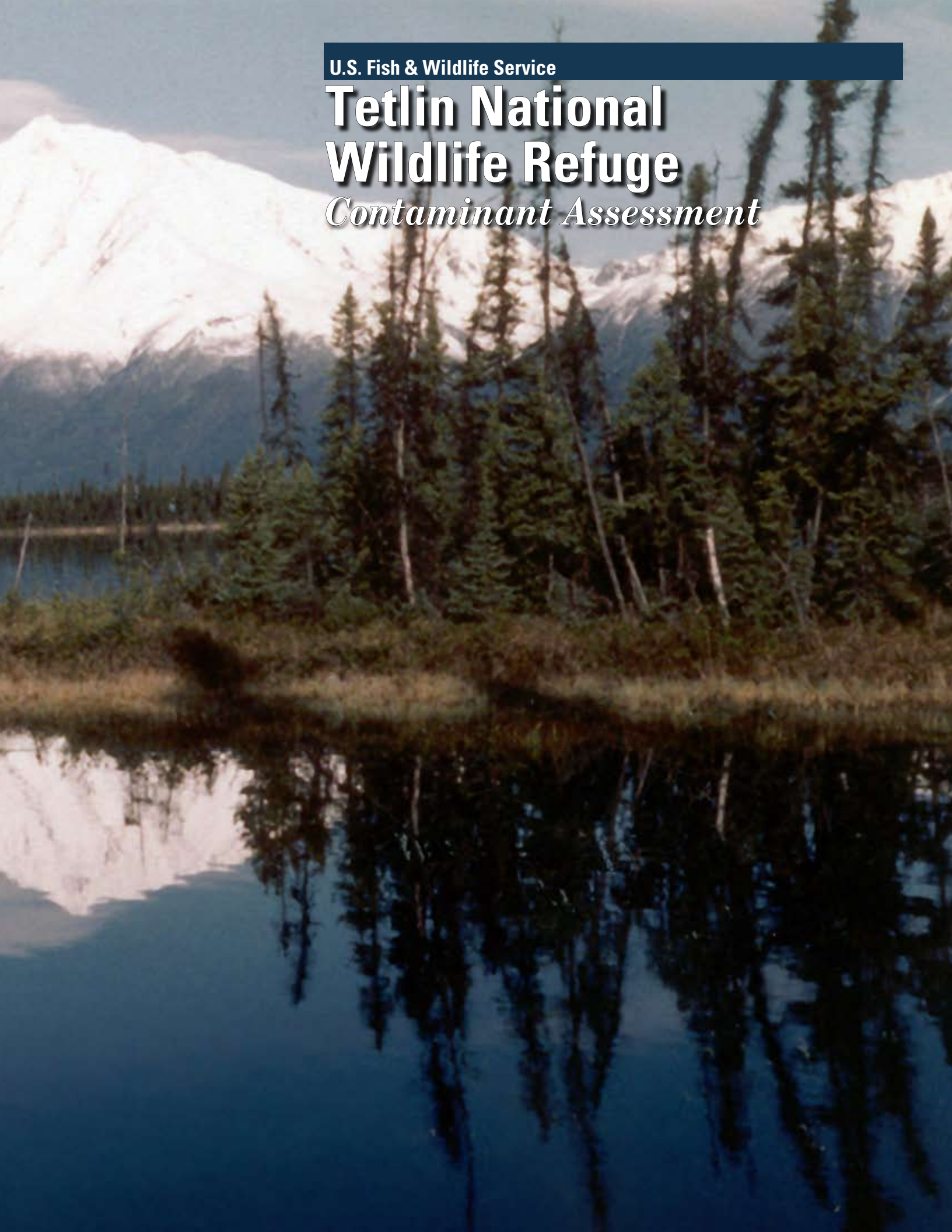


U.S. Fish & Wildlife Service

# Tetlin National Wildlife Refuge

*Contaminant Assessment*



Tetlin National Wildlife Refuge  
Contaminant Assessment

July 2007

This report may be cited as:

USFWS. 2007. Tetlin National Wildlife Refuge Contaminant Assessment. U.S. Fish and Wildlife Service, Regional Office, Anchorage AK. 54pp.

# *Executive Summary*

The purpose of the Contaminant Assessment Process is to compile and summarize known past, present, and potential contaminant issues on National Wildlife Refuges. This report documents contaminant issues on the Tetlin National Wildlife Refuge.

Most people regard National Wildlife Refuges as pristine areas reserved for wildlife. Although managing wildlife is a primary management goal, refuges often experience a wide variety of other uses. In Alaska, refuges have also been used for natural resource extraction, military operations, as well as recreational use. These activities may result in contamination of trust resources and require remediation.

Former military installations were the major source of contamination identified within the Tetlin National Wildlife Refuge boundary by this assessment. The Northway Village area supported a major military base during World War II and several sites within the area, but not on Refuge land, have contaminant issues. The Haines to Fairbanks pipeline was built to support military efforts and has several contaminant issues associated with it.

Other contaminant issues stem from inholdings and activities that predate the creation of the Refuge. Additional issues may arise as extraction of natural resources increase outside Refuge boundaries.

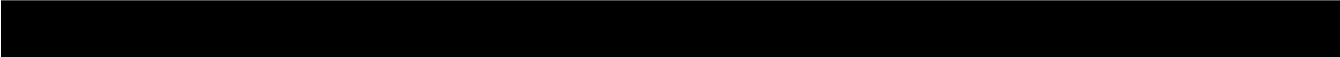
Despite its distance from industrialized areas, Tetlin National Wildlife Refuge has several contaminant issues that have been highlighted in this report. The Contaminant Assessment Process has gathered information to help Service personnel make informed management decisions about contaminant threats to refuge lands and resources.

# Table of Contents

List of Figures and Tables.....	v
Acronyms and Abbreviations.....	vi
Acknowledgments.....	viii
Author’s note .....	viii
Contaminant Assessment Process .....	1
The Contaminant Assessment Process in Alaska .....	2
Tetlin National Wildlife Refuge Complex.....	4
Contaminant Source and Issues .....	10
Formerly Used Defense Sites.....	11
Northway Staging Field .....	11
Pipelines.....	15
CANOL pipeline.....	16
Haines to Fairbanks pipeline .....	17
Lakeview Pump Station.....	23
Landfill.....	26
Alaska Highway .....	27
Seaton Roadhouse .....	27
Camps and Cabins.....	33
Trapper’s Cabin .....	33
Scottie Creek Cabins .....	33
Mining.....	35
Water Quality .....	38
Recreation.....	40
Hunting and Fishing.....	40
Recreational Vehicles .....	40
Biotic Sources and Physical Transport.....	41
Biotic Sources .....	41

**Table of Contents**

Physical Transport ..... 41  
Conclusion ..... 42  
Literature Cited ..... 43



# *List of Figures*

## *List of Figures*

Figure 1. The 16 National Wildlife Refuges in Alaska ..... 2

Figure 2. Location of the Tetlin National Wildlife Refuge ..... 4

Figure 3. Generalized Land Status of the Tetlin National Wildlife Refuge ..... 6

Figure 4. Site map for FUDs at Northway Staging Fields, Northway, AK..... 12

Figure 5. Route of the Haines to Fairbanks pipeline ..... 17

Figure 6. Map of sampling sites for the FUDs contaminant investigation along the Haines-Fairbanks Pipeline. 22

# *Acronyms and Abbreviations*

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
AFS	Air Force Station
ANILCA	Alaska National Interest Lands Conservation Act
ANCSA	Alaska Native Claims Settlement Act
AST	Above Ground Storage Tank
BEST	Biomonitoring of Environmental Status and Trends
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
bgs	Below Ground Surface
BLM	Bureau of Land Management
BRD	Biological Resources Division
CANOL	Canadian American Northern Oil Line
CAP	Contaminant Assessment Process
CCP	Comprehensive Conservation Plan
CFR	Code of Federal Regulations
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DERP	Defense Environmental Restoration Program
DEW	Distant Early Warning
DEQ	Division of Environmental Quality
DOD	Department of Defense
DOI	Department of the Interior
DRO	Diesel Range Organics
EO	Executive Order
EPA	United States Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GRO	Gasoline Range Organics
HVE	High Vacuum Extraction
IRP	Installation Restoration Program

## Acronyms and Abbreviations

LORAN	Long Range Navigation
MAR	Minimally Attended Radar
NORAD	North American Aerospace Defense Command
OCs	Organochlorines
PAHs	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
ppm	Parts per Million
ppb	Part per Billion
POL	Petroleum, Oil and Lubricants
POP	Persistent Organic Pollutant
RCB	Risk Based Concentration
RRO	Residual Range Organics
Service	United States Fish and Wildlife Service
SVOCs	Semi Volatile Organic Compounds
System	National Wildlife Refuge System
TNWR	Tetlin National Wildlife Refuge
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corp of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USGS	United States Geological Survey
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds



## **Acknowledgments**

Many individuals contributed to this report. The Tetlin National Wildlife Refuge staff provided information, logistic support, and reviews that were helpful, particularly Buddy Johnson, Heather Johnson, Hank Timm, Philip Martin, Phil Johnson, and Angela Matz provided support and feedback throughout the CAP process. Thanks also go to Cris Dipple, Tony Booth, Kim Milton, and Bret Christensen for reviewing this report.

## **Note**

This product is a synthesis of available information on contaminant issues in the Tetlin National Wildlife Refuge. Many sources have been used to produce this document and some passages have been reproduced from the Refuge's Annual Narratives, webpage, and fact sheet. When appropriate, specific source of information has been cited and listed in the Literature Cited section of this document. However, the volume of internal memos, Department of Defense documents, and personal observations and conversations precluded the citation of every source used to produce this CAP.

# Contaminant Assessment Process



The Contaminant Assessment Process (CAP) is a standardized and comprehensive method for assessing contaminant threats on National Wildlife Refuges, which encompass over 92 million acres in the United States. 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 U.S.C. § 668dd(a)(2)]. It is the responsibility of the United States Fish and Wildlife Service (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 U.S.C. § 668dd(a)(4)(B)].

---

*“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.”*

---

Wildlife refuges are often thought of as pristine areas, however many refuges have contaminant issues. The CAP is an important way of documenting, assessing, and monitoring contaminant threats on refuges. The CAP 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 synthesize existing information thereby documenting past, present, and potential contaminant issues that may affect refuges. Assessing contaminant sources and receptors, contamination events, transport mechanisms, and areas vulnerable to contamination are all aspects of the CAP. This comprehensive account of actual and potential contaminant issues are entered into CAP’s national database, which enables Service personnel to initiate remedial activities or more detailed studies of potential problems affecting trust resources, develop proposals for future investigations, and initiate pollution prevention activities. The CAP was initiated nationally on refuges in 1995-1996.

### 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). Fully 82% of the National Wildlife Refuge lands are in Alaska, totaling more than 76 million acres. Although Alaska is often regarded as a pristine wilderness, very few places in Alaska, even the most remote, are untouched. Alaska's history, and seemingly its future, is linked to natural resources. The exploration and extraction of oil and precious metals has left a legacy of contaminant problems throughout the state, as well as in its National Wildlife Refuges. Alaska also has played a key role in national defense during and following World War II. Past and current activities in Alaska's refuges include oil exploration and drilling, mining, military activities, and even nuclear weapons testing. Often, sites are abandoned after operations cease and, due to the high cost of removal, debris and entire structures are left to decay. In some areas, hazardous materials were spilled with little or no cleanup. On many refuges, abandoned 55-gallon drums, which eventually rust and release their contents, dot the landscape.



Figure 1. The 16 National Wildlife Refuges in Alaska.

The Alaska National Interest Lands Conservation Act (ANILCA) mandated that refuges develop a Comprehensive Conservation Plan (CCP; 16 U.S.C. § 304(g)(1)(1980)) that identify and describe “significant problems which may adversely affect the populations and habitats of fish and wildlife” ANILCA § 304(g)(2E)(1980). Implementation of the CAP in Alaska has made these issues part of the public record and helped managers incorporate contaminant issues into refuge CCPs.

Five refuges in Alaska have received contaminant assessments; Kenai, Alaska Peninsula, Becharof, Togiak, and Izembek National Wildlife Refuges. These comprehensive reports detailing contaminant issues on the refuges are available in hard copy, compact disc, and via the internet at <http://alaska.fws.gov/fisheries/contaminants/process.htm>. For further information about these reports, please contact the Regional Office in Anchorage, Alaska at 907/786-3483.



*Fireweed is one of the first species to move into a recently burned area.*

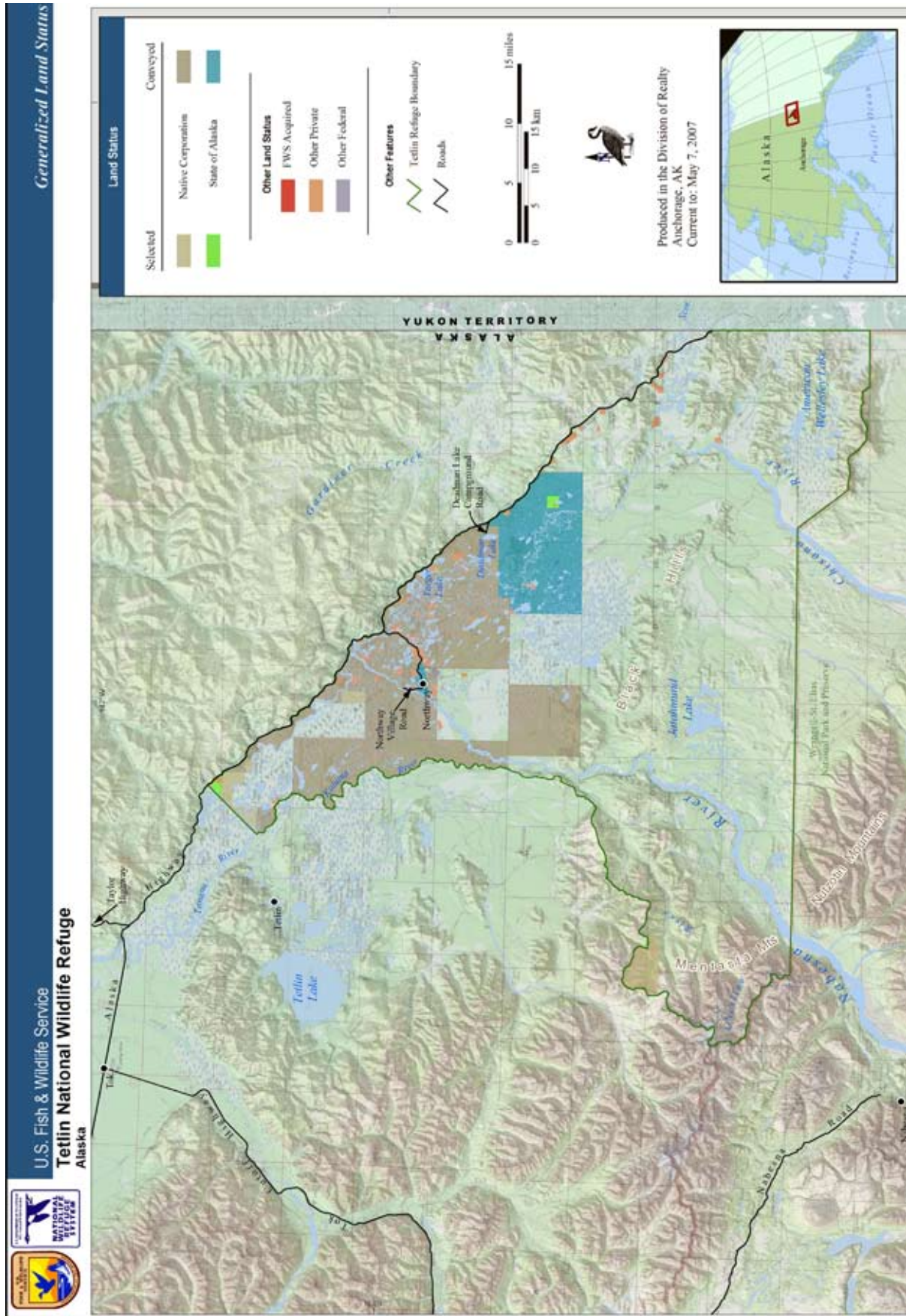
USFWS

# *Tetlin National Wildlife Refuge*

Tetlin National Wildlife Refuge (TNWR Figures 2 and 3) abuts the Canadian border just northeast of the Alaska Range and is bordered by Wrangell-St. Elias National Park and Preserve to the south. This common boundary with Wrangell-St. Elias National Park and Preserve and Kluane National Park in Canada form the world's largest contiguous conservation unit. The northern boundary of TNWR extends 65 miles along the Alaska Highway. One of two Alaska refuges that can be reached by road, TNWR is 230 miles southeast of Fairbanks on the Alaska Highway and Anchorage lies 350 miles southwest via the Glenn Highway.



**Figure 2. Location of the Tetlin National Wildlife Refuge.**



**Figure 3. Generalized land status of the Tetlin National Wildlife Refuge.**  
 USFWS Division of Realty and Natural Resources.

The Refuge was established in 1980 with the passage of ANILCA, which set aside 730,000 acres to protect key wetland habitats in the Upper Tanana Valley. The boundaries of the Refuge encompass 931,500 acres, however the Service does not have management authority over all of this land. Private landowners, Native Corporations, and the State of Alaska have title to lands totaling about 203,291 acres within the Refuge boundaries



B. Johnson/USFWS

*Wetlands and ponds support migration and breeding of the many waterfowl species that occur on the Refuge.*



USFWS

*Northern hawk owls (Surnia ulula) are year round residents of the Refuge.*

Tetlin National Wildlife Refuge is a dynamic landscape of forests, wetlands, tundra, lakes, mountains and glacial rivers bounded by the snowy peaks of the Alaska Range. The upper Tanana River valley is a major migratory bird route. An estimated 143 bird species breed on TNWR, including species such as red-winged blackbird (*Agelaius phoeniceus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and blue-winged teal (*Anas discors*) that are rare or absent elsewhere in the state. The Refuge, which was primarily created to support one of the highest densities of nesting waterfowl in Alaska, produces an estimated 35,000 to 65,000 ducklings each year. Thirty-two osprey (*Pandion haliaetus*), 64 bald eagle (*Haliaeetus leucocephalus*), and 13 peregrine falcon (*Falco peregrinus anatum*) pairs occupied nests on and adjacent to the refuge in 2003 [1]. Spectacular migrations of sandhill cranes (*Grus canadensis*), tundra (*Cygnus columbianus*) and trumpeter (*Cygnus buccinator*) swans occur each spring and fall. Several thousand swans stage on Tetlin NWR each fall and the Refuge supports an expanding population of trumpeter swans, a nationally significant species. Up to 200,000 sandhill cranes, representing about one half of the world population, migrate through this corridor. Migrants begin arriving in the valley in April on their way to breeding grounds elsewhere in the state. The Refuge's location within a major migration corridor contributes to the diversity of landbirds, many of which reach their northern range limit here. However, only about 25 year-round resident species are able to tolerate the extreme winter weather.



USFWS

*Lesser yellowlegs (Tringa flavipes) are the most abundant breeding shorebird on the Refuge.*



There are 44 species of mammals known to occur on Tetlin Refuge. The Refuge is home to most of the mammals that regularly occur in interior Alaska. Refuge mountains, forest and tundra are inhabited by Dall sheep (*Ovis dalli*), moose (*Alces alces*), caribou (*Rangifer tarandus*) from three distinct herds, wolves (*Canis lupus*), grizzly (*Ursus arctos*) and black (*U. americanus*) bear. Two of the six known humpback whitefish (*Coregonus sardinella*) spawning areas in the Yukon River drainage are located within the Refuge. Along with caribou and moose, these fish are important subsistence resources for area residents. Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*) and burbot (*Lota lota*) are also found in the Refuge's many streams and lakes. Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. keta*) were historically present on TNWR however, no salmon are known to occur in Refuge waters today. Tetlin NWR contains important sport and subsistence fisheries for burbot, Arctic grayling, northern pike, and several species of whitefish.



S. Bresser/USFWS

*Wolves are captured and fitted with collars to study early summer movements and predation rates.*

The management of each refuge is dictated, in large part, by the legislation that created the Refuge. In 1980, ANILCA [16 U.S.C. § 302 (8) (B) states “[t]he purposes for which the Tetlin National Wildlife Refuge is established and shall be managed include--

(i) to conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, waterfowl, raptors and other migratory birds, furbearers, moose, caribou (including participation in coordinated ecological studies and management of the Chisana caribou herd), salmon and Dolly Varden;

(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;

(iv) to ensure, 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; and

(v) to provide, in a manner consistent with subparagraphs (i) and (ii), opportunities for interpretation and environmental education, particularly in conjunction with any adjacent State visitor facilities.”

---

**Tetlin NWR is the only refuge in Alaska tasked with providing opportunities for interpretation and environmental education.**

---

While the first four purposes are common to most wildlife refuges in Alaska, the TNWR was given the unique responsibility of providing opportunities for interpretation and environmental education. Identified special values of TNWR include the sand dunes of the Tanana Valley, the subsistence way of life practiced by residents of the area, wetland habitats for waterfowl and other bird species, fish and wildlife resources, cultural resources, and opportunities for public education regarding natural and cultural resources afforded by the proximity of the Alaska Highway.



USFWS

*Pulsatilla patens in the first flower to bloom after snowmelt.*

# *Contaminant Sources and Issues*

Prior to and since its establishment, TNWR has experienced a variety of activities that have introduced contaminants into the environment. Former military facilities lie within the boundary of the Refuge. During World War II, the Alaska Highway and oil pipelines were built on lands that abut, or in the case of the pipeline, traverse portions of the Refuge.



# Formerly Used Defense Sites

## Northway Staging Field

Construction of the Northway Airport and associated staging areas began in 1941 to support troop deployment in Alaska during World War II. Northway served as a refueling and maintenance stop for aircraft and a staging area for work on the Alaskan Highway, Canadian Oil pipeline project, and a defense fuel pipeline. The army ceased using the site at the end of World War II and returned ownership and operation

to the Civil Aeronautics Administration and its successor agency, the then named Federal Aviation Agency (FAA). The FAA transferred the Northway Airport and an additional 1,200 acres of land to the State of Alaska in 1966. Other lands associated with the site have been transferred to a Native corporation and several private landowners. The Northway Staging Fields site is comprised of 52 areas of concern divided into five Operable Units (OUs) that lie within TNWR boundaries on State and Native conveyed lands that cover approximately 11.5 square miles (over 7,000 acres) around the Northway Airport.



Historic Photo/DOD

*Tank farms at the Northway Staging Field*

In 1983, the Defense Environmental Restoration Program (DERP) was established (P.L. 98-212) to consolidate and expand environmental restoration at active installations and Formerly Used Defense Sites (FUDS), such as Northway Staging Field site. The Department of Defense (DOD) is responsible for environmental restoration of properties that were formerly owned by, leased to, or otherwise possessed by the United States and under the jurisdiction of the Secretary of Defense. The Army is the executive agent for the FUDS program and the U.S. Army Corps of Engineers (USACE) manages and directs the program's administration. In 1994, the USACE identified 52 areas of contaminant concern at the Northway Staging Field Site [2] (Figure 4). These areas

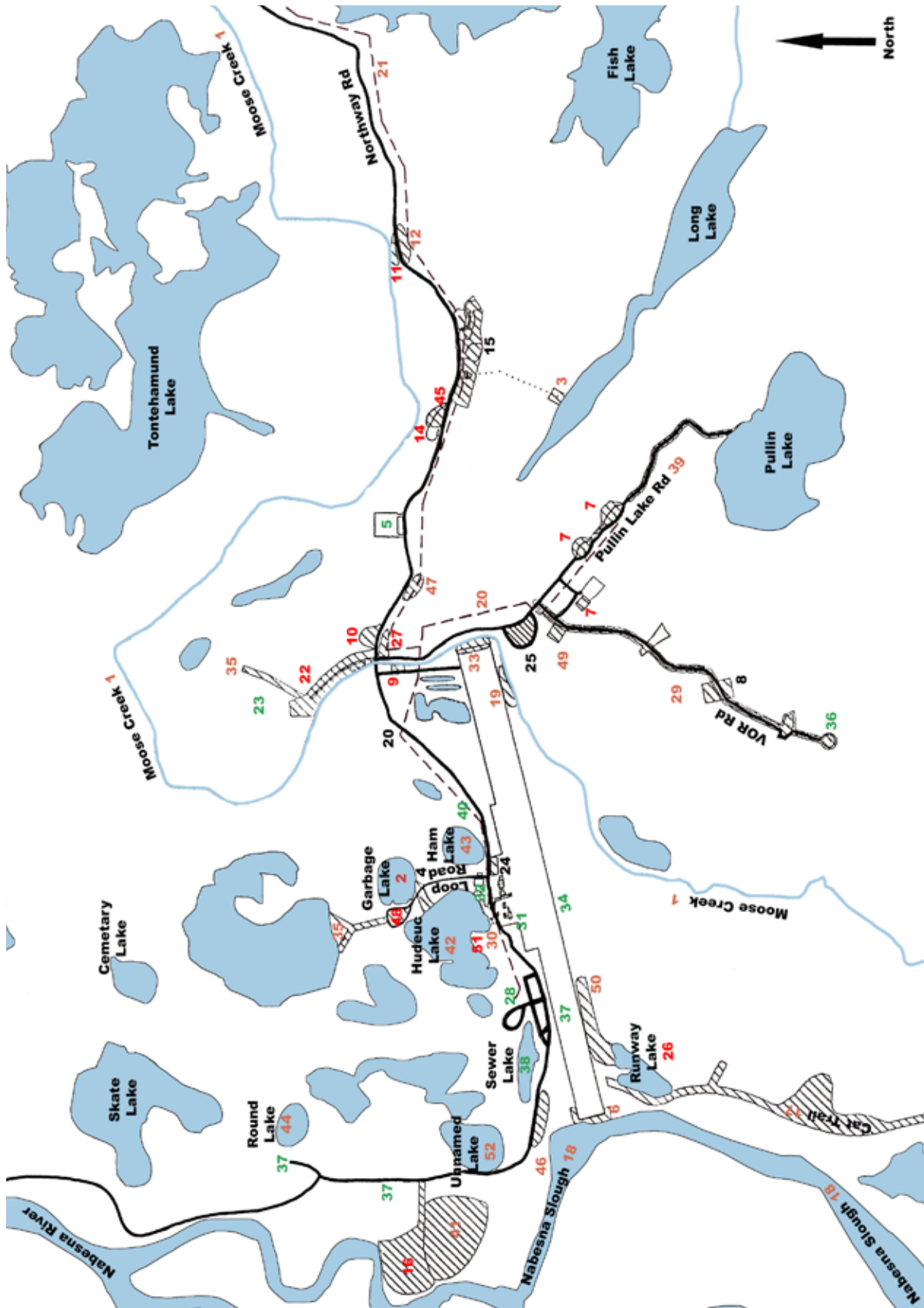


Figure 4. Site map for FUDs and areas of contaminant concern at Northway Staging Fields, Northway, AK, U.S. Army Engineer District, AK, Northway Site Plan. See reference #2 for legend..

contained a pipeline, several hundred 55-gallon drums, above- and underground fuel storage tanks, mounds of tar-contaminated soil, and large quantities of hazardous debris.

In the mid-1980s, a partial cleanup of barrels and tarred soil was conducted by the FAA and Alaska Department of Environmental Conservation (ADEC). Several sites (now areas 9, 10, and 37) were listed as a Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) sites by the Environmental Protection Agency (EPA) during this time. The first field inspection was conducted in 1986, which documented much of the solid wastes in the Northway area and estimated cleanup costs [3]. Preliminary sampling and analyses by USACE

detected DDT/DDE in fish tissue and sediment sampled near the asphalt barrel disposal area next to Moose Creek in 1987. These results prompted the Service to conduct a limited contaminant study in the Moose Creek drainage in 1990 [4]. This study detected DDE in one northern pike liver (0.71 ppm) and one soil sample (0.05 ppm). The Service concluded that concentrations of aliphatic and aromatic hydrocarbons in water, sediment, and fish were low and, based on the limited number of samples that had concentrations above detection limits, the Service also concluded that DDT and its metabolites were below threshold levels in Moose Creek.

In the early 1990s, numerous reports were generated that provided literature reviews, site rankings, preliminary risk analyses, results from limited sampling and analyses, and assessment of responsible parties. There were also claims by local residents that cancer rates in Northway were elevated with respect to national averages. In 1993, the entire Northway Village Staging Area was added to EPA's CERCLIS database



E. Snyder-Comm/USFWS

*Crushed barrels containing asphalt residues exposed along the slopes of the Moose Creek landfill.*

and a preliminary assessment that provided information on sources of potential contamination was completed. A Focused Remedial Investigation was conducted in 1994 which identified 38 areas of contaminant concern in Northway [5]. Several subsequent investigations have increased the number of individual contaminant areas to 52. Forty-one of the 52 sites have surface debris that is either wholly or partially military in origin.

In 2002, a Decision Document for OU1, which comprises 31 sites (21 of military origin), was approved for No Further



*Lake in Northway Village showing 55-gallon drums that were dumped in it.*

Action. It was determined that these sites either have no source of chemical contaminants or no significant chemical risk to human health or the environment. In general, decisions to close sites as No Further Action were based on limited site history, visual inspection, and few (if any) data from field screens of surface soils. In several instances, risk to human or ecological receptors were considered non-significant, in part, because “permafrost likely creates a barrier to groundwater flow between the suprapermafrost and

subpermafrost aquifers throughout the Northway vicinity” [5]. However, as Alaska’s permafrost thaws [6] the risk to human and ecological receptors is likely to increase.

In 2004, a Proposed Plan was drafted recommending No Further Action for the 11 sites that comprise OU3 [7]. The No Further Action recommendation was proposed because sites either are not contaminated above background levels, meet ADEC’s or established alternate cleanup levels, or do not pose unacceptable risk to human health or the environment. Several sites with petroleum contamination, most notably Ham Lake, still remain active and present a potential contaminant impact to trust resources within TNWR.

## Pipelines

The military buildup in Alaska that was part of and subsequent to World War II required transport of large amounts of fuel to interior Alaska. Traditional methods (tankers, trains, and trucks) for supplying fuel were both unreliable and vulnerable to attack. Alaska's importance during the Cold War effort necessitated a quick and reliable fuel delivery system to military installations and construction of pipelines, which were smaller and less visible than other delivery systems, were authorized [8]. The first pipeline to be constructed in the Interior was the Canadian American Northern Oil Line (CANOL) that delivered fuel from a refinery in Whitehorse, Yukon Territory, Canada to Fairbanks, AK, Skagway, AK, and Watson Lake, YT. The combined length of the CANOL pipeline was 1,600 miles. After the war, the Haines-Fairbanks pipeline was constructed to supply fuel to several Air Force bases. The 626 mile long pipeline could deliver 27,500 barrels per day from Haines to Fairbanks, AK.

*Pipeline welding the CANOL on Macmillian Pass.*



Both pipelines were on and/or adjacent to lands that are now part of the TNWR. Spills, leaks, and chemical spraying to control vegetation have been documented in these pipeline corridors. Neither pipeline is in use and numerous environmental evaluations have been conducted since the early 1990s.



### CANOL pipeline

The CANOL pipeline had a 35 months lifespan from conception to abandonment, and by one account operated only 11 months. The pipeline was constructed to carry oil from Norman Wells on the Mackenzie River in the Northwest Territories to Whitehorse in the Yukon (where a refinery was built). Fuel was needed for construction of the Alaska Highway, military bases in Canada and Alaska, and airfields used to ship planes to Russia. From Whitehorse, a smaller pipeline was built alongside the new Alcan Highway to Ladd Field in Fairbanks, AK. Construction started in summer 1942 and was completed in February 1944. Between July and November of 1944, the project provided all of the motor vehicle fuel requirements for military needs between Watson Lake and Fairbanks and also exported between 20 million and 40 million liters of oil to Skagway. On March 8, 1945, eleven months after the oil first reached Whitehorse, the U.S. Army terminated the project.

The U.S. government planned to sell the pipeline to the highest bidder, who would then operate the CANOL pipeline. However, no companies bid to operate the pipeline and salvage operations were undertaken by the U.S. military and later, in 1947, by Imperial Oil. Salvage operations included the removal of brass valves, power units, motors, and pipes. Environmental remediation was not part of any salvage operation. At present, sections of pipe, vehicle dumps, barrel caches, and camps remain along the CANOL pipeline route.

In 1998, the EPA performed a site inspection for the CANOL Pump Station J site, adjacent to the TNWR. Surface water and sediment was sampled from two locations on the Refuge, as well as at several locations potentially upstream (north) of Refuge lands. Samples were analyzed for residual range organics (RRO), diesel range organics (DRO), volatile organic compounds (VOCs) and inorganics. Based on analytical results, Site Inspection, and “other pertinent information”, the EPA anticipated no further Federal Superfund action for Pump Station J.

In 2002, the Tanana Chiefs Conference, Inc. conducted a Phase II Environmental Site Assessment on a Native Allotment in Northway Village in response to a landowner



Harry Rowed/National Film Board of Canada/  
Library and Archives Canada/PA-174542

CANOL pipeline inspection.

within the allotment encountering petroleum contaminated soil while excavating for a septic tank. Thirty-three soil samples were collected on the allotment and analyzed for DRO, gasoline range organics (GRO), benzene, toluene, ethylbenzene, and xylenes (BTEX), VOCs, semi-volatile organic compounds (SVOCs), and lead. Diesel range organics (DRO) and GRO were detected at concentrations above ADEC cleanup levels. DRO concentrations ranged from 880 to 12,000 mg/kg in soil samples, which exceeds ADEC Method One Cleanup Level of 200 mg/kg, Method Two Migration to Ground Water Cleanup Level of 250 mg/kg, and in several cases Method Two Soil Ingestion Cleanup Level of 10,250 mg/kg. GRO concentrations ranged from 100 to 500 mg/kg in soil, which equaled or exceeded ADEC Method One Cleanup Level of 100 mg/kg and in some cases exceeded the Method Two Migration to Ground Water Cleanup Level of 300 mg/kg. An estimated 60,000 to 70,000 cubic feet of soil are contaminated on the allotment. Due to the ongoing remediation in Northway Village, it is unclear at this time what remedial actions will be used to address these petroleum contaminated soils.

### Haines to Fairbanks Pipeline



**Figure 5. Route of the Haines to Fairbanks pipeline.**

Planning to replace the defunct CANOL pipeline was initiated in 1945 and the Haines-Fairbanks pipeline was built from 1953-55, crossing tundra, mountain ranges, swamps, and streams and supplied fuel to Fort Greely, Fort Wainwright (previously known as Ladd Air Force Base), and Eielson Air Force Base in interior Alaska. Approximately 21 miles of the pipeline was built on or adjacent to Refuge lands, the largest continuous stretch (almost 7.75 miles) occurring from milepost 1242.5 to 1235 on the Alaska Highway, near the former Seaton Roadhouse (see below). There are several potentially affected drainages, including Mirror Creek, Little Scottie Creek, Scottie Creek, Desper Creek, and the north and south forks of Sweetwater Creek.

The 626 mile long, eight-inch diameter pipeline system required a 50-foot corridor and, including pump stations, occupied over 2,400 acres which were acquired by Declaration of Taking and withdrawal of public lands, including what are now TNWR lands (Fig 5.). The pipeline carried diesel fuel, jet

fuel automotive gasoline, and aviation gasoline from the Port of Haines to military bases from 1955-1973.

Initially, five pump stations moved the fuel over mountain passes along the route. However, the increasing demand for fuel necessitated the construction of six additional pump stations in 1961 (including the Lakeview Pump Station, see below). The addition of the six pump stations increased maximum fuel delivery from 16,500 to 27,500 barrel/day. The US Army was in charge of distribution of fuel although the United States Air Force (USAF) used over 90% of the fuel carried in the pipeline [8].



S. Bresser/USFWS

*A portion of the Haines to Fairbanks pipeline prior to removal.*

When the pipeline was completed in late 1955, the integrity of the line was tested with water. No major leaks were found and the pipeline began delivering fuel in November 1955.

Pressure was soon lost and delivery slowed to a trickle due to frozen water in the line. Ice was removed from the pipeline by cutting the pipe where blockages were found. Fuel and ice were discharged on the ground and left to evaporate.

The Haines to Tok section of the pipeline was permanently shutdown due to high maintenance and repair costs in 1972 after corrosion was detected on that section of the pipeline. The pipeline section was cleaned with propanol, water, and air and left in place. In 1973, the Tok to Eielson section of the pipeline was scrubbed clean and deactivated. Although the majority of the pipeline was no longer in service, the tank farms were used for storage until 1979. There were 40 recorded spills on the Haines-Fairbanks pipeline, the majority associated with the 1956 water freeze. Under the FUDS program, the USACE will investigate petroleum contamination within the pipeline right-of-way. The USACE has developed a sampling plan that will be implemented in fall 2005 (see [http://www.dec.state.ak.us/spar/csp/sites/haines\\_fair\\_pipe.htm](http://www.dec.state.ak.us/spar/csp/sites/haines_fair_pipe.htm) for updates and final report).



*Pipeline corridor can be seen as a discolored strip in vegetation.*

USFWS

During the initial investigation and planning for petroleum sampling, documents were discovered that indicated that herbicides were used to control vegetation along the corridor in the 1960s (see [9] for references to original documents). Some herbicides mentioned in the documents, particularly Esteron Brush Killer, contained the same ingredients used to make “Agent Orange” and potentially contained similar dioxin congeners (e.g., 2,4,5-trichlorophenoxyacetic acid; 2,4,5-T) that are of toxicological concern. Therefore sample analyses in subsequent studies focused on the more toxic 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) congener that is often formed during the manufacture of Esteron Brush Killer.



D. Rocque/USFWS

*The pipeline corridor is easy to find as it is devoid of large trees in most places.*

Results from several studies conducted in Canada indicated that Esteron was applied to the pipeline corridor [10]. Sampling that evaluated risk to human health and the environment was completed in October 2003 by USACE. Of the 23 soil samples collected and analyzed by the FUDS program, only three were on or adjacent to TNWR. Because the toxicity of the different compounds or congeners that are present in dioxins varies greatly, individual congeners are given a “Toxicity Equivalence Factor” (TEF) which expresses

that congeners' toxicity relative to 2,3,7,8-TCDD [11]. To determine the total TCDD "Toxicity Equivalence Quotient" (TEQ) of a dioxin mixture, the concentration of each congener are multiplied by their TEF and added together.

ADEC risk based cleanup goals for dioxin is 39 ng/kg in soils and all sample TEQ values were below this concentration. Samples collected on or adjacent to the Refuge had a TEQ value of < 0.75 ng/kg and 2,3,7,8-TCDD was not detected in any sample (on or off Refuge). Of the seven samples that had TEQ levels above that considered background, one (sample SU17, 0.75 ng/kg) was collected near the Refuge, close to the Seaton Roadhouse site (see below). USACE stated that the distribution of dioxin congeners closely resembled the distribution expected from general combustion processes, not dioxin-contaminated 2,4,5-T. Although the USACE acknowledges that these results are not conclusive proof that these herbicides were not sprayed along the pipeline they are not planning additional sampling for dioxins along the pipeline. ADEC concluded that no detectable remnants of herbicides or herbicide-generated dioxins were present in any sample and that widespread or systematic use of "Agent Orange" like herbicides did not occur along Alaska portions of the Haines-Fairbanks pipeline.

As part of their continuing investigation of contamination along the Haines-Fairbanks Pipeline, the FUDS program is conducting sampling at numerous gate and check valve locations, as well as documented spill sites along the pipeline corridor. At present, only one of these areas of concern, Gate Valve 46, is located on the Refuge. This site is located at Mile Post 357 of the Haines-Fairbanks Pipeline, approximately 18 miles from border with Canada (Fig 6).

The State of Alaska is soliciting proposals to build a natural gas pipeline that would transport gas to consumers both within and outside of the State. Should such a pipeline be permitted and built, one of the potential routes would follow the Alaska Highway into Canada. This route could cross the refuge in more than one location. This major project would require extensive planning and review during the permitting process.

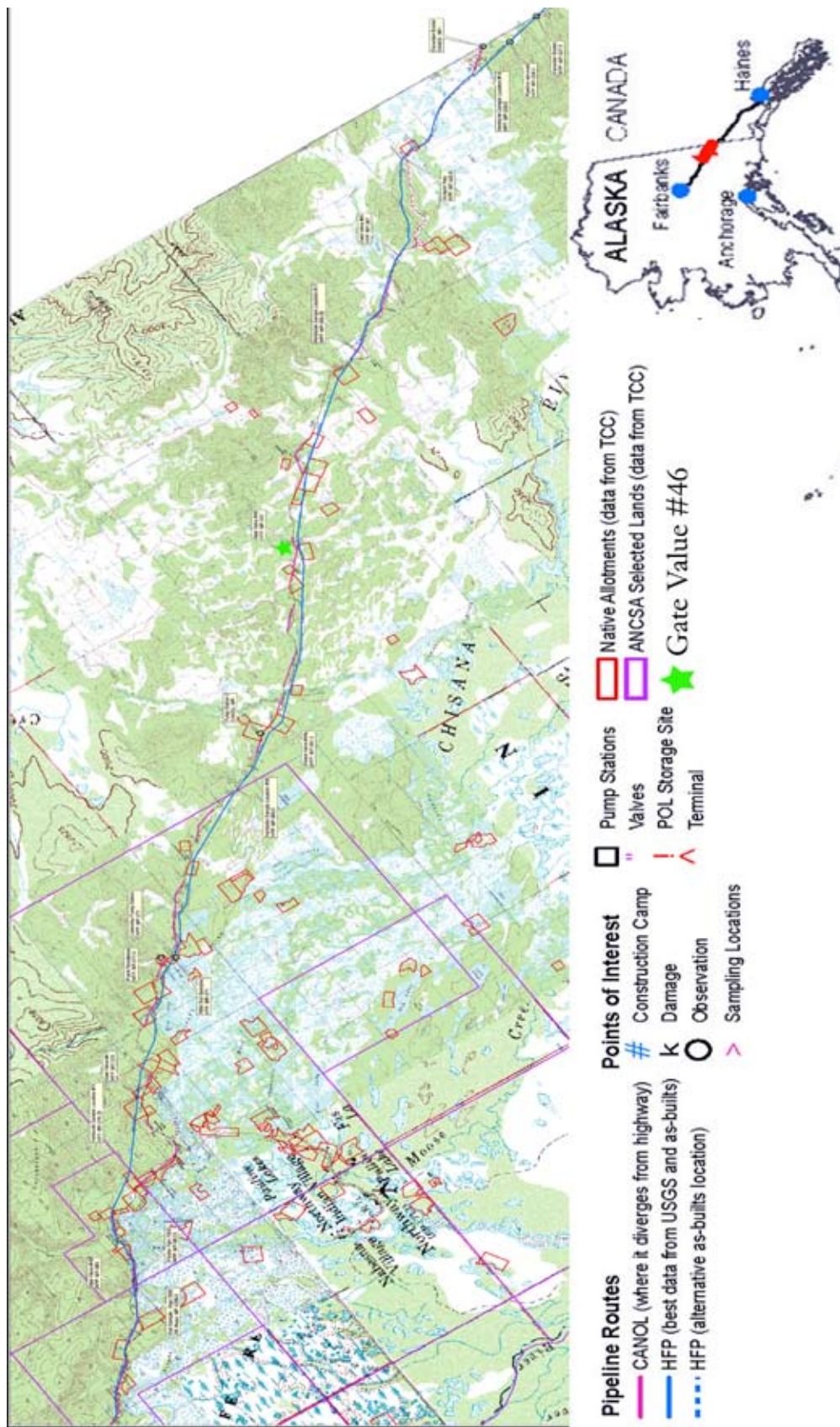


Figure 6. Map of sampling sites for the FUDs contaminant investigation along the Haines-Fairbanks Pipeline. Gate Value #46 is the only sample site on the Refuge and is highlighted by a green star. US Army Corp of Engineers, FUDS Program

### Lakeview Pump Station

In 1961, in response to increasing fuel needs, the Haines to Fairbanks pipeline capacity was upgraded with the addition of six new pumps stations that would be used to boost pressure. The additional pump stations increased the highest pump capacity from 16,500 barrels a day to 27,500. The new stations were only used at full capacity for a few years, until military fuel needs decreased.



*Miscellaneous debris at the Lakeview Pump Station in 2004.*

D. Roelke/USFWS

Among the new stations was the Lakeview Pump Station. In 1965, PLO No. 3689 withdrew 21.48 acres from the public trust (Milepost 1256.4 on the Alaska Highway) for the U.S. Army as part of the Haines to Fairbanks pipeline and the future location of the Lakeview Pump Station. The station was built in 1961 and includes a combination building (engine room, pump room, office, generator room, and maintenance shop) and six trailers for family housing. The station was deactivated with the pipeline in 1973. A brief Environmental Assessment was conducted by the U.S. Army that stated there was no impact to the environment at the Lakeview Pump Station. Later in 1973, the U.S. Army notified BLM that the site was no longer needed and requested revocation. For the next seven years, there was discussion among Federal agencies regarding the legal obligation to conduct a formal Environmental Impact Statement on excess land. This became moot in 1980, when the passage of ANILCA created TNWR and incorporated a portion of the Lakeview Pump Station into the Refuge.

Despite being within Refuge boundaries, there were varying legal opinions as to the ownership of the Lakeview Pump Station and associated land. In 1984, the U.S. Government Services Administration conveyed a 3.2 acre portion of the site outside of TNWR to the Federal Highway Administration, which subsequently conveyed the land to Alaska Department of Transportation (ADOT). In 1986, the FWS issued a 20 year



permit to ADOT for a 5.54 acre portion of the Lakeview Pump Station within the Refuge boundaries. For the following ten years, state and federal agencies disagreed over who was responsible for the Lakeview Pump Station, with no agency eager to assume liability for the potentially contaminated parcel.

In 1992, the Refuge manager conducted a site visit to Lakeview Pump Station where he documented a section of above ground pipeline and a concrete storage vault smelling of diesel fuel. Photos taken depict numerous storage tanks, an old burn pit, a boneyard debris, tar piles, and piping. Surface soil samples were collected later in 1992 near the pump station and analyzed for organochlorines and Total Petroleum Hydrocarbons (TPH). Organochlorines were not detected in any sample (n = 4), but TPH concentrations ranged from 64 to 33,600 ppm (n = 16), with the highest concentration in samples collected near the building that was currently in use by ADOT. The results of this analysis and the potential for contamination of groundwater caused the Service to take the position not to accept transfer of the land from the U.S. Army. However, in 1996, PLO 7182 revoked (in part) PLO 3689 and placed a large portion of the former withdrawal under FWS management. Army realty records show that 2.5 acres of the original 21.48 acre site are still held by the U.S. Army.

During discussions with ADOT employees in 1997, the refuge was informed that the water well at the site had been tested for petroleum contamination beginning in 1987. ADOT-funded analyses of water samples conducted in 1988 detected up to 270 ppb benzene, 430 ppb toluene and 290 ppb xylenes. Later test results in 1996 found 517 ppb benzene, 90.7 ppb toluene, and 105 ppb xylenes. The refuge subsequently interviewed two former DOD workers and the wife of a third worker who lived at the site during its operation. They were aware of the water well contamination. The first known contamination event occurred when an employee overfilled a day tank and fuel migrated to the ground. Shortly after this spill, fuel was noted in the water well. An unsealed concrete floor sump in the main pump room was also identified as a significant source of contamination. This sump collected fuels that drained out of the pumps when they were being worked on. When the sump was full, fuels were pumped to an open burn pit and

burned. This sump operated for over a year before leaks were discovered and fixed. Following these events, the door on a clothes dryer was blown off its hinges. This was attributed to the ignition of fumes retained on clothes that had been washed in the contaminated well water. It is unknown if the open burn pit was lined with an impermeable liner. A similar pit at the Tok facilities was not lined, however at that site they later built a steel liner filled with sand.

Since the mid-1980's the site has been used by ADOT as a maintenance facility, equipment yard and as a staging area for road building materials. Three above ground fuel storage tanks with associated piping and a fuel island remain at the facility. ADOT is currently using one of the ASTs and the dispenser island. Floor drains at the facility are plumbed to an oil/water separator, which discharges to a holding tank. ADOT installed this system in 1992. Prior to that date, the floor drains discharged to the septic system.



S. Breese/USFWS

*Bulk waste oil storage tanks outside Alaska Highway right-of-way in 1992. Several areas of petroleum stained soil are also noticeable.*

Recent ADEC information for this site noted that a test boring near the fuel island detected diesel range organics (DRO) at 2,160. In 2006 testing, the onsite well, which is no longer used as a drinking-water source, contained 740 ppb benzene and 3 ppm GRO (gasoline range organics) but no DRO, suggesting that one of the gasoline tanks or piping to the dispenser island may be the source of the well contamination.

In December, 2006, the Service was notified by the USACE that ADOT's beneficial use of the Lakeview Pump Station precludes listing of the site under the FUDS cleanup program.

# Landfill

A landfill was established in 1978, prior to the creation of TNWR, near the Canadian border. The landfill is managed by the General Services Administration for the Customs Service and is entirely within the boundaries of the Refuge. A second, closed dump is within the Refuge in the same area and likely a predecessor to the current landfill. At present, neither dump appears to be in use. Old tires, empty barrels, and galvanized culverts litter the area, but no evidence of spills or leaks was observed in the area.

There was also evidence of a shooting range in the area. Makeshift targets were set up and wooden debris with shot holes littered the area. Spent casings were also noted in the area. However, the environmental characteristics of the area make it is unlikely that this shooting range poses a significant ingestion risk to wildlife. However, lead shot from this range has the potential to leach into soils and ground or surface waters.

*A recently used shooting range occupies a former landfill near the Canadian border.*



D. Roelke/USFWS

# Alaska Highway

The Alaska Highway serves as the northern border of TNWR. Runoff from the highway may contribute some heavy metals and petroleum products to the watershed and surrounding wetlands. Heavy metals are present in auto exhaust, worn tires and engine parts, brake linings, weathered paint, and rust. In addition, oils and grease are also leaked onto road surfaces from car and truck engines. The Alaska Highway may also be a likely source of future spill events from tanker truck accidents.

## Seaton Roadhouse

The site of the former Seaton Roadhouse is located at Milepost 1235 and operated during the 1950s on land that is now within the Tetlin NWR. During that era, the roadhouse included a gas station and automotive repair shop. The site has been abandoned for decades and became part of TNWR with the passage of ANILCA.

*A compilation of photographs showing structures and debris at the Seaton Roadhouse site that was incinerated by Service personnel.*

In 1985, several structures remained on the site. In the fall of that year, Service personnel performed a “clean-up” that consisted of bulldozing the debris into piles and conducting a prescribed burn, which included much of the debris.



USFWS

Currently, a 3-m wide stream cuts through the old road grade of the Alaska Highway, entering Seaton Pond approximately 100 meters down-gradient from the site of the old roadhouse. Seaton Pond appeared impaired during a spring 2003 site visit, and a subsequent Level 1 Environmental Site Assessment by Service environmental contaminants biologists and Tetlin NWR staff. Other than algae and a few grass blades, no aquatic life was noted in the pond, although sediment layers indicated historic vegetation. Sediments were rusty-orange on the surface, and were underlain by a black, peaty, oily layer. Sheens were also noted on two small (<1 meter wide) surface water bodies, one pond and one spring/stream, that also entered the pond.

*Seaton Pond in early fall.*



D. Rocque/USFWS

*Parking is easy to find at the Seaton Roadhouse, but vandals quickly descend on unattended vehicles.*



D. Rocque/USFWS

The Refuge is interested in developing this site as an interpretive area including exhibits, a parking lot, and trails open to the public. Currently, the site is used by local residents for recreation. The remnants of at least two collapsed structures are located on the site, in addition to drums and debris piles that litter the area. The site is also of concern because it may have been used as a staging area for the Army's aerial spraying of Agent Orange (2,4,5-T) to clear vegetation from the Haines-Fairbanks pipeline route in the 1950s and 1960s. Although the information, gathered during the Level 1 survey, is somewhat speculative, the Service has an obligation to ensure that the public and trust resources are

not exposed to dioxin residues. There was also enough public concern to prompt the USACE to conduct dioxin sampling along the length of the pipeline corridor in Alaska (see above).

Absence of positive results from the pipeline testing is not sufficient evidence to rule out contamination at Seaton Roadhouse, however, since higher pesticide residues are often found at mixing and loading sites, where spills occur most often. Sampling was conducted to evaluate potential hydrocarbon, metal, herbicide, and dioxin/furan contamination at Seaton Roadhouse. Samples were collected in September 2004, June 2005 and September 2005. Environmental Contaminants Specialists collected a total of 39 soil samples, 22 surface water samples and 22 sediment samples. Sample locations were determined in the field, targeting disturbed areas, areas with soil staining, chemical odors, drums/debris, or at representative locations (e.g., sediment and water samples were taken at equidistant locations around the perimeter of three ponds). Three soil samples were taken at background locations for comparison with samples taken from areas of potential concern.

Water samples were analyzed for DRO and GRO. Soil samples collected in June 2005 were analyzed for GRO, DRO and inorganic constituents (including mercury). Soil samples collected in September 2005 were analyzed for dioxins/furans with total organic carbon, and chlorophenoxy herbicides.



D. Rocque/USFWS

*Photos taken in fall 2004 depicting the various debris at the Seaton Roadhouse site.*

Sediment samples were collected in both September 2004 and June 2005 for GRO, DRO and inorganic parameters.



*Iron in stream leading to Seaton Pond.*

Soil Results: Three soil samples contained arsenic above the ADEC cleanup level of 2 mg/kg, however the method reporting limit for arsenic in all soil samples was above the cleanup value. Ten chromium values were above the ADEC cleanup value of 26 mg/kg. Although multiple soil samples exceeded ADEC cleanup levels for chromium and arsenic, those levels are within background concentrations found throughout Alaska, were scattered within the site, and did not appear to be linked to specific areas of concern. In 2007, the Service plans on conducting further evaluation of background soil concentrations in the area around Seaton Roadhouse, to help determine if these results are related to site contamination.

One sample taken near the location of some electrical debris contained 460 mg/kg lead, which exceeds the ADEC cleanup level of 400 mg/kg in residential soil. In 2007 we plan on determining the extent of contamination prior to soil cleanup.

GRO was detected in nine soil samples and DRO was detected in 16 of the soil samples, but none exceeded ADEC Method 2 cleanup values. In 2007 the Service plans to take additional soil samples verify that soil a cleanup of hydrocarbon contaminated soils is not required at this site.

The only herbicide detected in soils was clopyralid, which was present in three samples. Clopyralid is a relatively persistent broad leaf defoliant found in 21 commercially available herbicides. No ADEC or EPA cleanup values have been established for this herbicide.

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), otherwise known as dioxins and furans, were evaluated in 20 soil samples from potential areas of concern. Toxic equivalency quotients (TEQs) for each congener were calculated using standard procedures and summed to produce a total TEQ concentration. One soil sample had a TEQ of 57.6 ng/kg, which exceeds the EPA's Region 9 Preliminary Remediation Goal (PRG) of 39 ng/kg. None of the remaining samples exceeded

39 ng/kg, and in fact the next highest TEQ was 0.67 ng/kg. In 2007, the Service plans to conduct additional dioxin sampling to define the extent of contamination at this location. We also plan on sampling at additional locations in 2007 to further assess potential for dioxin contamination at this site.

**Sediment Results:** Inorganic sediment results were compared to screening criteria for freshwater sediments. Two of the sediment samples had nickel concentrations above the probable effects level (PEL) of 35.9 mg/kg (at 36 and 49 mg/kg, respectively). No known source for nickel is known or suspected at the site, so these may represent background concentrations. GRO was not detected in any of the sediment samples. DRO was detected in 15 sediment samples, however no sample exceeded the 250 mg/kg ADEC Method 2 cleanup value applied to this site.

**Surface Water Results:** GRO was not detected in any of the surface water samples. DRO was detected in 6 of the surface water samples. None of the observed DRO values exceeded the ADEC groundwater standard of 1.5 milligrams per liter (mg/L). Additional water quality testing is planned for 2007 to confirm these findings.



D. Rocque/USFWS

*Photos taken in fall 2004 depicting the various debris at the Seaton Roadhouse site.*

Despite earlier debris removal projects, the Seaton Roadhouse site still has considerable solid waste that should be removed. Several areas contained buried and exposed drums, miscellaneous metal and wood debris, and large equipment. This site will need extensive solid waste removal before it can be opened to the public as an interpretive site.





USFWS

*Scotty Creek Flats near the northeast corner of TNWR provides some of the most productive waterfowl habitat in the state.*

# Camps and Cabins



One of three structures at the Trapper's cabin site.

D. Rocque/USFWS



Some of the many 5-gallon fuel canisters that litter the Trapper's cabin site.

D. Rocque/USFWS

## Trapper's Cabin

A Level I Environmental Site Assessment was conducted in August 2004 by Service contaminant biologists on recently acquired structures located south of the visitor's center on the Alaska Highway. The Refuge is interested in developing this site as an interpretive area, which will include exhibits and trails open to the public. One collapsed and two standing structures served as a year-round residence and as a home base for a trapping operation. A "bunker" was also built into the hillside. Empty 55-drum and many 5-gallon gas cans and debris piles litter the area. Refuge personnel recovered explosives in 2003, including blasting caps from the bunker that were subsequently detonated offsite by the proper authorities. A petroleum odor was present in one of the standing cabins and the interior was littered with debris, including fuel canisters. The Refuge is pursuing cleanup at this site.

Blasting caps were recovered from the "bunker" at the Trapper's cabin.



D. Rocque/USFWS

## Scottie Creek Cabins

Several cabins exist on the east and west sides of Scottie Creek on the southern side of the Alaska Highway. These cabins were built before the passage of ANILCA and therefore constitute inholdings within Refuge boundaries. In some cases, the cabins are located on the right of way for the Alaska Highway. None of the cabins visited in 2004 showed signs of occupancy. Cabins were in varying degrees



of disrepair, some with broken windows, doors removed or off hinges or walls or ceiling collapsed. Many of the cabins showed signs of vandalism. In most cases, cabins were surrounded by solid waste, 55-gallon barrels, fuel canisters, and other potentially dangerous debris. The proximity of these cabins to Scottie Creek and other trust resources, makes them a potential contaminant concern.



*Clockwise from top: Three of the five cabins northwest of Scottie Creek, backside of one cabin with semi-full cans of asbestos roof coating, and 55-gallon drums and fuel barrel containing unknown liquids. D. Rocque/USFWS.*

# Mining

As of 2004, there were no active mining claims on TNWR, but mining prospects on allotments within and near the Refuge boundaries are currently being investigated. There are no large metal mines currently operating in the nearby Yukon Territory, but a large-scale hydraulic mine on a tributary of Scottie Creek, one of the most productive drainages for waterfowl breeding on TNWR, was active as late as 2000. Several placer mining operations also exist in the Chisana River and Scottie Creek drainages bordering the Refuge. There are three active placer mines in Wrangell-Saint Elias National Park and Preserve that could potentially affect TNWR; Bonanza Creek, the Nabesna River, and the White River. Future placer mining is expected in the mineral-rich Nutzotin and Mentasta mountains along the southwestern and southern boundaries of the Refuge, and near the village of Northway, as the economy, regulations, or extraction processes change.

*A settling pond at the head of Scottie creek just across the Canadian side of the border has filled up and is no longer effective. The lower Scottie creek in the refuge is one of the most productive waterfowl areas in the Refuge.*



H. Timm/USFWS

Placer deposits contain valuable minerals that have been concentrated by erosion in stream, river, or glacial gravels. Placer mining usually involves the removal of deposits, sluicing of the mineral bearing material, and disposing of the tailings. The removal of large volumes of sediment from the streambed can cause or contribute to erosion, bank destabilization, leaching of heavy metals, increased suspended



E. Snyder-Comm/USFWS

*Sedimentation of lake on Yellow Water Creek, six miles downstream from Canada placer mine.*

solids, downstream sediment transport, and/or increased sunlight and water temperature due to the removal of vegetation. Often, this process completely scours the stream and/or river bottoms down to bedrock. Tailings, the residual dredged sediment and bottom material, create large mounds that can block stream channels.

Placer mining drastically alters riparian areas and instream habitats and is

extremely detrimental to organisms that rely on stream bottoms for habitat and reproduction. In placer mining, finer sediments are separated and returned to the stream or river, often reintroducing contaminants, such as heavy metals that were once bound to sediments, back into the environment. Heavy metals such as arsenic, copper, lead, mercury, nickel, and zinc can be present in the sediments and, under the right environmental conditions, can leach into the surrounding waters. Additionally, returning sediments increases the sedimentation and turbidity of the water, which decreases primary production [12] and are major contributors to declines in aquatic fauna [13]. Plant, invertebrate, and fish abundance and productivity decline in streams with placer impacts[14, 15].

The Service conducted a study between 1987-1992 to establish baseline water quality and heavy metal concentrations in water, sediment and fish from drainages with mining potential or history in TNWR [16]. The study established permanent monitoring sites in historic or proposed mined

and reference drainages, on the major streams and rivers of the TNWR. Metal concentrations and their effects on Refuge resources including fish, invertebrates, and their habitats were determined for each site based on mining status and underlying geology as indexed by source. The study focused on TNWR's three primary watersheds, the Nabesna, Chisana, and Tanana rivers, and their major tributaries.

There were significant differences in metal concentrations between glacial and clear streams in sediment and water. In sediments Cr, Cu, and Mg were all greater in glacial streams and Zn was lower. In water, total Fe, Mg, and Sr concentrations were greater in glacial streams and in some cases for Al, Cd, Zn, and Hg exceeded 2003 Alaska Water Quality Aquatic Freshwater Acute Criteria in both glacial and clear stream. Metal concentrations in northern pike did not differ between fish from glacial streams and those from clear streams. Most metals in fish were at relatively low concentrations, including mercury concentrations, which were all below concentrations that cause mortality or behavioral changes in a variety of adult fish species. Although few fish samples exceeded the Food and Drug Administration (FDA) action level of 1 ppm wet weight for methyl-mercury in edible tissues, these data are currently more than a decade old and it is unknown if mercury has increased since the samples were collected.

*Stuver Lake receives water from Stuver Creek, one of the clear water streams sampled during the heavy metals study conducted on TNWR.*



E. Johnson/USFWS

# Water Quality

Preserving water quality is one purpose of every Alaska Refuge. Land cover and use can affect the water quality of rivers, lakes and other surface waters. Potential sources of point- and non point-source pollution, such as communities and resource development projects, can threaten refuges' generally pristine waters. Baseline water quality data provide a benchmark for identifying and quantifying the degree of contamination or change. On most of Alaska's refuges, there are limited or no water quality data available. In conjunction with operating stream gages to obtain continuous flow records, the Water Resources Branch began a water quality study on several streams in the Tetlin National Wildlife Refuge during 2005. Field measurements of water temperature, specific conductance, pH, alkalinity, and dissolved oxygen are made on Desper, Gardiner, and Scottie Creeks and water samples are collected and analyzed for major inorganic ions, nutrients, and trace metals three to five times each year in open water and under ice. In addition,



*Scottie Creek*

D. Rocque/USFWS

continuous water temperature data are collected throughout the year. Field measurements of water temperature, specific conductance, pH, and dissolved oxygen are also observed at Kalutna River, Nabesna River, and Mirror Creek. Data collection will occur over a six year period (2005 to 2010).

A three year macroinvertebrate and diatom survey on Desper, Gardiner, and Scottie Creeks will begin in 2007 and be conducted by the University of Alaska Anchorage Environment and Natural Resources Institute (UAA ENRI). Owing to their taxonomic and morphological diversity, aquatic invertebrates have proven to be effective indicators of environmental conditions in water bodies. Changes in biodiversity are often linked to changes in habitat quality/complexity, pollution loads, and nutrient status. Additionally, changes in invertebrate taxonomic composition can be diagnostic of specific changes occurring in the stream ecosystem. The use of multiple biological assemblages (i.e., fish, macroinvertebrates, and/or algae) in aquatic monitoring programs can enhance the ability to detect and diagnose ecological impairment. These biological studies will be incorporated with the water quality and quantity data that the Water Resources Branch is collecting.



*The Chisana and Nabesna rivers on the Tetlin NWR.*

USFWS



# Recreation

## Hunting and fishing

Birds, especially waterfowl, are susceptible to lead poisoning from shot and lead poisoning has been documented in spectacled and common eiders on the Yukon Delta National Wildlife Refuge [17, 18, 19]. Waterfowl, upland game birds, and big game hunting in TNWR is enjoyed by many. A federal ban on lead shot for waterfowl has been in effect since 1991 however, lead shot is still available for upland game hunting and may be used at times on the Refuge.

People also visit the Refuge to enjoy the sport fishing opportunities and residual lead from fishing weights and jigs may pose potential contamination issues. In areas of high fishing pressure some states have implemented restrictions on lead use for fishing to help alleviate lead toxicity from fishing gear. Additionally, the Service has established lead-free fishing areas in a number of National Wildlife Refuges and Waterfowl Production Areas. (<http://policy.fws.gov/library/99fr43834.pdf>).

## Recreational Vehicles

Primary access to the Refuge is via the Alaska Highway. Access to the interior of the refuge is limited to watercraft, small ski/float equipped airplane, foot travel or snowmachine. Snow machines may only provide access to remote areas when snow cover is sufficient; ATVs are restricted to established roads. Although emissions from two-stroke engines are higher than four-stroke engines, it is unlikely that these vehicles pose significant air quality issues. However, the EPA estimates that one hour of operation by a 70-horsepower two-stroke motor emits the same amount of hydrocarbon pollution as driving 5,000 miles in the average automobile.



USFWS

*A snowmachiner on TNWR during adequate snow cover.*

# *Biotic Sources and Physical Transport*

## **Biotic Sources**

Migratory birds may serve as a possible biotic vector for contaminants. Because avian species are highly mobile, they could be exposed to contaminants outside, as well as within, the Refuge boundaries. When migratory birds return to TNWR, they may transport any accumulated contaminants back to the Refuge to become available to other Refuge species and humans. Migratory avian prey species, particularly waterfowl, were hypothesized to be one route of exposure to DDE for interior breeding peregrine falcons [20]

## **Physical Transport**

At the regional scale, the most notable physical pathway of contaminants to high-latitude environments is long-range atmospheric transport. Atmospheric deposition in the Arctic occurs mainly in the winter when the Aleutian Low pressure cell drives much of the atmospheric circulation of the Northern Hemisphere. Airborne contaminants are drawn to high-latitudes from industrial areas in Europe and Asia by circulation patterns where, due to colder temperatures, the contaminants condense and precipitate out of the atmosphere [21]. Once chemicals reach colder climates typical of high-latitudes, they are less likely to revolatilize as in warmer climates, and therefore accumulate in Arctic regions [22]. Rivers and ocean currents are also important contaminant pathways. Contaminants in terrestrial environments are carried by snow-melt, surface water, groundwater, and rivers.



*TNWR and adjacent Native lands host the densest nesting population in the state of osprey (Pandion haliaetus), a raptor historically impacted by persistent organic pollutants.*

Persistent organic pollutants (POPs) are toxic chemicals that are not easily metabolized by organisms and are often passed up the food web where they biomagnify and, especially in top predators, accumulate to harmful levels. POPs, along with some trace metals such as cadmium, mercury, and lead, PAHs, and radionuclides are of particular concern in the Arctic. A full discussion of physical pathways of contaminant transport can be found on the Arctic Monitoring and Assessment Programme web site (<http://www.amap.no/>).

## Conclusions

The Tetlin National Wildlife Refuge has a range of contaminant issues, some of which have been identified and highlighted in this report. The majority of contaminant issues on the Refuge stem from past and military operations uses previous to the creation of TNWR. Future threats include expansion of mining activities and spills associated with the Alaska Highway. This Contaminant Assessment Process has gathered information to help Service personnel to make informed management decisions about contaminant threats to the Refuge Complex lands and resources. It is the responsibility of the Service to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Utilizing the CAP is one way in which the Service can ensure that our country's National Wildlife Refuges maintain their environmental health and integrity.



S. Bresser/USFWS

*Stuver Creek, one of many spring-fed streams in the Refuge that never freeze.*

# References

1. Timm, H. K. W. N. J. a. G. H. C. 2004. Raptor Monitoring in the Upper Tanana Valley, Game Management Unit 12, Alaska, 2003. Progress Report 01-04, Tetlin National Wildlife Refuge U. S. Fish and Wildlife Service, Tok, AK. 1-25.
2. Dames and Moore. 1994. Final work plan remedial investigation and feasibility study, Northway Staging Field Site, Northway Alaska. Prepared for the U.S. Army Corps of Engineers, Alaska District.
3. Woodward-Cyldle Consultants. 1986. Site inventory report, Defense Environmental Restoration Program, Northway Staging Area, Northway, Alaska.
4. E.Snyder-Conn and S.Breezer. 1990. Assessment of the impact of the Northway Airport Asphalt Disposal Sites on contaminant concentration in water, sediment, and fish in Moose Creek, Tetlin National Wildlife Refuge. NAES-PR-90-01. U.S. Fish and Wildlife Service.
5. Dames and Moore. 1995. Final report, 1994 focused remedial investigation and feasibility study, Northway Staging Field Site, Northway, Alaska. 3 Volumes plus 4 Attachments.
6. Sturm, M, Perovich, DK and Serreze, MC. 2003. Meltdown in the North. *Scientific American* 289(4): 60-65.
7. U.S.Army Corp of Engineers. 2004. Proposed plan for no Department of Defense action indicated and no further remedial action planned at Operable Unit 3, Northway Staging Field, Northway, Alaska. 1-20.
8. Hollinger, K. 2003. The Haines-Fairbanks Pipeline. Lesondak, G. R. CEMML TPS 03-04, 1-62. Ft. Collins, Co, Center for Environmental Management of Military Lands .
9. U.S.Army Corp of Engineers. 2004. Chemical Data Report: Herbicide residue survey, Haines-Fairbanks pipeline

- Alaska. 1-23. Elmendorf AFB, AK, Alaska District.
10. MDA Consulting Limited. 1999. Kluksu environmental study follow-up and Wolf Creek snow chemistry study - Final Report.
  11. Van den Berg, M; Birnbaum, L; Bosveld, AT; Brunstrom, B; Cook, P; Feeley, M; Giesy, JP; Hanberg, A; Hasegawa, R; Kennedy, SW; Kubiak, T; Larsen, JC; van Leeuwen, FX; Liem, AK; Nolt, C; Peterson, RE; Poellinger, L; Safe, S; Schrenk, D; Tillitt, D; Tysklind, M; Younes, M; Waern, F; Zacharewski, T. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environmental Health Perspectives* 106(12):775-92.
  12. Henley, W. E., Patterson, M. A., Neves, R. J., and Lemly, D. A. 2000. Effects of sedimentation and turbidity on lotic food webs: A concise review for natural resource managers. *Reviews in Fisheries Science* 8: 125-139.
  13. Richter, B. D., Braun, D. P., Mendelson, M. A., and Master, L. L. 1997. Threats to imperiled freshwater fauna. *Conservation Biology* 11: 1081-1093.
  14. Wagener, S. M. and LaPerriere, J. D. 1985. Effects of placer mining on the invertebrate community of interior Alaskan streams. *Freshwater Invertebrate Biology* 4: 214.
  15. Lloyd, D. S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. *North American Journal of Fisheries Management* 7: 45.
  16. Matz, A., Doyle, T., Snyder-Conn, E., and Seagars, D. 2005. Metals in water, sediments, and fish of the Tetlin National Wildlife Refuge, Alaska, 1987-1992. 1-63. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, AK.
  17. Franson, J. C., Petersen, M. R., Creekmore, L. H., Flint, P. L., and Smith, M. R. 1998. Blood lead concentrations of spectacled eiders near the Kashunuk River, Yukon Delta

- National Wildlife Refuge, Alaska. *Ecotoxicology* 7:175-181.
18. Franson, J. C., Petersen, M. R., Meteyer, C. U., and Smith, M. R. 1995. Lead poisoning of spectacled eiders (*Somateria fischeri*) and of a common eider (*Somateria mollissima*) in Alaska. *Journal of Wildlife Diseases* 31:268-271.
  19. Flint, P. L. and Grand, J. B. 1997. Survival of spectacled eider adult females and ducklings during brood rearing. *Journal of Wildlife Management* 61:217-221.
  20. Ambrose, S., Matz, A., Swem, T., and Bente, P. 2000. Environmental Contaminants in American and Arctic Peregrine Falcon Eggs in Alaska, 1979-95. U.S. Fish and Wildlife Service, Northern Alaska Ecological Services. Technical Report NAES-TR-00-02. 67 pp.
  21. Somnich, S. L. and Hites, R. L. 1995. Global distribution of persistent organochlorine compounds. *Science* 269:1851-1854.
  22. Wania, F. and Mackay, D. 1993. Global fractionation and cold condensation of low volatility organochlorine compounds in polar regions. *Ambio* 22:10-18.

**Tetlin National Wildlife Refuge**

**P.O. Box 779**

**Tok, AK 99708**

**Telephone: 907/883 5312**

**U.S. Fish and Wildlife Service**

**1 800/344 WILD**

**<http://www.fws.gov>**

**July 2007**

