analytes Tested in the 1988 Oil and Gas Study

Inorganics	Polynuclear Aromatic Hydrocarbons (PAHs)	Organochlorines
antimony (Sb)	naphthalene	oxychlordane
arsenic (As)	1-methylnaphthalene	cis-nonachlor
cadmium (Cd)	2-methylnaphthalene	alpha chlordane
chromium (Cr)	2,6 dimethylnaphthalene	gamma chlordane
copper (Cu)	2,3,4-trimethylnaphthalene	transnonachlor
iron (Fe)	1-methylphenanthrene	heptachlor
manganese (Mn)	acenaphthylene	heptachlorepoxide
mercury (Hg)	fluorene	p,p'-DDE
lead (Pb)	phenanthrene	o,p'-DDD
selenium (Se)	anthracene	p,p'-DDD
thallium (Tl)	fluoranthene	o,p'-DDT
	pyrene	p,p'-DDT
	benzo(a)anthracene	total DDT
	chrysene	mirex
	benzo(b)fluoranthene	dieldrin
	benzo(k)fluoranthene	aldrin
	benzo(e)pyrene	alpha BHC
	benzo(a)pyrene	hexachlorobenzene
	perylene	beta BHC
	indeno(1,2,3-c,d)pyrene	lindane
	dibenzo(a,h)anthracene	delta BHC
	benzo(g,h,i)perylene	total Cl-2 (PCB)
	biphenyl	total Cl-3 (PCB)
		total Cl-4 (PCB)
		total Cl-5 (PCB)
		total Cl-6 (PCB)
		total Cl-7 (PCB)
		total Cl-8 (PCB)
		total Cl-9 (PCB)
		total PCBs
		toxaphene

Analyte	Detection Limit
Inorganics	Vary for each sample and element
PCBs	0.5 ppm
All other organochlorines	0.02 ppm
PAHs	0.01 ppm

Appendix B: Analytes Tested at the Island Bay Drum Cache, June 1992

Aliphatic Hydrocarbons

	n-decane
	n-docosane
	n-dodecane
	n-dotriacontane
	n-eicosane
	n-heneicosane
	n-hentriacontane
	n-heptacosane
	n-heptadecane
	n-hexacosane
D	n-hexadecane
	n-nonacosane
D	n-nonadecane
S	n-octacosane
D	n-octadecane
	n-pentacosane
	n-pentadecane
	n-tetracosane
	n-tetradecane
<2x	n-tetratriacontane
<2x	n-triacontane
	n-tricosane
	n-tridecane
	n-tritriacontane
	n-undecane
	phytane

Polynuclear Aromatic Hydrocarbons (PAHs)

<2x	1,2,5,6-dibenzanthracene
<2x	1,2-benzanthracene
	1,6,7-trimethyl-naphthalene
	C1-fluoranthenes & pyrenes
	C1-phenanthrenes & anthracenes
	C1-chrysenes
	C1-dibenzothiophenes
	C1-fluorenes
	C1-naphthalenes
	C2-phenanthrenes & anthracenes
	C2-chrysenes
	C2-dibenzothiophenes
	C2-fluorenes
	C2-naphthalenes
	C3-phenanthrenes & anthracenes
<2x	C3-chrysenes
	C3-dibenzothiophenes
	C3-fluorenes
	C3-napthalenes
	C4-phenanthrenes & anthracenes
<2x	C4-chrysenes
	C4-naphthalenes
	acenaphthalene
	acenaptthene
	anthracene
<2x	benzo(a)pyrene
<2x	benzo(b)fluoranthene
<2x	benzo(e)pyrene
<2x	benzo(g,h,i)perylene
<2x	benzo(k)fluoranthene
S	biphenyl
	chrysene
S	dibenzothiophene
	fluoranthene
	fluorene
<2x	indeno(l,2,3-cd)pyrene
	naphthalene
<2x	perylene
	phenanthrene
	pyrene

Organochlorines

<2x	aldrin
<2x	hexachlorobenzene
<2x	heptachlor
	PCB-total
	alpha BHC
<2x	alpha chlordane
<2x	beta BHC
<2x	cis-nonachlor
<2x	delta BHC
	dieldrin
<2x	endrin
	gamma BHC
<2x	gamma chlordane
<2x	heptachlor epoxide
<2x	mirex
<2x	o,p'-DDD
<2x	o,p'-DDE
<2x	o,p'-DDT
<2x	oxychlordane
<2x	p,p'-DDD
	p,p'-DDE
<2x	p,p'-DDT
	toxaphene
<2x	trans-nonachlor

<2x **Analyte did not meet quality assurance criteria for detection limits.**

D **Analyte did not meet quality assurance criteria for duplicates.**

S **Analyte did not meet quality assurance criteria for spike recoveries.**

Appendix C: Remote Cabin Sites

Alaska Peninsula/Becharof Refuge Visit
August 22, 2000
Contaminant Assessment Process

1. Bible Camp on Becharof Lake (N 57°55.18.09 W 156°04.47.26)

At least 40 buried/partially buried drums, generators, and other miscellaneous debris exist at this site. Much of the debris is covered by thick vegetation, so it is hard to determine the extent of the debris. It is impossible to see most of the debris from the air due to the dense vegetation. Contamination may result from leaking drums (if they have contents). It is recommended that all debris be removed as soon as possible. This site is used by the public for recreational and educational purposes.

2. Lower Ugashik Lake Cabin (N 57°25.18.63 W 156°49.18.01)

This site has a variety of potentially contaminated areas and solid waste issues. Other debris, parts, drums, etc. also are associated with this site. A generator building exists within 25 yards of the shore of Lower Ugashik Lake. The smell of hydrocarbons is very strong in and near the building. Fuel cans partially covered by dense vegetation can be found near the building.

Five gallon fuel cans near the generator building.

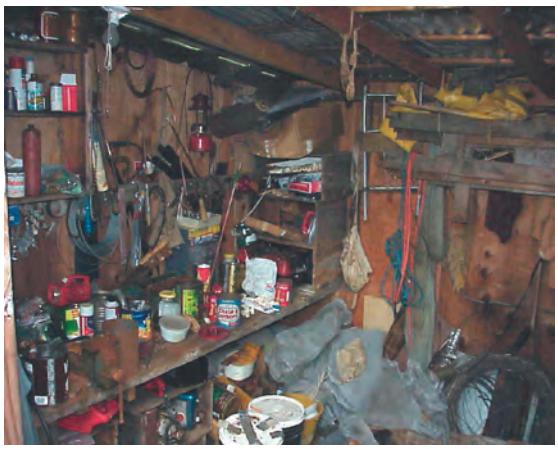
Generator building.

There is a watch tower located at the site. A strong hydrocarbon smell associated with gear oil permeates the area surrounding the watch tower. Hydrocarbon contamination is obvious at this site, and some remediation may be necessary. It is recommended that all debris be removed from this site and that remediation occurs (if needed) as soon as possible.

Watch tower.

Hydrocarbon spill.

Hydrocarbon spill.



Parts room.

Miscellaneous debris.

Fuel shed.

Drums by Ugashik Lake.

3. Subsistence Cabin (N 58°02.17.48 W 156°52.35.11)

Some debris can be found in this area, such as a few 55-gallon and 5-gallon drums and an old snowmobile. It is recommended that all debris be removed from the area as soon as possible.

Old snowmobile.

4. Trade and Manufacturing Site (N 58°02.00.48 W 156°52.05.79)

This area has debris ranging from an old jeep to batteries to empty Coleman fuel canisters. It is recommended that all debris be removed from the area as soon as possible.

Old jeep.

Five gallon cans.

5. Egegik River Fisheries Cabin (N 58°02.56.90 W 156°52.42.29)

A fuel oil leak occurred at this site for an unknown amount of time. The leaking fuel system was removed on July 24, 2000. The cabin is the property of the State, and the land is managed by the Refuge. Refuge personnel have also used the cabin as a field station on occasion. Refuge personnel have dug under the cabin and confirmed the leak has contaminated the ground beneath the cabin. The fuel leak appears to be quite extensive and, it is recommended that the contaminated area be evaluated and remediated if necessary. This cabin is located on the Egegik River, and it is possible that fuel may enter the river depending on the hydrology of the area and the extent of the spill.

Front of cabin.

Location of leaking fuel oil.

Location of leaking fuel oil (close-up).

Appendix D: *Exxon Valdez* Shoreline Oil Impacts

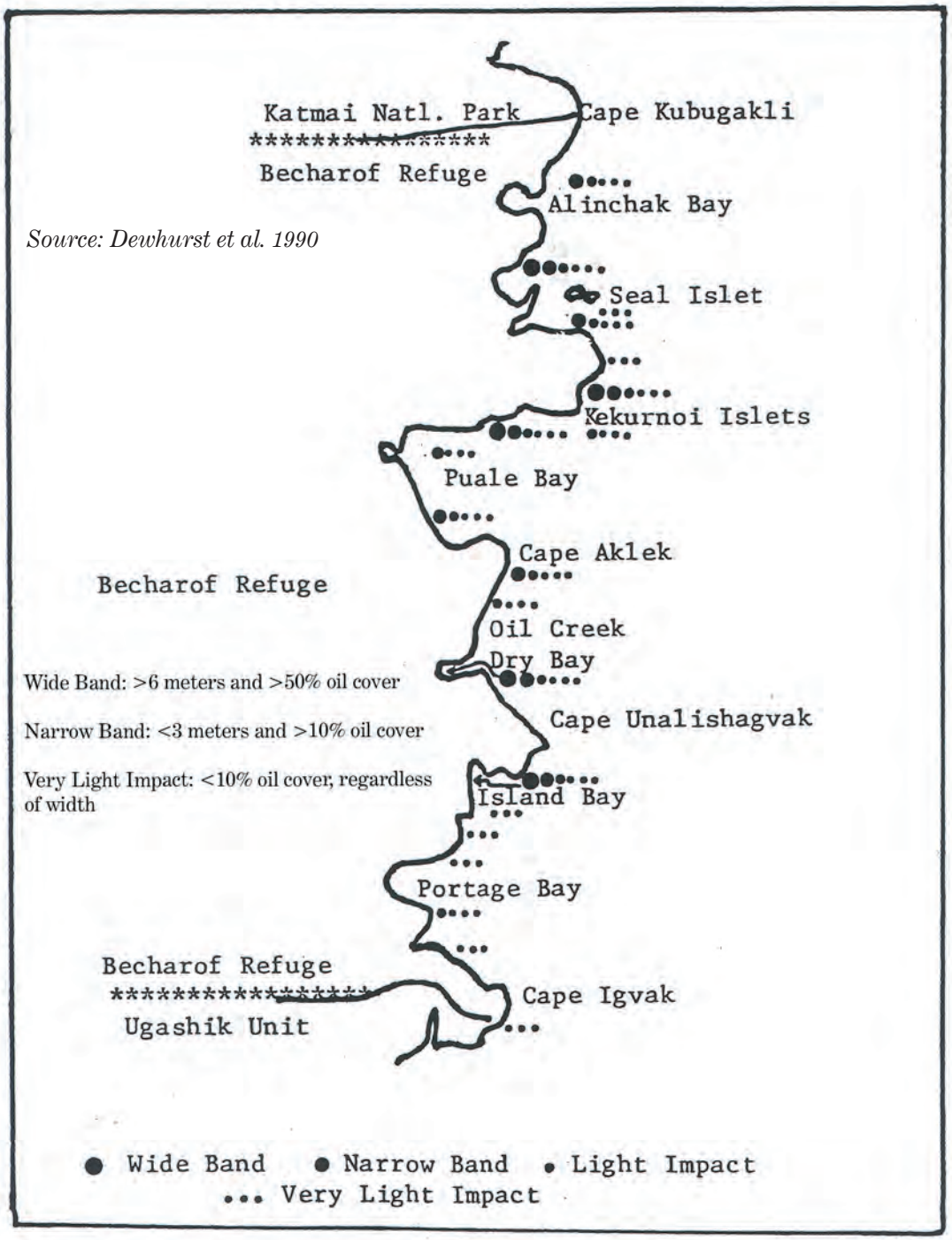


Figure 2a. Shoreline oil impacts observed on the Becharof Unit of the Alaska Peninsula/Becharof National Wildlife Refuges, Pacific Coast, April-August 1990.

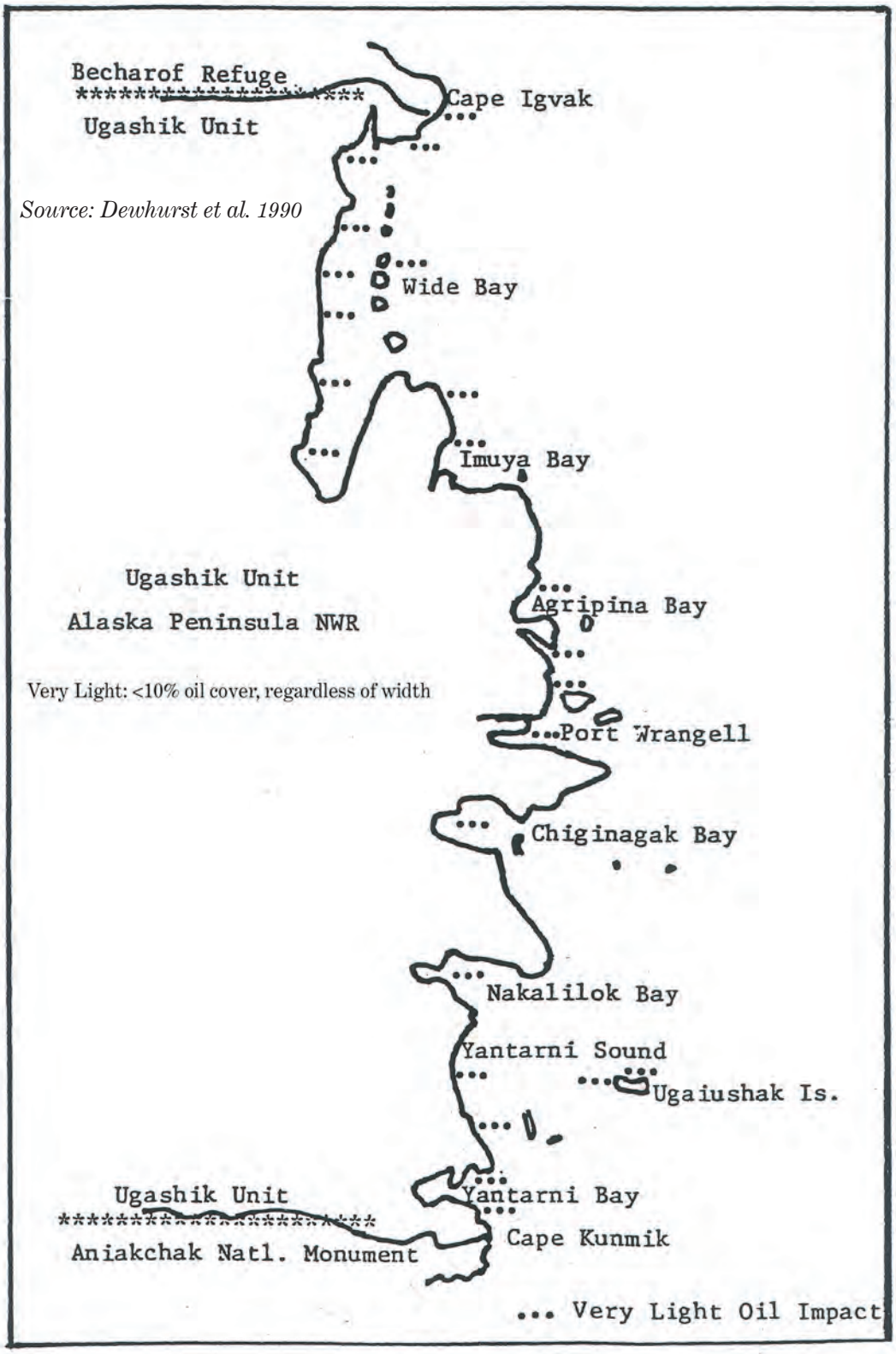
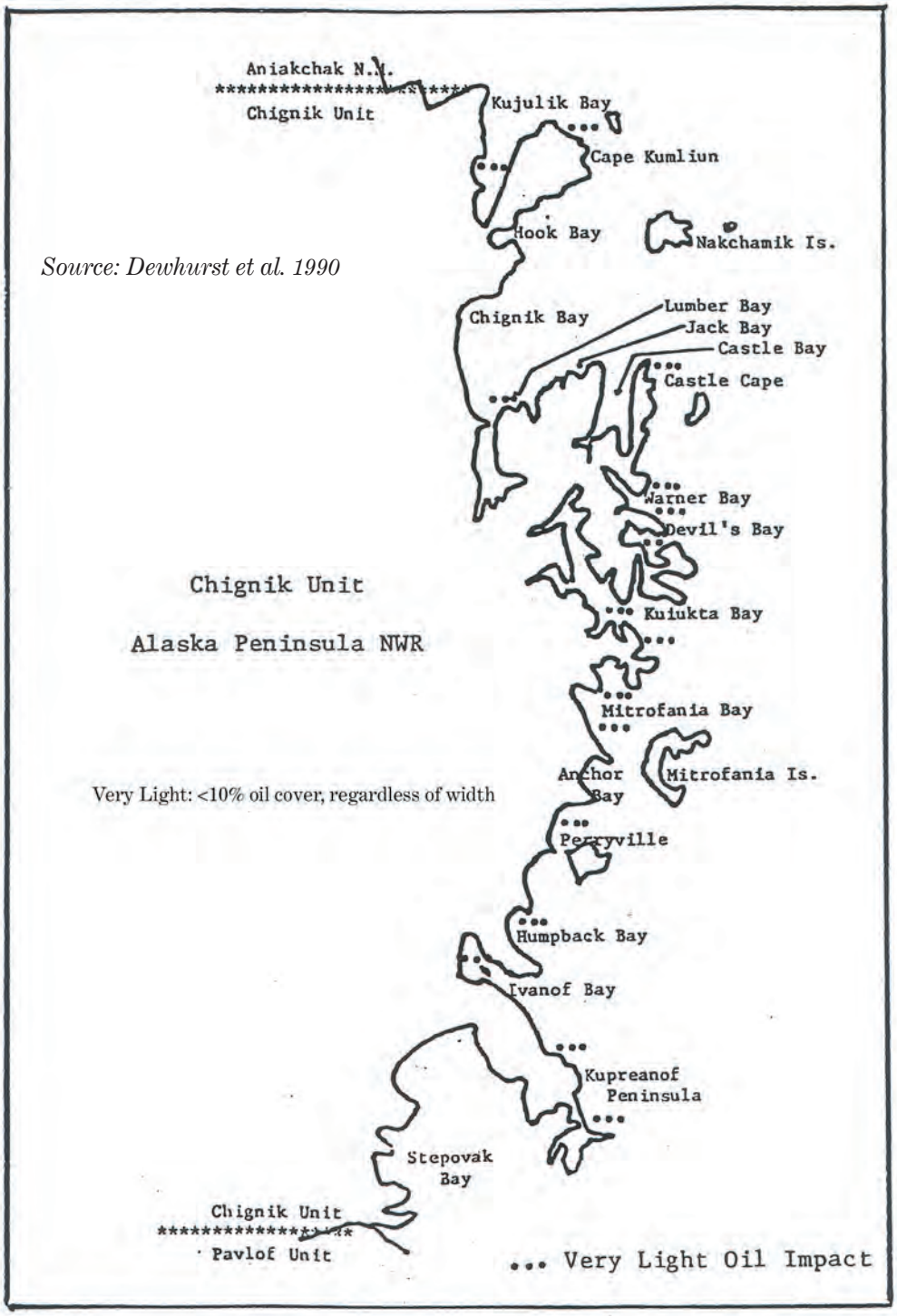


Figure 2b. Shoreline oil impacts observed on the Ugashik Unit of the Alaska Peninsula/Becharof National Wildlife Refuges, Pacific Coast, April-August 1990.



Source: Dewhurst et al. 1990

Figure 2c. Shoreline oil impacts observed on the Chignik Unit of the Alaska Peninsula/ Becharof National Wildlife Refuges, Pacific Coast, April-August 1990.

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