Public Health Assessment for

NAVAL AIR FACILITY, ADAK
(a/k/a ADAK NAVAL AIR STATION)
ADAK, ALEUTIAN ISLANDS CENSUS, ALASKA
EPA FACILITY ID: AK4170024323
SEPTEMBER 6, 2002

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH ASSESSMENT

NAVAL AIR FACILITY, ADAK
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ADAK ISLAND, ALEUTIAN ISLANDS, ALASKA

EPA FACILITY ID: AK4170024323

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, fullscale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E56), Atlanta, GA 30333.

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ACRONYMS and ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BRAC	Base Realignment and Closure
BTEX	Benzene, Ethylbenzene, Toluene, Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSF	Cancer Slope Factor
CPF	Cancer Potency Factor
DOD	Department of Defense
DDESB	Department of Defense Explosive Safety Board
DRO	Diesel Range Organics
EPA	U.S.Environmental Protection Agency
FOSL	Finding of Suitability to Lease
FOST	Finding of Suitability to Transfer
FUDS	Formerly Used Defense Site
GPR	Ground Penetrating Radar
HC	Health Consultation
IRP	Installation Restoration Program
JP-5	Jet Fuel Number 5
LOAEL	Lowest Observed Adverse Effect Level
LTHA	Lifetime Health Advisory
LTM	Long Term Monitoring
MEC	Munitions and Explosives of Concern
MCL	Maximum Contaminant Level
MRL	Minimal Risk Level
MW	Monitoring Well
NFA	No Further Action
NAVFAC	Naval Facility
NOAEL	No Observed Adverse Effect Level

NOSSA ..... Naval Ordnance Safety and Security Activity
NPL ..... National Priorities List
NSGA ..... Naval Security Group Activity
OSHA ..... Occupational Health and Safety Administration
OU ..... Operable Unit
PAH ..... Polycyclic Aromatic Hydrocarbon
cPAH ..... Carcinogenic Polycyclic Aromatic Hydrocarbon
PCB ..... Polychlorinated Biphenyl
PCE ..... Tetrachloroethylene, Perchloroethylene
PHA ..... Public Health Assessment
PHAP ..... Public Health Action Plan
POL ..... Petroleum, Oils, and Lubricants
ppb ..... parts per billion
ppm ..... parts per million
RI/FS ..... Remedial Investigation/Feasibility Study
RfDo ..... Oral Reference Dose
RCRA ..... Resource Conservation and Recovery Act
RMEG ..... Reference Media Evaluation Guide
ROD ..... Record of Decision
SARA ..... Superfund Amendments and Reauthorization Act of 1986
SAERA ..... State-Adak Environmental Restoration Agreement
SVOC ..... Semi-Volatile Organic Compound
TCE ..... Trichloroethylene
TCLP ..... Toxicity Characteristic Leachate Procedure
TPH ..... Total Petroleum Hydrocarbons
ug/dL ..... micrograms per deciliter
UST ..... Underground Storage Tank
VOC ..... Volatile Organic Compound

SUMMARY

Adak Island is located in the Andreanof Island group of the Aleutian Islands, the string of rugged, volcanic islands (archipelago) curving 1,200 mi (1,900 km) west from the tip of the Alaska Peninsula. These islands separate the Bering Sea from the Pacific Ocean. While the entire island of Adak is currently owned by the U.S. Fish and Wildlife Service of the Department of Interior, the former Naval Air Facility, (NAF) Adak, occupies land on the northern portion of Adak Island. The southern portion of Adak Island is uninhabited.

The base operationally closed in March 1997 and most Navy personnel left Adak by April 1997 (URS 1997a). The last Navy personnel left Adak in March 2002. The Adak Reuse Corporation is performing the infrastructure operation under lease from the Navy until the property is transferred. During its recent operating status, the Naval Air Facility was responsible for air operations, base management, utility and infrastructure operations. Other Navy operations on the island included conducting oceanographic research and communications functions.

Naval Air Facility, Adak was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List (Superfund List) in May 1994, based on indications that there was contamination in multiple areas on-base which could affect people, wildlife, and the environment. Since 1942, military operations at Adak have resulted in municipal and industrial waste generation and disposal. Wartime and post wartime preparedness training exercises, invasion deterrent tactics, hazardous materials handling and storage, and ordnance demilitarization have lead to additional environmental contamination and physical hazards that were present on Adak Island.

Since ATSDR's initial involvement in 1994, The Navy has done a remarkable job removing or reducing the numerous hazards on the former military reservation at Adak Island. With the institutional controls in place, people can now safely inhabit and work on the island.

From the data and information ATSDR has gathered from site visits, document reviews, and discussions with stakeholders, we identified 12 situations where people could be exposed to chemical contamination or physical hazards; three of those present a public health hazard, one lacks enough data or information to assess the hazard, and eight present no public health hazard.

Public Health Hazards: Three exposure situations pose a public health hazard and require intervention in order to reduce the hazard. *They are (1) exposure to lead in the tap water in Sandy Cove and Eagle Bay homes containing lead plumbing, and (2) physical hazards posed by debris, Rommel stakes, and possible unexploded ordnance throughout the downtown area and (3) the remote areas.*

Lead released from plumbing or solder into tap water at Sandy Cove and Eagle Bay could pose a hazard to children and the fetuses of pregnant women. Education that recommends flushing the tap water lines and using cold water for cooking and infant formula could considerably reduce the hazard. Educational material is given to all adults coming on base when they receive the key to their quarters. ATSDR would like the currently distributed educational material to include recommendations to only use cold water for making formula and reconstituting juices and cooking. This is most applicable for families with potentially pregnant women and children.

Although the likelihood is extremely low that people could be injured or killed by physical hazards posed by debris, Rommel stakes, and possible unexploded ordnance during routine daily activities potential current and future hazards still exist and cannot be entirely eliminated for people recreating in the downtown and remote areas. The Navy has thoroughly investigated and removed all known Rommel stakes and unexploded ordnance from the downtown areas, and many in the remote areas and greatly reduced the hazards to people walking, hiking, fishing, playing, and digging. To reduce the likelihood even more of people handing explosive and physical hazards, the Navy initiated and continues to educate people on the possible appearance of hazardous and explosive item and the procedure for notifying the correct officials.

Indeterminate Public Health Hazards: One human exposure situation poses an indeterminate public health hazard due to suspected contamination and lack of data and information presented for ATSDR to assess whether or not there is a hazard.

Indoor air sampling for JP-5 related contaminants has not been conducted in certain Sandy Cove Housing Area homes located above JP-5 fuel leaks that have saturated the soils and seeped into underground water. The groundwater table is very shallow in this area and homes are located just a few feet above these soils and water. JP-5 vapors may have migrated into the homes and could potentially pose a public health hazard to people living in the homes. Indoor air sampling for components known to be present in JP-5 such as total petroleum hydrocarbons, and n-alkanes used to "fingerprint" the JP-5, is needed to determine if the air inside homes is safe. Children, especially those exposed in utero, could develop neurological impairment if exposed to JP-5 in indoor air over long periods of time.

No Public Health Hazard: From the data ATSDR has reviewed, six human exposure situations pose no public health hazard because, although people are or can be exposed to contaminants, the levels are too low to result in adverse health effects. They are as follows: (1) children exposed to soil in yards and neighborhood playgrounds in Sandy Cove, Eagle Bay, and Moffett View, (2) workers and residents exposed to asbestos in building materials in schools, homes, and workplaces, (3) residents, workers, and visitors participating in recreational activities at or near Metals Landfill, (4) people eating resident fish and shellfish from Kuluk Bay, (5) people eating resident fish and shellfish fillets from Sweeper Cove and Sweeper Creek, (6) children exposed to sediments in Helmet Creek, 7) workers and residents exposed to lead-based paint and asbestos from recycling scavenged materials found in unused structures and 8) people eating fish and shellfish from Clam Lagoon, Andre Lake and Finger Bay.

INTRODUCTION

Former Naval Air Facility, Adak is a base closure site with some information available as to proposed reuse. ATSDR reviewed the proposed reuse scenarios. We have organized this report to provide safety information to current and future residents specific for common activities. Section I discusses hazards related to activities associated with the "downtown" area. The hazards associated with everyday unavoidable activities are presented in Subsection A. Section B presents our evaluation of exposures in the downtown area that could occur frequently through recreational activities. In Section II, we discuss exposures outside "downtown" in remote area that are likely to occur infrequently and which require active interaction with the environment such as fishing and hiking. We have evaluated the potential areas of contamination identified to date by the Navy, EPA, and ADEC. Additionally, we discuss public health concerns expressed to ATSDR by concerned citizens.

ATSDR relied on available documentation and relevant discussions for our human health evaluation. The recommendations presented are specific for each reuse scenario and the population which may be impacted. We present our concerns for the protection of human health in all reuse scenarios due to the possibility that conditions such as roles and responsibilities for institutional controls, land transfer, land or building reuse, and contaminant discovery may change (URS 1997c). A list of the documents ATSDR has reviewed for the preparation of this public health assessment is included in the Literature Reviewed section of this report. Although ATSDR reviewed the sampling from various media and areas of contamination, this report focuses on the media with which people will come in contact and the media which present significant health implications. ATSDR does not evaluate occupational exposures such as those occurring in industrial buildings, power plants, or utility trenches which come under the jurisdiction of the Occupational Safety and Health Administration (OSHA).

In this document, Naval Air Facility, Adak represents the northern portion of Adak Island used as the military reservation formerly called Naval Air Station (NAS). For the purposes of this document, Naval Air Facility, Adak will represent the Adak Naval Complex, which contains the Naval Air Facility, Naval Facility (NAVFAC), and Naval Security Group Activity (NSGA).

The downtown area refers to the Navy's designation of the downtown area - Parcel 1 and 2, the developed area that is currently being used and which is being considered for reuse. Downtown includes the airfield, port facilities, light industrial, administrative, schools, clinic, commercial, and residential areas. Remote areas include any area outside the downtown area (URS 1997c).

Table 1 - Summary of Public Health Issues, Conclusions and Recommendations Identified at NAF, Adak

I. Exposure in the *Downtown Area*:

A. Unavoidable Daily Activities - Living - Passive Exposures

Public Health Issue	Time frame	Exposure Activity	ATSDR Conclusion Category	Conclusions	Recommendations/Planned Actions
A1.Residents (children and pregnant women) exposed to lead in tap water in Sandy Cove and Eagle Bay homes.	Current and Future Exposure	Drinking tap water or ingesting any food item cooked or made with tap water	**Public Health Hazard**	Sampling data show that water allowed to reside in drinking water taps for 6 hours contained elevated levels of lead above the EPA action level in some drinking water taps. Flushing taps prior to use greatly reduces the hazard.	Currently distributed educational material should be changed to include recommendations to only use cold water for making formula and reconstituting juices and cooking. If the former day care center is opened as a day care center in the future, the party responsible for the Lead and Copper Rule compliance should test the tap water in that facility at least biannually for lead and copper levels.
A2.Residents (adults and children) possibly exposed to JP-5 in indoor air in Sandy Cove homes.	Potential Current and Future Exposure	Living in home located above shallow groundwater plume	Indeterminate Public Health Hazard	Sampling data is inadequate to determine if people are being exposed to JP-5 fuel related contaminants and their breakdown products in indoor air.	The Navy should sample indoor air in Sandy Cove to determine if JP-5 components, such as total petroleum hydrocarbons, and n-alkanes used to "fingerprint" the JP-5, have migrated into the living space.
A3.Children exposed to soil in yards and neighborhood playgrounds in Sandy Cove, Eagle Bay, and Moffett View.	Current Future Exposure	Playing in the dirt in yards and playgrounds in Sandy Cove, Eagle Bay, and Moffett View.	No Public Health Hazard	Aerial photographs taken over the years since after WWII show no indication that the land was used for hazardous material operations.	None
A4.Workers and residents exposed to asbestos in building materials in schools, homes, and workplaces.	Current and Future Exposure	Working and living in buildings and homes in the downtown area	No Apparent Health Hazard	Asbestos present in homes and workplaces not a hazard unless deteriorated or disturbed.	None

Table 1 - Summary of Public Health Issues, Conclusions and Recommendations Identified at NAF, Adak (Cont.)

I. Exposure *in the Downtown Area*

B. Recreational and Construction Activities - Active Exposures - Walking, Hiking, Fishing, Eating Fish, Playing, Digging, and Excavating

Public Health Issue	Time frame	Exposure Activity	ATSDR Conclusion Category	Conclusions	Recommendations/ Planned Actions
B1.Residents, workers, and visitors (adults and children) contacting physical hazards (explosives, and Rommel stakes) throughout the downtown area.	Current and Future Encounters	Walking, Hiking, Fishing, Playing, Digging, and Excavating in the downtown area	**Public Health Hazard**	Although the likelihood of people being injured or killed by unexploded ordnance materials, or Rommel stakes during routine daily activities is extremely low, potential current and future hazards still exist and cannot be entirely eliminated for people recreating in the downtown area.	Because of the exposed surface debris on NORPAC Hill, the Navy should conduct surface removal action of the debris in the area within 40 feet of each side of the road ascending NORPAC Hill for workers who need access.
B2.Residents, workers, and visitors (adults and children) participating in recreational activities at or near Metals Landfill (Site SWMU 13).	Current and Future Exposure	Walking, Hiking, Fishing, Playing, Digging and Excavating on or near Metals Landfill	No Apparent Public Health Hazard	Metals Landfill (Site SWMU 13) currently poses no apparent public health hazard to residents, workers, and visitors participating in recreational activities at or near the landfill.	Future monitoring at Metals Landfill until 2003 includes evaluation of depth of soil cap, analysis of groundwater, surface water seeps/leachate where noted, and marine tissue. To increase the probability of finding surface water seeps/leachate, ATSDR recommends seep samples be collected in the early summer or late spring when the soil is more saturated.

Public Health Issue	Time frame	Exposure Activity	ATSDR Conclusion Category	Conclusions	Recommendations/ Planned Actions
B3.People (subsistence consumers) eating contaminated resident fish and shellfish from Kuluk Bay.	Current and Future Exposure	Subsistence consumers of shellfish	No Apparent Public Health Hazard	Contaminant levels including aluminum, arsenic, cadmium, chromium, dieldrin, PCBs, and lead, present in rock sole, rock greenling, Pacific halibut, Pacific cod, and blue mussels from the intertidal areas of Kuluk Bay currently present no apparent public health hazard to recreational or subsistence consumers. Provisions for landfill erosion and tidal surges during storms to degrade landfill releasing contaminants into Kuluk Bay have not been addressed.	To ensure that contaminant levels do not increase, future seafood monitoring in Kuluk Bay (scheduled until 2003) should not be limited solely to PCBs, but include analysis for methylmercury. and inorganic constituents especially aluminum, arsenic, cadmium, chromium, and lead. Seafood sampling should be included in the Superfund Comprehensive Five-Year Review every five years for 20 years. Analytes should include semivolatile compounds, methylmercury, ordnance compounds, specific PCB congeners, pesticides, and inorganics.
B4.People (subsistence consumers) eating contaminated seafood from Sweeper Cove and Sweeper Creek.	Current and Future Exposure	Subsistence consumers of resident fish and shellfish	No Apparent Public Health Hazard	ATSDR determined that contaminant levels in fish were too low to cause harmful health effects for people who eat fish fillets recreationally or for subsistence from Sweeper Cove and Creek. Whole fish samples showed slightly elevated contaminant levels.	None
B5.Children potentially exposed to contaminated sediments in Helmet Creek.	Potential - Future Exposure	Children playing in sediments. Incidental ingestion.	No Apparent Public Health Hazard	According to the Navy, sediments in Helmet Creek downgradient of Roberts Landfill were collected in 1993 and 1996 and "indicate that sediments in Helmet Creek are not contaminated".	None.

Table 1 - Summary of Public Health Issues, Conclusions and Recommendations Identified at NAF, Adak (Continued)

II. Exposure *Outside* the Downtown Area

Public Health Issue	Time frame	Exposure Activity	ATSDR Conclusion Category	Conclusions	Recommendations/ Planned Actions
1.Residents, workers, and visitors (adults and children) contacting physical hazard (explosives, and Rommel stakes) throughout the remote areas.	Current and Future Encounters	Walking, hiking, fishing, playing, digging, 4-wheeling, snowmobiling, and excavating in the remote areas	**Public Health Hazard**	Although the likelihood of people being injured or killed by unexploded ordnance materials, or Rommel stakes during routine daily activities is extremely low, potential current and future hazards still exist and cannot be entirely eliminated for people recreating in remote areas.	Navy plans to continue education.
2.Workers and residents (adults and children) potentially exposed to lead-based paint and asbestos from recycling scavenged materials found in unused structures.	Future Exposure	Using materials found in unused structures for repairs or construction of homes or other buildings	No Apparent Public Health Hazard	Taking material from unused buildings throughout the remote areas could result in exposure to lead-based paint and asbestos. However, those exposures are not likely to result in adverse health effects.	Navy plans to continue education about areas which are off-limits. Demolition of cabins in remote areas was scheduled for summer of 2002.
3.People (subsistence consumers) eating potentially contaminated seafood at various locations outside the downtown area (Clam Lagoon, Finger Bay, and Andrew Lake).	Current and Future Exposure	Subsistence consumers of seafood	No Apparent Public Health Hazard	Levels of contaminants were detected in resident fish and shellfish collected from Clam Lagoon, Andrew Lake, and Finger Bay. Based on information in the scientific literature, ATSDR determined that levels of arsenic, cadmium, mercury, vanadium, PCBs, and bis(2-ehtylhexyl)phthalate in seafood collected from the remote areas on the former base have not been shown to result in adverse health effects and therefore, present no apparent public health hazard.	None.

BACKGROUND

SITE DESCRIPTION

Adak Island is located southeast of Anchorage, Alaska in the Aleutian Island chain of islands (archipelago). The Aleutian Islands are volcanically formed islands with treeless terrains that stretch 1,100 miles between the Bering Sea and Pacific Ocean. The entire island is currently owned by the Department of Interior. The northern portion of Adak Island was occupied by the Department of the Navy, however, the military facility closed in 1995 under the Base Realignment and Closure Act. The southern portion of Adak Island, as well as most of the other islands in the Aleutian Island chain, is part of the Alaska Maritime National Wildlife Refuge. The southern portion is uninhabited.

The Adak Naval Complex is comprised of the Naval Air Facility (NAF), Naval Facility (NAVFAC) and Naval Security Group Activity (NSGA). The Department of Navy owns the buildings and improvements at the former NAF/Naval Complex.

During its recent operating status, the Naval Air Facility was responsible for air operations, base management, utility and infrastructure operations. NAVFAC, formerly conducted oceanographic research. NSGA was responsible for communications functions. The base operationally closed and all active military missions ceased in March 1997 (URS 1997a).

HISTORY

At the time Captain Alexi Chirof's Russian vessel *St. Paul* landed on Adak on September 9, 1741, there was a group of island inhabitants known as Aleuts. The Aleut population at that time was nearly 20,000 across the entire Aleutian Islands. To date, sixteen archeological sites have been identified within the naval complex (URS 1997a). Recently, U.S. Fish and Wildlife Service has performed additional surveys on Adak Island which may have delineated more sites (U.S. Fish and Wildlife, 2000).

In 1867, the United States purchased the Alaskan Territory (including the Aleutian Islands) for $7,200,000 from the Russians. Known as Sewards Folley, the Alaska Territory presented opportunity for wealth from fur and gold. By 1910, over-hunting had significantly reduced the population of fur-bearing animals, mainly seals and sea otters (USFWS 1991).

Aleutian Islands

The Aleutian Islands were established as a National Wildlife Refuge in 1913, by executive order of President Taft (USFWS 1991).

On December 7, 1941 the United States declared war on Japan after the Japanese attacked Pearl Harbor, Hawaii. The Japanese attacked the U.S. a second time on June 3, 1942 at Dutch Harbor on the small island of Amaknak across the Illiuliuk Bay from the village of Unalaska, Alaska. On June 7, 1942, the Japanese settled on the Aleutian Islands of Kiska and Attu although the U.S.

turned back the attack by land-based air units operating from secret bases at Umnak Island and Cold Bay (URS 1997a).

In 1980, President Carter signed the Alaska National Interest Lands Conservation Act which made the Aleutian Islands a subunit of the Alaska Maritime National Wildlife Refuge (USFWS 1991).

Adak Island

Adak was chosen as an airfield farther west from the battles. At Adak Island, on August 30, 1942, the U.S. Army landed at Kuluk Bay. The tidal lagoon was filled in to construct runway "A" for the fighter, light bomber and light transport aircraft. Runway "B" became operational November 21, 1942 north of "A" to accommodate the B-26, B-24, B-25, and B-17 bombers. Work on the runways was constant with improvements and additions. The runways now identified as 18-36 ("A") is 5,800 feet and 5-23 ("B") is 7,800 feet long (URS 1997a).

The Navy forces established 12 amphibious plane facilities at Andrew Lake, then called Andrew Lagoon. In 1944, the Navy constructed Mitchell Air Field and used Clam Lagoon and Andrew Lake for support. Operations at Mitchell Field ceased in 1950 when the Navy moved to the downtown area of Sweeper Cove in the summer of 1943, before the U.S. re-occupied the islands of Kiska and Attu. After World War II, the Army base became Davis Air Force Base. In 1950, the Air Force left the Island and the Navy took over all facilities. The base then became known as Naval Air Station, Adak (URS 1997a).

History of Contamination

Because of its unique history, Naval Air Facility, Adak is not like typical NPL sites. Although it has many similar issues with other NPL sites, such as chemical contaminant releases from use, storage, accidents, and disposal activities, NAF has some unique exposure issues as well.

As stated previously, on June 3, 1942, after the Japanese attacked Pearl Harbor, Hawaii, (December 7, 1941) they attacked the U.S. a second time by air bombing of Dutch Harbor on the small island of Amaknak, Alaska. On June 7, 1942, the Japanese landed on the Aleutian Islands of Kiska and Attu. The battles in the Aleutians were the only World War II battles on U.S. soil. In defense, the U.S. quickly mobilized and set up operations in other Aleutian Islands. Adak was developed for use by the military for training and temporary storage and transporting of chemical warfare agent bombs, incendiary bombs, and explosives, and other ordnance materials. At its peak, over 100,000 military personnel were staged on or near Adak preparing to battle the Japanese on neighboring islands and preparing for Japanese invasion on Adak Island. To protect the military outpost on Adak, barbed wire laced through boot-piercing pointed screw stakes designed (but possibly not installed) to have trip wires attached to land mines, and other physical hazards were intentionally laid out to channel invading troops toward strategic firing range areas. Mounted machine gun emplacements covered the shoreline. Target practice, which often consisted of firing at sites away from the populated "downtown" area into the sides of hills and mountains, left metallic debris and unexploded ordnance scattered throughout the island. These activities were conducted in a time of war, at a time when little thought was given to peace time

consequences. These activities left a large and unique array of physical hazards. The Navy along with EPA, ADEC, The Aleut Corporation, and others have worked to reduce those hazards given the technology of today and the environmental conditions of Adak.

Current Ownership and Land Use and Proposed Land Use

In April 2001, the city of Adak became incorporated. The majority of people living on Adak are involved in reuse activities. Since it is an island, air transportation is provided by Penn Airlines. The last Navy personnel left Adak in March 2002. The Adak Reuse Corporation and its sub lessees, together with the city of Adak, will continue to operate the infrastructure of the former Naval Air Facility, Adak until the property is transferred.

A land exchange agreement between the Department of the Interior, the Department of the Navy, and the Aleut Corporation under the Alaska Native Claims Settlement Act has been negotiated. Custody of most of the 77,000 acres comprising the former Naval Air Facility, Adak would be transferred to the Department of the Interior and subsequently, approximately 46,000 acres to the Aleut Corporation in exchange for similar lands within the Aleutian Islands. The proposed land use will be concentrated in the downtown area and would be similar to the recent former uses of the airfield, port, fuel depot, and shipping areas. Support for the residents, workers, and visitors will also be in the downtown area. Areas outside the downtown area have been proposed for recreational use. There are several areas such as landfills and other sites outside the downtown area which have digging or excavation restrictions.

HISTORY OF ENVIRONMENTAL INVESTIGATIONS ON ADAK

The Navy has conducted numerous studies to determine locations of environmental contamination. The first study began in 1986 when the Naval Energy and Environmental Support Activity (NEESA) conducted the Initial Assessment Study of the Naval Air Station, Naval Security Group Activity, and Naval Facility, Adak (NAS) under the Navy Assessment and Control of Installation Pollutants Program. The Initial Assessment Study identified 32 areas that potentially received hazardous substances. These areas included landfills, storage areas, drum disposal areas, spill sites, waste oil disposal sites, and firefighter training sites. The Navy determined that twenty-two of the original 32 sites warranted further investigation under the Phase I report. Additional investigations were conducted in 1988 and 1990, interim actions were performed in 1992. In 1991, U.S. EPA conducted a Facility Inspection of NAS Adak, as required under RCRA which resulted in the designation of 81 sites that were potentially contaminated.

Sites were further classified in the Preliminary Source Evaluation (PSE), a two-level risk based screening approach used to determine which potential hazardous source areas pose a risk to human health or the environment. PSE-1 was the first step to identify an area in question without taking environmental samples. PSE -1 sites were grouped into Batch 1 containing 30 source areas and Batch 2 containing 20 source areas. Two source areas, not included in the PSE, were identified as needing interim remedial/removal actions.

PSE-2 was the first step to take environmental samples comparing results with risk-based screening concentrations and to calculate cumulative risk at a particular site. Fifteen sites were investigated under the PSE-2. Batch 1 includes 15 sites and Batch 2 consists of 10 sites.

In October 1992, NAS Adak was proposed for the NPL and officially placed on the list in May 1994 based on indications from the 1991 EPA RCRA inspection that suggested contamination in multiple areas on-base likely affecting the humans, wildlife, and the environment. The federal facilities agreement was signed in November 1993 which specified the scope of work to be completed under the CERCLA process. Preliminary Source Evaluation Studies were conducted on the non-petroleum sites under the Installation Restoration Program (IRP) and petroleum sites were investigated under the State-Adak Environmental Restoration Agreement (SAERA) between the Alaska Department of Environmental Conservation and the Navy. SAERA addresses the assessment, containment, monitoring, and remediation of soil and groundwater affected by contamination from petroleum, oils, and lubricants (POLs) and leaks from underground storage tanks. The original SAERA identified 26 sites. The list has expanded and now totals 128 sites.

For purposes of environmental investigation and remediation, Adak has been divided into three Operable Units. OU A addresses soil, sediment, surface water, and groundwater contamination. OU A is composed of 58 CERCLA sites and 128 petroleum sites. Other sites that have been investigated include RCRA sites. Federal Facilities Compliance Act (FFCA) of 1990 states that EPA governs RCRA sites. Under FFCA, three sites have been closed out (cleaned-up). The Hazardous Waste Container Storage Facility (SWMU 24, the Fuel Division Area Drum Storage SA77) and the Metals Landfill Waste Pile (a small area within the Metal Landfill, SWMU 13). Closure at these sites has been completed (URS 1997a). OU B addresses ordnance and explosives/unexploded ordnance (OE/UXO) areas of concern. OU B has been divided geographically into OU B-1 (155 sites) and OU B-2 (37 sites).

The RI and FS have been completed and a ROD executed for OU A (U.S. Navy, EPA, and ADEC 2000). All remedial actions selected for OU A have been completed. The RI/FS (U.S. Navy 2001c) and ROD (U.S. Navy, EPA, and ADEC 2001) have been completed for OU B-1.

BASE REALIGNMENT AND CLOSURE (BRAC) ACT PROCESS

In October 1995, NAF Adak was officially closed under the Base Realignment and Closure Act (BRAC). The base operationally closed on March 31, 1997. While the base is being closed under BRAC laws, several laws related to reuse, such as the requirement for an environmental impact statement do not apply because the property is owned by the U.S. Fish and Wildlife Service Department of Interior and use of the property including the buildings, will be relinquished to the Department of Interior by the Navy (URS 1997a).

LAND USE

The Local Reuse Authority was formed to develop and implement a reuse plan. The Adak Reuse Planning Committee was initially established by the state of Alaska to serve as the local reuse authority. In 1997, the State of Alaska Land Reuse Authority determined that Adak was not an economically viable entity. On that basis, the State declined to proceed with further reuse implementation. Subsequently, a number of regional stakeholders sought and received state support to form a new local reuse authority. The Adak Reuse Committee became the Land Reuse Authority. The planning committee consists of stakeholders with current or potential economic interest in Adak following the transfer of the property from the Navy. A reuse plan has been prepared and has been used as the basis for future land use planning (URS 1997d, 1999c).

Institutional controls have been defined as restrictions on the use of land to reduce risks to the public from releases or potential releases of hazardous substances that may be above or below ground. Numerous institutional controls have been selected in the OU A Record of Decision. There is much debate and controversy over the effectiveness of institutional controls. Because it is currently not financially or technologically possible for a military facility like NAF Adak that has operated for more than 50 years to remove all chemical and physical hazards, procedures for estimating the theoretical hazard are being used here and all over the world.

The Navy maintains the responsibility for long-term liability, implementation, and enforcement of institutional controls. They are required to ensure the institutional controls remain effective and reliable for as long as the control remain in effect. The *Institutional Control Management Plan* describes the approach the Navy will use the ensure controls remain protective (EFA NW, 2001).

The Aleut Corporation has identified some target markets to use facilities provided on Adak such as fish processing and support services. Because of the deep ports and central location between Tokyo, Seattle, and Russia it provides an excellent support of fisheries operating in the Aleutians. Adak could also provide full service to vessels including fuel, water, supplies, cold storage, warehouses, crew exchanges, and ship to ship transfer of frozen seafood products. Additionally, transhipment and staging facilities could operate on Adak including regional transhipment, marine support to shipping and air cargo business from Russian ports, Pacific nations, and the airport could be used for air freight shipping. Other entities may also find possible uses for facilities on Adak (URS 1997a).

DEMOGRAPHICS

The maximum population was nearly 100,000 troops and 100 ships in 1943 just before the U.S. reclaimed Kiska and Attu. In 1953, after the Navy took over all facilities, 15 officers, and 176 enlisted were assigned to the base. By 1966, there were 995 military and civilian personnel on

Adak. In 1973, there were 1,054 people and in 1981 the Naval Complex consisted of 2,000 persons. In 1990, the Naval Complex was occupied by 5,600 people (2,800 military)(URS 1997a).

In January 1997, the military mission of NAF Adak was terminated. By March 31, 1997, most military personnel had left. April 1, 1997, Adak entered into caretaker status with a staff of 10 Navy personnel and approximately 200 civilians as contractor employees. In March 2002, the last Navy personnel left Adak Island. Approximately 50 personnel from the Adak Reuse Corporation, its subleases, and the city of Adak operate the infrastructure. Adak Fisheries has 40 – 120 seasonal employees, and the Aleutian Regional School District has 7 personnel and 25 students.

Future residents are expected to include men, women, and children involved in the fishing, shipping, or air cargo industries with potential use by tourists such as recreational hunters, fishermen, and bird-watchers. Estimated populations have been classified as low, middle, and high reuse scenarios and are 123, 189, and 932 for permanent residents respectively (URS 1997d). Currently, the Navy believes that there are no people on Adak that engage in a subsistence lifestyle, but this is likely to change in the future.

NATURAL RESOURCES

Groundwater on Adak is not suitable for drinking water use due to contamination from sites on island, salt water intrusion, and low yield. Instead, drinking water is supplied by surface water lakes. Surface water resources are abundant with more than 500 freshwater lakes and streams including Andrew Lake. Saltwater inlets include Sweeper Cove, Clam Lagoon, Finger Bay, Shagak Bay, Kuluk Bay that provide access to fishing. Fish species include sand lance, Pacific herring, Pacific Ocean perch, sculpin, rockfish, sole, Pacific halibut, starry flounder, barnacles, limpet, snails, littleneck clams, cockles, soft-shelled clams, butter clams, and blue mussels. Dolly Varden, sockeye, pink salmon, coho, and chum have also been identified (URS 1997a).

Wildlife is abundant on Adak. Mammals include caribou herds in the south end of the island which are hunted year round with no bag limit on the number of animals which may be taken. Otter, seal, and other marine mammals are present, as are many variety of birds (USFWS 1991). The Norway rat and Arctic Fox, both of which have been introduced, are the only other terrestrial mammals on the island.

The natural environment of Adak is treeless although a countable number of evergreens have been cultivated on a patch of land unofficially named Adak National Forest. Tundra grasses fill the landscape with numerous varieties of flora.

ENVIRONMENTAL CONTAMINATION AND HUMAN EXPOSURE PATHWAYS

I. EXPOSURE SITUATIONS IN THE DOWNTOWN AREA

ATSDR has identified nine exposure situations in the downtown area. Four exposure situations presented in Subsection A are ongoing or are likely to occur in the future by way of daily or everyday living activities. In Subsection B, we discuss five additional exposure situations in the downtown area that occur by way of recreational or construction activities such as walking, hiking, fishing, playing, digging, snowmobiling, 4-wheel driving, or excavating. We have included in our conclusions and in Table 1 the ATSDR hazard conclusion category for each exposure situation. Figures 1 through 3 illustrate the downtown area of Adak with the Navy's designation for each parcel.

A. Exposures from Unavoidable Daily Activities

A1. Residents Exposed to Lead in Tap Water in Sandy Cove and Eagle Bay Homes - Current and Future Exposure - Public Health Hazard

A health hazard exists for children and fetuses of pregnant women who may be exposed to lead from drinking water taps if their drinking water piping is not flushed correctly. People can reduce or eliminate the health hazard by flushing the drinking water taps for 2 to 3 minutes every morning and when the water has sat in the plumbing for more than 6 hours. Additionally, monitoring for increasing levels and regular distribution of educational material is critical to preventing health hazards. Sampling data from 1993, 1997, and 1998 show elevated lead levels in drinking water taps at Sandy Cove and Eagle Bay homes. The source of the lead is the plumbing containing lead solder or brass fixtures. Lead levels present a health concern for infants, children, and fetuses of pregnant women because they are the most susceptible to the health effects of lead. Nonpregnant adults including the current contractor residents or future residents are not at risk.

What is lead?

Lead is a naturally occurring, bluish-gray metal found in small amounts of the earth's surface. It is often used in batteries, pipes, brass, solder, and paints. The amount and wide-range use of lead has decreased over the last several years because of the harmful neurotoxic effects of lead in people. Lead can get into drinking water several different ways, including corrosion of lead piping, lead-based solder, and brass water faucets.

Background

Drinking water on Adak Island is supplied by Lake Bonnie Rose, a fresh water lake that is located at 1,262 feet elevation in a remote location away from any roads or hiking trails. Lake Bonnie Rose holds 500 million gallons of water (URS 1997d). Lake De Marie, approximately 1.2 miles from Lake Bonnie Rose was equipped to provide backup water if needed, but was taken out of service in 1999. Water treated by injection of chlorine gas at the PRV-1 location. Although Lake Bonnie Rose water is free from contaminants, the water is somewhat corrosive. When allowed to sit in pipes containing lead solder or brass components, the water causes the lead (and copper) to leach from the plumbing material into the water. The longer the water is allowed to remain in the pipes, the greater the likelihood lead levels will increase. Therefore, it is recommended that any time taps have not been used within six hours, the pipes should be flushed (allowed to run for 2-3 full minutes) until the water temperature is noticeably colder.

Many homes are currently left unoccupied for weeks or longer due to the smaller number of people on island as compared to before 1997 (4 percent of the 1996 population) when the facilities were part of the active military base. Sandy Cove neighborhood contains 334, 3-bedroom, single-family homes (167 sets of duplex homes) built in 1984. Eagle Bay contains 100, 3-bedroom, single-family homes (combination of single, duplex, triplex, and quadplex homes). The current procedure is to house people in Sandy Cove. Eagle Bay homes are unoccupied. Moffett View neighborhood consists of 70 single-family homes (combination of single, duplex, and triplex structures) (ATSDR 1994). Homes in Moffett View are not currently being used although the homes have not been disconnected from the utilities.

The Adak Reuse Corporation (ARC) is currently leasing the entire facility from the Navy. Housing maintenance is the responsibility of ARC and its subleasees. The ARC and its subleasees provides educational material to all newcomers when they get the key to their residence. In addition, similar information is provided on the televised "community channel" which announces island events, activities and other instructional information. Written material tells individuals to flush their tap water faucets before use in the morning and after the faucet has not been used in the past 6 hours. ATSDR reviewed the informational flyer. The current material does an excellent job identifying and explaining the problem and provides useful information on actions needed to reduce exposure such as flushing the water lines.

The Lead and Copper Rule is a federal law implemented by each state. While the Navy is currently responsible for compliance with the Lead and Copper Rule, it will become the responsibility of the party who takes over the management of the water system to conduct required sampling at a state approved laboratory, submit data to the state, and provide any additional follow-up actions that may be needed such as corrosion control, education, or filtration. Failure to continue the program could result in sanctioning penalty, or punitive action from the state (ATSDR 1998b).

Sampling

In 1993, in accordance with EPA's Lead and Copper Rule, NAS Adak began testing the tap water on base for lead and copper (ATSDR 1998b). Homes in Sandy Cove, Eagle Bay, and Moffett View were sampled in 1993. The sampling priority scheme established by EPA concentrates on buildings that had copper pipes and lead-containing solder installed between 1983 and 1987 because the solder used during that time was more apt to leach lead into the tap water (EPA 1991). The base's sampling plan, in accordance with EPA regulations, concentrated on those buildings and focused on single-family homes, where the population at greatest health risk live. These homes were selected because they meet the criteria for Tier 1 sampling priority. As specified in the Rule, Tier 1 homes are single-family homes containing copper pipes with lead solder installed after 1982 or lead pipes and/or lead service lines.

EPA Lead and Copper Rule categorizes the number of Tier 1 homes required to be sampled based on the population served by the water system. The specific population breakdowns are as follows: less than or equal to 100 people, 101 to 500, 501 to 3,300, 3,301-10,000, 10,001–50,000, and greater than 100,000. In 1993, between 3,301 and 10,000 people were served by the water system, (actual population figures were 5,653 people). Therefore, 40 Tier 1 homes were required to be sampled.

ATSDR reviewed the tap water sampling data for potential health hazards. Even though copper levels in some homes were also elevated above the drinking water standard, the maximum copper levels detected for all sampling rounds were below levels likely to cause health problems. For that reason, ATSDR focuses the discussion on lead levels because of the potential for adverse health effects. Additionally, actions taken to reduce lead such as flushing the lines, water filters, and corrosion control additives would also reduce copper levels.

The 1993 sampling results showed 20 out of 40 homes sampled with lead levels above the EPA action level of 15 parts per billion (ppb). The maximum detected level was 55 ppb. Lead and copper were not detected in any of the water distribution plants, which indicated that the source of the contamination was the plumbing. Because the base has been in the process of closing since 1994 and residency was considered short-term, the Alaska Department of the Environmental Conservation waved the requirements of the Lead and Copper Rule. Requirements such as regular tap water sampling (every 6 months until 90% of samples are below EPA's established action levels of 15 ppb for lead and 1300 ppb for copper), developing a water treatment plan to reduce lead and copper, and bring the base systems into compliance were waved. However, the base did provide educational material to the residents which recommended flushing the lines for several minutes. Because delays have occurred in the turnover process, ADEC began requiring the lead and copper sampling program to begin again (ATSDR 1998b).

Both the Navy and ADEC agreed to begin sampling because the future of Adak was less uncertain. In May 1997, The Aleut Corporation expressed a strong desire to obtain the facility and transfer it into a private sector community, which would support the fishing and tourism industry.

With the closure of Adak as a military facility, NAVFAC (or EFA NW) became the custodian of the facility, with the responsibility for environmental restoration and transfer of the facility to a viable entity. As the caretaker, EFA NW contacted the State regulators and agreed to begin another round of sampling to determine if lead and copper were still a concern after the downsizing of Adak's drinking water system.

In September 1997, the second round of samples were collected from drinking water taps in nine single-family (Tier 1) homes. Sample numbers decrease from 40 to 9 due to fewer people served during base closure. In six homes, lead levels were below the action level. Two homes had lead levels of 15 ppb and 74 ppb. In March 1998, the same nine homes were retested. Two samples were collected from each home. The first sample was a "first draw," water coming out of the tap after being allowed to sit in the pipes for at least six hours. The second sample taken was after the water was allowed to "flush" for 30 seconds. Results showed eight out of nine sampled homes above the EPA action level of 15 ppb (concentration range 18-111 ppb). Results of the 30 second "flush" showed only one out of nine homes above the action level (actual concentration 16 ppb). This indicates that flushing the water lines has a remarkable impact on reducing lead levels in the drinking water taps. However, to help ensure lead levels from tap water plumbing are safe, water should be allowed to run for 2-3 minutes prior to drinking or being used for cooking. In a letter on July 8, 1998, ADEC requested that a second set of samples be collected because the majority of samples collected were taken in vacant units.

On August 29, 1998, a second set of samples was collected from 10 housing units and 3 other locations (the medical facility, galley, and pier). After first-draw samples were collected, a second set of samples were collected after the faucets were allowed to run for 3 minutes. The results of analyses showed that lead was elevated above the action levels in 5 units. The data revealed that the metals levels did drop off dramatically after the 3-minute flushing further illustrating the need for a 3-minute flushing time to protect public health.

By mid-1999, the Navy received a firm commitment from TAC regarding their intentions to retain Adak as a community. The Navy issued a contract to obtain services for a corrosion-control study. The contractor conducted a bench-scale treatability test to evaluate corrosion-control treatment options in addressing the problem of copper and lead in Adak's drinking water (Hart Crowser, 2000). The objective of the test was to identify the optimal treatment option for reducing the concentration of lead and copper in Adak's drinking water. Three specific treatment methods were used: (1) pH/alkalinity adjustment, (2) calcium hardness adjustment, and (3) corrosion inhibitor addition. The bench-scale study was completed by August 31, 2000. The results showed that the introduction of calcium phosphate was effective in lowering the elevated levels of lead and copper; however, it failed to lower the metals to state regulatory levels. The report indicated that the faucets within the housing units could be contributing elevated metals.

A study in 2001 was performed to determine the effectiveness of replacing the existing fixtures with faucets that were lead and copper free. The results showed that replacing faucets lowered both copper and lead levels by 67 and 86 percent, respectively. The reduction of metal concentrations was encouraging; however, this method failed to achieve a reduction to regulatory limits for lead and copper.

The data from the studies show that replacing faucets will be slightly more effective in reducing lead and copper concentrations than source treatment. The data for the faucet study is considered more realistic, because the study was conducted on Adak. The corrosion-control study was performed within a laboratory under controlled conditions; therefore, the true effectiveness of using calcium phosphate in the field is not known. Although the corrosion control study attempted to simulate the conditions on Adak, actual conditions may vary producing different results.

From the available sampling results, it is difficult to establish if an increasing lead level trend is occurring or if elevated lead levels can be related to homes left unoccupied. Therefore, ATSDR is concerned that the party who becomes responsible for the drinking water system be made aware of the past problems with compliance. According to the Navy, the Aleut Corporation will be appraised of past sampling results as part of the agreement to lease the water system from the Navy. Additionally, in order to protect public health, the state should closely monitor the sampling and educational compliance requirements under the new ownership. ATSDR is also concerned that drinking water taps should be sampled in the former day care center should it be used as such in the future.

Human Exposure Routes and Public Health Implications

ATSDR is concerned about exposed individuals which may include the most sensitive population, fetuses of pregnant women and children who may be exposed to lead contaminated drinking water in the homes, at schools, day care, and at work. Children and pregnant women can absorb enough lead to raise their body burden of lead to levels that could pose a health problem from intermittent exposure to even moderate levels of lead over an extended period of time, e.g., more than a year (Maes et al.)

In order to evaluate the likelihood of adverse health effects in people on Adak who drink lead contaminated water, we reviewed the available scientific information. Studies of lead's health effects on people are based on blood lead levels, a measure of the amount of lead absorbed by the body, not the amount of lead detected in water or some other medium. Blood lead is measured in micrograms per deciliter (µg/dL). Several studies have analyzed the correlation between lead levels in drinking water and resulting blood lead levels in infants, older children, and adults (Marcus 1989a,1989b,1990,1991).

ATSDR used an algorithm and EPA's IEUBK computer model for estimating the likelihood of adverse health effects in people on Adak who drink lead-contaminated water. Based on these scientific tools, people drinking water containing lead at levels above 50 ppb could absorb

enough lead to experience long-term health consequences. Moreover, people highly sensitive to the effects of lead, particularly children, infants, and fetuses, could experience irreversible adverse health effects such as decreased IQ and compromised mental development (CDC 1991)

The health effects of lead are not immediately apparent. Once in the blood, lead is distributed to soft tissue (kidneys, bone marrow, liver, and brain) and mineralizing tissue (bones and teeth). Bones and teeth contain about 95% of the total body burden of lead in adults (ATSDR 1992).

It is the total body burden of lead that is related to the risk of adverse health effects. Because the body accumulates lead over a lifetime and releases it slowly, even small doses of lead over time can cause lead poisoning. Further, relatively low blood lead levels can cause adverse health effects, some of which, like decreased IQ or mild behavioral disorders, may not produce noticeable signs or symptoms.

Exposure to high levels of lead can damage the brain, red blood cells, and kidneys of adults at blood lead levels ranging from 40 to 100 µg/dL and children at blood lead levels of 35 to 50 µg/dL. Acute effects of exposure to high lead levels are nausea, vomiting, and headache. Lead exposure in adults may increase blood pressure. High levels of blood lead (40 µg/dL) may affect sperm or damage other parts of the male reproductive system, making it difficult for a couple to have children (ATSDR 1992).

Fetuses and children are especially sensitive to the effects of lead. Additionally, when women are pregnant, lead stored in their bone can enter their bloodstream, increasing the amount of lead reaching the fetus and resulting in premature birth, low birth weight, and decreased mental ability. In infants and young children, lead exposure has been shown to decrease intelligence, slow growth, and cause hearing problems at blood lead levels at or below 10 µg/dL, a level previously thought to be safe. These effects can persist as children get older and interfere with successful performance in school (CDC 1991).

Summary

The likelihood that children would consistently drink water with high lead levels is low because once the taps have been turned on, lead levels drop rapidly. However, lead levels in drinking water can potentially cause serious health consequences. For that reason it is important that education be conducted frequently to remind people to flush their lines. The steps to reduce exposure are simple and have a demonstrated dramatic effect. Flushing the water lines for 30 seconds each time the tap is turned on and flushing for 2-3 minutes whenever the taps have not been used for more than 6 hours can reduce exposures to levels below health concern.

Conclusions and Public Health Action Plan for Lead Exposure (Tap Water)

Conclusions:

1. Lead contaminated tap water poses a potential health hazard for children and fetuses of pregnant women who may be living on Adak now and in the future.
2. Sampling data shows elevated levels of lead in drinking water taps in homes in Sandy Cove, Eagle Bay, and Moffett View neighborhoods.
3. Flushing water lines is a simple way people can reduce their exposure to lead in drinking water. From sampling results, flushing for 2-3 minutes drastically reduces the lead levels in tap water.
4. Currently distributed educational flyers are informative, and give recommendations for flushing those taps not used in 6 hours to reduce the potential hazard.

Completed and On-going Actions:

1. Educational material is given to all adult employees coming on base when they receive the key to their quarters.
2. The Navy has completed a source-treatment study evaluating corrosion control and will be conducting a faucet replacement study evaluating the effectiveness of replacing fixtures.
3. Based on the results of the faucet replacement study, the Navy plans to replace existing fixtures in every Sandy Cove housing unit with faucets that contain zero percent lead and copper.

Planned Action:

1. ADEC will continue to work with the Adak Reused Corporation on Adak Island to continue sampling tap water for lead and copper contamination in accordance with EPA regulations as overseen by ADEC.

Recommended Actions:

1. ATSDR recommends that the Aleut Corporation change the currently distributed educational material to include recommendations to only use cold water for making formula and reconstituting juices and cooking. This is most applicable for families with potentially pregnant women and children.
2. If the former day care center is opened as a day care center in the future, the party responsible for the Lead and Copper Rule compliance should test the tap water in that facility at least biannually for lead and copper levels.

A2. Residents Possibly Exposed to Jet Propellant - 5 (JP-5) in Indoor Air in Sandy Cove Homes - Current and Future Potential Exposure - Indeterminate Public Health Hazard

People, particularly children, may be exposed to harmful levels of JP-5 vapors, breakdown products and biogenic gases (methane, ethane, etc.) in the indoor air of their homes in Sandy Cove Housing area now and in the future. Spills and releases from JP-5 tanks and associated lines and piping (SWMU 62, New Housing Fuel Leak) have saturated the soils and seeped into underground water. The groundwater table is very shallow in this area. Homes are located just a few feet above these soils and water. JP-5 and related vapors and coming from the soils and from free-floating product may have migrated into the homes and could potentially pose a public health hazard to people living in the homes. Indoor air sampling is needed to determine if the air inside homes is safe. Children and especially those exposed in utero, could develop neurological impairment if exposed to high levels of JP-5 in indoor air.

What is JP- 5?

JP-5 stands for Jet Propellant- 5. JP-5 is the primary jet fuels used by the U.S. Navy. It is a colorless liquid and has the smell of kerosene because kerosene is the major substance of JP-5. Jet fuels are refined under more stringent conditions than kerosene and contain various additives for use in military aircraft (anti-oxidants), dispersants and/or corrosion inhibitors) not found in kerosene.

What are the possible health effects from JP-5?

Health effects of concern from inhalation exposure to jet fuels include eye irritation and central nervous system effects similar to intoxication. The major health concerns of these low-level exposures are adverse birth outcomes in children.

(ATSDR 1998a)

Contamination History

In 1988, new piping was installed underground connecting JP-5 containing tanks to the airport facility. Materials used to backfill the piping included heavy rocks and boulders may have punctured the newly installed piping. One year after the pipe installation, a large slick of JP-5 free-floating product was noted in Kuluk Bay. Investigations in 1989 discovered the breaks and leaks in the piping. Pipes were removed and an investigation of the groundwater under the Sandy Cove, Eagle Bay, and Turnkey Housing areas began (ATSDR 1999f). The release was named Solid Waste Management Unit 62 or (SWMU 62), New Housing Fuel Leak. It has been identified as having free-floating product on the groundwater table and may release gases into the air due to the shallow groundwater table in the area. Homes located over the contaminated groundwater may trap gases creating a hazard to people living in the airtight homes of Sandy Cove, Eagle Bay, and Turnkey Housing areas.

According to the BRAC Cleanup Plan document, this contaminant plume is the largest free-floating product plume on the island to date. JP-5 petroleum hydrocarbon releases in 1988 and 1989 occurred at three housing areas: Sandy Cove, Eagle Bay, and Turnkey. It was estimated to contain four large and four smaller plumes and be about 2.6 feet thick.

Extent of Contamination, Sampling, and Cleanup

JP-5 released to the soil has migrated into the groundwater (URS 1999a). Sandy Cove and most of the downtown Adak area, was man-made in 1940s by filling in a natural tidal lagoon (URS 1997a). Groundwater is at shallow depths in this area and varies from 1 foot to 28 feet below ground surface (URS 1999d). Tidal influences of groundwater may exacerbate the problem by pushing vapors from JP-5 floating on the surface of the groundwater table up through the thin soil cover and cause an accumulation of JP-5 vapors in homes.

Since 1989, four large and four small groundwater contamination areas called plumes have been delineated (URS 1997d). Recovery wells and a subsurface product recovery system were installed in 1989. The Navy began pumping the contamination out through recovery wells in 1989. Later in 1989, 109 monitoring wells and 6 product recovery systems were installed (URS 1997d). However, investigations in 1993 discovered that the recovery system was failing and that some of the plumes have migrated further beyond the capture zone. In 1996, a new system was installed that included sensors that shut down the system when operating conditions deviated from design parameters (URS 1997d).

According to the Navy, since the onset of free product recovery in the downtown housing area, approximately 154,000 gallons have been recovered. Free product monitoring information collected during July 1999 indicates that approximately 3.1 acres of the original 100 acres downtown housing area contain free product. By agreement between the Navy and Alaska DEC, free product recovery was to be terminated in the downtown housing area when less than 0.5 gallons of free product per 1,000 gallons of treated groundwater is recovered by the system for a period of one year. The system has met this criteria and on May 1, 2000, the Navy shut down the pump and treat system.

The Navy has reported that they removed soil under the housing units where releases were identified (ATSDR 1999c). These releases were not associated with the housing area fuel leak, but were localized fuel spills from tanks providing heating fuel to individual housing units (Bristol, 2000). These activities typically removed between the top one to two feet of soil. Clean sand was used to backfill the removal locations and vapor barriers were installed in the crawl spaces (URS 1999a). According to the Navy, vapor barriers are currently in place beneath all housing units at Sandy Cove and Eagle Bay housing areas (ATSDR 2000a).

According to the Navy project manager, Sandy Cove Housing Units 134 and 167 were formerly impacted by a petroleum release from the distribution line which services these units, but these units are no longer in use. All housing units on Adak are currently heated by heating oil that is stored in individual aboveground storage tanks (ASTs). The previous distribution piping system has been abandoned and the lines cleaned.

Sandy Cove houses are constructed on concrete foundations with vented crawl spaces. Additionally, the Navy states they all have vapor barriers. Although this construction might reduce levels of soil gas, foundations crack and electrical lines can act as conduits for gas migration into homes.

Under circumstances of shallow groundwater contamination, volatile chemicals may migrate through soils and into homes through the backfill material along utility service lines entering the home and through cracks in building foundations. Indoor air sampling was not performed in the Sandy Cove housing area to determine if gas migration from the shallow groundwater contamination was entering the home; therefore, no conclusions can be drawn regarding whether the indoor air quality was impacted.

Studies and publications by the US Air Force Center for Environmental Excellence indicate that anaerobic biodegradation processes dominate the natural "intrinsic" remediation of contaminated aquifers (Wiedemeier et al.,1995; Newell et al., 1995). Bacteria that attack hydrocarbons generate carbon dioxide under aerobic conditions and methane under anaerobic conditions. Not only do bacterial activities occur, but percent levels of carbon dioxide and methane are often generated. Methanogenesis (39%) and sulfate reduction (29%) are estimated to account for approximately 68% of anaerobic degradation. Biogenic methane and carbon dioxide data, generally can be used for mapping the distribution of contaminated soils; even when the contamination is very old and the lighter hydrocarbon volatiles are nearly absent (ETI 1998).

Additionally, JP-5 contains additives to improve performance. Typical additives to jet fuels include antioxidants, metal deactivators, static dissipator, corrosion inhibitors, fuel system icing inhibitors, octane enhancers, ignition controllers, and detergents/dispersants. These additives are used only in specified amounts, as governed by the military and which may include 2,6-di-tert-butyl-4-methylphenol and tert-butyl-2,4-dimethylphenol among other chemical additives. These additives typically would move through and disperse in groundwater very rapidly and would not likely be detectable 10 years after release.

Data Gaps for Evaluating Human Exposure to JP-5 in Indoor Air of Sandy Cove Homes

The Navy has conducted numerous sampling events of groundwater, soil, and soil gas. However, the sampling cannot address all the possible health hazards posed by SWMU 62 for two main reasons:

1. *Incomplete list of analytes* - The samples were not analyzed for chemicals likely to be detected in JP-5. JP-5 contains 98% kerosene which is made up of about 20 different chemicals in varying percentages. Table 2 lists most of the chemical components. According to the American Petroleum Institute, benzene, toluene, ethylbenzene, and polyaromatic hydrocarbons, the focus of the Navy's sampling, would <u>not</u> be detectable in weathered JP-5, but other components would be present including methane and carbon dioxide (ATSDR 1999d). The benzene, toluene, ethylbenzene, and xylenes (BTEX) content of JP-5 is typically below 0.02% and polyaromatic hydrocarbons are virtually excluded (ATSDR 1999a). Light, middle, or heavy products of the distillation process are based on the boiling points of each chemical. Jet fuels are middle distillates of petroleum crude oils that are

composed of hydrocarbons generally coming off distillation columns at temperatures between 150 and 300 degrees Centigrade (IARC 1989). BTEX and PAHs, because they have lower boiling points, are removed from the distillation process sooner than the middle distillates. Furthermore, once released into the environment JP-5 changes and degrades, BTEX are the first constituents to disburse and degrade.

2. *Indoor air was not sampled.*

Other Information Needed for a More In-Depth Evaluation of Indoor Air Safety

1. Locations of the monitoring wells in relation to the plumes, depths, and monitoring parameters.
2. Location and volume of soil removed including contaminant concentrations.
3. Depth to contamination.
4. Geological and hydrogeological descriptions.
5. Detailed description of remediation efforts to date including future plans for the remediation, sampling, monitoring, and characterization including roles and responsibilities.

Human Exposure Routes and Public Health Implications

People living in the Sandy Cove housing units may currently be exposed to components released from the JP-5 fuel leak by breathing fumes indoors. Because of the tremendous amount of fuel spilled, the closeness from surface soil to groundwater, the airtightness of the homes, and previous complaints noted during ATSDR's 1993 site visit, ATSDR believes that fumes from JP-5 could be present in homes. Pregnant women and children would be more susceptible to the health effects associated with exposure to JP-5. Since there is no medical test that can determine if someone has been exposed to JP-5, ATSDR recommends that indoor air of homes in the Sandy Cove housing area be sampled for Total Petroleum Hydrocarbons, N-alkanes and C9-C12 fractions of hydrocarbons. ATSDR requests to review the sampling work plans with details from the groundwater and source area maps and hopes to work with the Navy to ensure that measures are taken to protect public health.

ATSDR reviewed the scientific literature for information on the health effects from breathing low levels of JP-5 and determined that most of the effects are neurological. Once inhaled, many of the JP-5 components cross the blood-brain barrier. In one study, a leak of JP-5 aboard a Navy jet left individuals with coordination and concentration difficulties, and fatigue (ATSDR 1999a). Other effects seen in humans include visual acuity impairment, postural sway, headache, nausea, apparent intoxication and anorexia. Studies on animals report hematological effects such as decreased hemoglobin, red blood cell count, and serum albumin levels for intermediate exposures lasting 13 weeks. Without indoor air analytical information, ATSDR cannot predict the types and severity of health effects, if any, that may be experienced by Sandy Cove residents. Moreover, without indoor air analytical information, ATSDR cannot determine the safety for Sandy Cove residents breathing air in their homes.

Table 2 shows the chemicals in JP-5 compared to some of the 525 different chemicals analyzed by the Navy at SWMU 62 (JP-5 fuel leak). As the table illustrates, *the primary JP-5 components were not analyzed.*

Table 2- Comparison of JP-5 Components and Breakdown Products versus Navy Sampling Parameters

Chemical	JP-5 Components *	Sampling Analytes	Chemical	JP-5 Components	Sampling Analytes
n-Decane	✔	----	1,3 Butadiene	----	✔
n-Undecane	✔	----	Chloromethane	----	✔
n-Dodecane	✔	----	Vinyl Chloride	----	✔
n-Tridecane	✔	----	Bromomethane	----	✔
n-Tetradecane	✔	----	Methylene Chloride	----	✔
n-Pentadecane	✔	----	Chloroform	----	✔
n-Hexadecane	✔	----	Acetone	----	✔
1,2,3,4-Tetramethylbenzene	✔	----	Acenaphthene	----	✔
1-Ethylpropylbenzene	✔	----	Acenapthylene	----	✔
2-Methylundecane	✔	----	Fluorene	----	✔
2,6-Dimethylundecane	✔	----	Fluoranthene	----	✔
1-Methylnapthalene	✔	----	Benzo(a)fluorene	----	✔
2,6-Dimethylnaphthalene	✔	----	Benzo(a)anthacene	----	✔
Heptylcylohexane	✔	----	Benzo(g,h,i)fluorranthene	----	✔
Methane	✔	----	Benz(k)fluoranthene	----	✔
Benzene	----	✔	Indeno(1,2,3-cd)pyrene	----	✔
Toluene	----	✔	Anthracene	----	✔
Ethylbenzene	----	✔	Phenanthrene	----	✔
Freon 12	----	✔	Pyrene	----	✔
Carbon Tetrachloride	----	✔	Chrysene	----	✔
Trichloroethane	----	✔	Benzo(a)pyrene	----	✔
Styrene	----	✔	Perylene	----	✔
Chlorotoluene	----	✔			
Propylene	----	✔			

* JP-5 product (undiluted) in amounts equal to or greater than 1 percent by weight (BP 1999, ATSDR 1999a).

Conclusions and Public Health Action Plan for JP-5 Exposure (Indoor Air)

Conclusions:

1. Navy sampling to date is inadequate to determine the health hazard posed by JP-5 and related breakdown products which may have released vapors that could migrate into homes in Sandy Cove housing area for two reasons. 1) Sampling to date, did not include analysis of many chemicals expected to be present in a JP-5 release. 2) Sampling of groundwater, soil, and soil gas do not provide sufficient information about indoor air, the medium to which people are exposed.

2. A potential public health hazard exists for the residents of Sandy Cove housing area due to JP-5 vapors collecting in their home from migration of contaminants from the JP-5 fuel spill (SWMU 62).

Completed Action:

1. The Navy has initiated two groundwater cleanup efforts for SWMU 62.Groundwater treatment stopped operation in May 2000 based on the achievement of cleanup goals implemented in coordination between the Alaska State Department of Environmental Conservation and the Navy.

Planned Action:

1. SWMU 62 will be part of a focused feasibility study (FFS) in the future.

Recommended Actions:

1. ATSDR recommends that the Navy conduct indoor air sampling (prior to turning over the island) of selected Sandy Cove homes for components known to be present in JP-5 such as total petroleum hydrocarbons, methane, and n-alkanes used to "fingerprint" the JP-5. SUMMA canisters would provide a quick and relatively inexpensive sampling procedure. ATSDR will assist the Navy in the selecting of homes once we receive specific information detailing the contamination source, plume (extent of contamination), location of monitoring wells, etc. (see below for needed information).

2. In addition to the air samples, the Navy should provide ATSDR the following information in order for ATSDR to evaluate exposure pathways:
   - extent of the groundwater plume (map and well locations and screening depths)
   - extent of the soil contamination (detailing any removals)
   - chemical analytes sampled including analysis methodology used, blanks, quality assurance/ quality control measures
   - depth to contamination
   - geological and hydrogeological descriptions
   - location of homes and buildings in relation to contaminant plume
   - description of remediation efforts to date
   - future plans for the remediation, sampling, monitoring, and characterization including roles and responsibilities.

A3. Children Exposed to Soil in Yards and Neighborhood Playgrounds in Sandy Cove and Eagle Bay in the Downtown Area - Current and Future Exposure - No Public Health Hazard

Aerial photographs and an interview with the former base environmental manager indicate that prior to the development of the housing areas, use of the property was minimal and does not indicate use or disposal of hazardous substances.

The Navy has provided ATSDR a series of aerial photographs taken in 1943, 1944, 1945, 1946, 1955, 1973, 1977, 1982, 1987, and 1991 which indicate that the land prior to the development of the Sandy Cove Housing Area was at various times used for outside staging, parking for the playground, or appeared not to be in use. Because there is no indication that hazardous materials were used, stored, or disposed on the property now included in the Sandy Cove Housing area, the Navy has no plans to sample the surface soil in this area.

ATSDR contacted the former NAS Adak Base Environmental Manager to gather additional information. The former environmental manager lived on Adak Island for 16 years and is credited with directing most of the environmental investigations on base prior to base closure in 1994. During past fuel spill investigations, his group collected soil samples and analyzed them for lead and volatile organic compounds and total petroleum hydrocarbons (TPHs). To the best of the manager's recollection, lead levels were not detected above the health standards at the time. TPH and VOC levels were elevated in areas where fuel had been spilled onto the ground, but there was no indication that surface soil was widely contaminated with fuel related components.

Based on the information ATSDR was able to obtain, it is unlikely that residential and playground soil in the Sandy Cove and Eagle Bay housing areas contain contaminants and therefore, do not pose a health hazard to adults or children who play there.

Conclusion and Public Health Action Plan for Children Exposed to Sandy Cove and Eagle Bay Neighborhood Soil

Conclusion:

1. Based on the information ATSDR was able to obtain, it is unlikely that residential and playground soil in the Sandy Cove and Eagle Bay housing areas would pose a health hazard to adults or children who may play

Completed Action:

1. Prior to base closure in 1994, the Navy conducted soil samples to determine extent of fuel contamination from fuel spills of residential heating oil and from flightline fuel piping.

Planned Action & Recommended Actions:

None

A4. Workers and Residents Exposed to Asbestos in Building Materials in Schools, Homes, and Workplaces - Current and Future - No Apparent Public Health Hazard

People have expressed concerns about asbestos exposure from homes, school, or workplaces in the downtown area. Asbestos exposure is unlikely to be a health hazard to most people because most asbestos is not friable and exposures would be to low levels. Friable is a term which refers to asbestos materials which are easily crumbled by hand. While asbestos is in many products people come in contact with daily, levels of exposure to most people do not present a health hazard. Occupational exposures of plumbing insulators, asbestos removal personnel, or asbestos workers would be of health concern; however, following OSHA regulations including wearing personal protective equipment would prevent exposure to asbestos. Information about asbestos containing structures and materials should be made available to the new residents and facilities workers.

What is asbestos?

Asbestos is the name applied to six different naturally occurring mineral fibers that have been used since the times of ancient Greece. Asbestos provides heat, cold, and sound insulation, friction and fire protection, and strength to many materials. Some of the products that may contain asbestos are roof shingles, ceiling, roof or wall tile, backing on vinyl floor tile, or in automotive brakes. Asbestos is still currently used as thermal insulation and heat shields in many household appliances such as toasters, irons, slow-cookers, dishwashers, refrigerators, ovens, range hoods and clothes dryers. Asbestos is very stable in the environment; it does not dissolve in water and is not broken down over time. Health problems related to asbestos exposure have been documented in workers who were exposed to extremely high amounts of asbestos dust for more than 20 years. on a daily basis.

(ATSDR 2001)

Background

During ATSDR's site visit and discussions with Restoration Advisory Board (RAB) members and other concerned people, the following concerns about asbestos exposure were expressed: incidental asbestos exposure from the high school floor tile, from homes that are likely to be reused, in workplaces, from asbestos in landfills, and from decaying buildings which do not get used. In addition, concern was expressed regarding the responsibility of the new occupants for removal of asbestos in decaying structures once the Navy leaves the island. The Navy is scheduled to complete the demolition of all structurally unsound facilities during the summer of 2002.

The community expressed concern about asbestos possibly being in the mastic (adhesive) of the floor tile of the hallway leading from the cafeteria to the gymnasium in the high school which is used as the cafeteria, recreational area, and offices for the contractors and Navy personnel. Navy contractors put down duct tape along each joint and over cracked areas to secure the tile. However, due to the high foot traffic of the hallway and the daily maintenance of sweeping and mopping the floor, the duct tape has come almost completely off. Although asbestos particles would not likely be released during normal daily activities such as walking on, sweeping or mopping the tile floor, anyone involved in repairing the floor tile could be exposed to asbestos if the floor tile is disturbed by sanding, sawing, or cutting. It is currently not known if the mastic

actually contains asbestos. For that reason ATSDR recommended that educational material be provided to the current and future occupants to alleviate fear of daily nonoccupational asbestos exposures. Past newsletters produced by the Navy have highlighted the inaccessible, nonfriable nature of the asbestos that may be related to floor tile or its associated mastic. Under routine use and non-abrasive surface cleaning, it is unlikely that this source would produce airborne fibers.

Currently, asbestos-containing building material (ACBM) remains in place in less than 35 buildings presently in use. These areas are used primarily as unoccupied storage space. ACBM also remains in some laid-away facilities. The majority of ACBM present is nonfriable. Intact, undisturbed, and appropriately maintained ACBM does not pose a significant health risk. The recommended in-place management program for the remaining ACBM is discussed in Hart Crowser's *Asbestos Management Plan for Former NAF Adak*, dated November 2000.

People living or working on Adak (now and in the future) are concerned about their asbestos exposures from their homes, workplaces, and from decaying buildings not planned for re-use.

Supervisor of Shipbuilding, Conversion & Repair – Portsmouth, VA –Environmental Detachment, Vallejo, CA (SSPORTS) conducted an asbestos survey of 222 buildings and structures at Adak NAF from July 1996 to August 1996. The purpose of the survey was to identify asbestos-containing materials. SSPORTS workers remediated friable, accessible asbestos-containing material in 149 buildings, with total abatement completed at 3 LORAN Station buildings. To document specific remediation actions conducted in the 152 buildings, SSPORTS issued the Adak NAF Asbestos Remediation Completion Report, January 1998.

In 1998, SSPORTS continued its abatement activities. In accordance with the Phase II Project Management Plan (PMP) for Asbestos Remediation at NAF Adak, SSPORTS repaired, removed, and evaluated all friable, accessible, and damaged ACM in buildings that posed a threat to human health and safety. SSPORTS conducted an overview of the entire island to locate, pick up, bag, tag and dispose of any visible, loose asbestos in safe, accessible areas. From mid-March to October 1998, remediation and building inspections occurred. A total of 398 buildings were certified as safe for occupancy and use. These efforts are documented in the 1998 Asbestos Remediation Completion Report for Adak NAF (released May 1999).

During January through December 1999, using special authority and funding provided by Congress, the Navy contracted with SSPORTS, Space Mark, and Ultramax, Inc. to remove asbestos-containing building materials in 93 buildings. The 1999 asbestos remediation efforts are summarized in the Asbestos Remediation Completion Report, released March 2000 by Roy F. Weston, Inc.

Human Exposure Routes and Public Health Implications

Most people living or working on Adak would not be exposed to levels of asbestos that would present a health hazard. Routine daily activities may involve accidentally (incidentally) inhaling tiny amounts of asbestos fibers suspended in the air from the high school floor tile, from

appliances in homes, and from materials in the workplaces. Additionally, any asbestos or asbestos containing material disposed in a landfill or otherwise buried does not present a health hazard to current or future residents because contact with buried material is not likely to occur.

Likewise current and future residents of Adak would also not likely be exposed to levels of asbestos that would pose a health hazard since asbestos containing materials are not likely present in Sandy Cove, Eagle Bay, and Moffett View housing areas.

Asbestos from decaying buildings which do not get re-used are not likely to present a health hazard. Disturbances involving bulldozing, destruction, or moving decaying structures could pose a hazard to the worker performing the activity. Workers involved in such activity should be educated about the potential contents of these structures. Current contractors and future workers not involved in asbestos-related activities are not expected to be exposed.

Those individuals who might be occupationally exposed to asbestos containing material such as plumbers or workers handling pipe insulation, or workers involved in asbestos clean-up activities should be made aware of the potential of material they may be handling to contain asbestos and wear the appropriate personal protective gear as required by OSHA.

Information presented in the scientific literature states that, inhaling large amounts of asbestos dust daily for over 20 years has shown to present a health hazard. Routinely, those types of exposures have been associated with lung cancer, mesothelioma, and asbestosis. While not all occupationally exposed individuals experience adverse health effects from their asbestos exposure, a scientific statistically significant number of people studied did show these diseases. It is not known why some people are affected by their exposure and others not, it may be due to their genetic predisposition or resilience, or their individual lifestyle habits (ATSDR 2001).

While there is great concern about the health implications of even small amounts of asbestos exposure, much research has been done over the last 30 years to support the fact that asbestos exposure presents a health hazard only to those people who have worked with large amounts of friable asbestos for more than 20 years. Occupations with documented asbestos exposure-induced health effects include asbestos miners and asbestos insulation installers in the shipbuilding or plumbing industries (ATSDR 2001).

These people experienced daily exposure to high levels of asbestos dust for more than 20 years. Adverse health effects include mesothelioma, a cancer of the lining of the chest cavity, and asbestosis, a condition of the lungs which results in the lungs containing fibrosis tissue. The symptoms of these diseases do not usually appear until about 20 to 30 years after the first exposure to asbestos (ATSDR 2001).

Asbestos has been used in homes, schools, and workplaces since the early 1800s. Therefore, there is much evidence that daily exposure to asbestos containing materials in homes, schools, and workplaces does not present a health hazard because more people would be experiencing asbestos-related illness. Even though there is concern about asbestos exposures from non-occupational conditions, recommendations by the American Lung Association, the Asbestos

Institute and others is to leave existing asbestos in place. Damaged asbestos-containing material should be repaired by "encapsulation", a procedure that uses a heavy fiber-glass wallpaper-type paste similar to a patch to seal the damaged areas. An area as large as 10 feet in length can be easily repaired by encapsulation instead of being removed. Removal creates more hazardous asbestos dust and with it the greater potential for exposure.

In the 1970s, there was tremendous media attention to asbestos and asbestos related illness. This sparked a frenzy of lawsuits and legislation proposals to ban the use of asbestos in the United States. Some countries have banned asbestos use and have found even greater health hazards associated with its alternative replacements such as fiberglass. Scientific evidence does not support the conclusion of a widespread health hazard associated with everyday non-occupational asbestos exposure. Many more hazards have been associated with asbestos-alternatives. For those reasons, while the use of asbestos had declined, asbestos was not banned in the U.S.

According to BRAC protocol, the Department of Defense policy for all BRAC sites is to leave as is in place all asbestos and lead based paint containing structures and to disclose their contents, condition for each building in the Finding of Suitability to Transfer documents (DoD 1998).

Conclusions and Public Health Action Plan for Asbestos Exposure (Downtown Area)

Conclusions:

1. Floor tile in the high school may contain asbestos-laden adhesive. Asbestos particles would not likely be released during normal daily activities such as walking on, sweeping or mopping the tile floor. However, anyone involved in repairing the floor tile could be exposed to asbestos if the floor tile is disturbed by sanding, sawing, or cutting.

2. Since asbestos was not used in building materials for those homes that are being or will be used in the future, current and future residents of Adak are not likely to be exposed to friable asbestos in their homes.

3. Only daily occupational exposure to high levels of asbestos dust for longer than 20 to 30 years has been shown to result in asbestos-related lung disease.

4. Asbestos disposed in landfills or otherwise left covered does not present a health hazard to current or future Adak residents.

Completed Actions:

1. Navy contractors conducted "shore-to-shore" asbestos survey of all standing, partially standing, or dilapidated structures on the Navy controlled portion of Adak Island.

2. All asbestos found to be damaged, friable, and accessible at the time of the survey has been encapsulated or properly removed.

3. The Navy has documented asbestos inspection and remediation reports (Weston March 2000) in a consolidated asbestos survey report for NAF Adak.

4. The Navy completed an in-place management plan for asbestos as contained within the Hart Crowser document, "asbestos Management Plan for Former NAF Adak, November 2000.

Recommended Actions:

1. Due to the reduced level of concern about asbestos exposure to current and future visitors to the high school from floor tile adhesive, and the efforts made by the Navy, ATSDR has no follow-up recommends.

B. Recreational or Construction Activities - Active Exposures

B1. Explosive and Physical Hazards Pose a Low Hazard to Adults and Children in the Downtown Area as a Result of Walking, Hiking, Fishing, Playing, Digging, Snowmobiling, 4-Wheel Driving, or Digging - Current and Future Exposure - Public Health Hazard

Although the likelihood of people being injured or killed by unexploded ordnance materials, or Rommel stakes during routine daily activities is extremely low, potential current and future hazards still exist and cannot be entirely eliminated for people recreating in the downtown area. Surveys, screening, intrusive sampling, and historical information reviews have been conducted on areas in the downtown region to help establish the potential level of hazard for people to come in contact with unexploded ordnance. The Navy has performed extensive investigations and removal actions that will continue as part of the remedial investigation process of Operable Unit B (OU-B). The Navy has determined that the downtown area does not pose an unacceptable hazard level to people who live, work, or play downtown. To reduce the likelihood of people to handle explosive and physical hazards, the Navy initiated and continues to educate people on the possible appearance of hazardous and explosive item and the procedure for notifying the correct officials.

What are explosive and physical hazards?

Explosive (OE) hazards include all components related to munitions that are designed to cause damage to personnel or material through explosive force or incendiary action. Unexploded ordnance (UXO) include military munitions that have been primed, fuzed, armed or prepared for action and that have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard, and that remain unexploded. Unexploded ordnance can include artillery, mortars, rocket ammunition, small arms ammunition, land mines, bombs, missiles, depleted uranium rounds, chemical warfare agents, demolition charges, pyrotechnics, depth charges, grenades, sea mines, torpedoes, etc.

Physical Hazards include Rommel stakes, stakes, metallic, and structural debris. Rommel stakes are either corkscrew-type turn or U-shaped stakes with sharp pointed edges used to slow-down and channel field troops. Injury is caused by puncturing and impaling boots or bodies of people who step or fall onto them.

(Foster Wheeler 1997)

Background

The presence of explosives and military-specific physical hazards has been a part of the history of Adak since World War II. Explosive and incendiary devices were laid to deter foreign intruders, stored at, transported from, and disposed on the military occupied areas of Adak, mostly occurring between 1942 and 1946. Additionally, extensive hands-on training of war-time personnel has contributed to the presence of unexploded ordnance and military-specific stakes. Despite extensive efforts to remove known ordnance and stakes, some may remain in the ground today.

The Navy has used the latest techniques and methods available to determine the speculated hazards posed by OE/UXO hazards at Adak. Initially, the Navy used the SiteStats/GridStats software and the Ordnance and Explosives Cost-Effectiveness Risk Tool (OEC*ert).* This method which has been widely used at other military installations call for collecting samples of only a small percent (statistical sampling of approximately 3%) of the area and applying the results in predicting the hazards for the entire area. This method makes certain assumptions about the conditions which ATSDR believed could not be accurately applied at Adak. The methodology assumed that the study area is homogenous or has the same characteristics: terrain, soil composition and consistency, same type of OE/UXO, same probability of OE/UXO penetration depths, etc. (Foster Wheeler 1998c) Typically, this methodology has been used for studying firing ranges in which a well-defined area has been used for a specific type of ordnance for training purposes (UASEC, NEODTD 1999). In such cases, the OE is released from a defined place toward a defined target area. On Adak, the downtown area was not used as a firing range. OE/UXO present in the downtown area most likely resulted from accidental releases from storage areas, during transport operations, or from souvenir collectors who brought OE/UXO from other areas to their quarters or work area.

For the Navy's 1996-1998 unexploded ordnance studies, the downtown area was selected as high priority and divided into three priority areas. See Figure 5 for specific boundaries. Each priority area was investigated similarly. Each priority area was divided into grids. Priority I area consisted of approximately 390 acres divided into grids 164 feet by 164 feet in size. Priority II area consisted of approximately 683 acres also divided into grids 164 feet by 164 feet in size. The combined total area of Priority I and II Area is 1083 grids (Foster Wheeler 1997). Priority III area consisted of approximately 1,334 acres divided into 1,453 grids 200 feet by 200 feet in size (Foster Wheeler 1998c).

Priority I Area -Consists of the majority of the essential reuse facilities such as housing, administrative buildings, schools, and industrial areas.

Priority II Area -Consists of unused housing areas, airfield support areas, taxiways, runways, and the fuel tank farm.

Priority III Area-Consists of the unoccupied "barracks," the power plant, utilities support buildings, and contractor's construction camp. Most of the area, however, is undeveloped tundra.

The studies each involved six phases of work.

- Historical Records and Archive Search - Records from 1943 to the present were reviewed from boxes of files that have been declassified and other non classified files. Information provided an idea of proposed minefield locations.

- Physical Survey - A physical survey of the areas investigated was done to establish a reference grid system on which the survey could be based. The boundaries of the investigation areas were established. Grids were delineated and a statistical number of grids selected for the Geophysical Investigation using the SiteStats/GridStats software package.

- Surface Sweep/Scan and Clearance - A surface sweep or scan was conducted using magnetic detectors to identify metallic material. Removal of surface debris and UXO was conducted over the entire area of the geophysical investigation. Rommel stake removal was conducted of the downtown area.

- Geophysical Investigation - An electromagnetic instrument was used to scan the subsurface of a select number of grids to identify metallic items referred to as "anomalies." Between 10 and 86% of total downtown area did not receive surface clearance or geophysical investigation.

- Grid /Anomaly Selection - Data from the Geophysical Investigation were entered into the SiteStats/GridStats software in order to select an even smaller portion of the area to be dug up in the intrusive investigation. Each of the grids used in the geophysical study were further divided into four portions or quadrants. Only the quadrants that received geophysical investigation were included in the intrusive investigation.

- Intrusive Investigation - Of the anomalies identified and computer mapped, a smaller percent was excavated or dug up to a maximum depth of 4 feet.

"In 1999, the Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) formally disputed the Navy's approach to investigating and characterizing Operable Unit B. As a result, the Adak Dispute Resolution Committee (DRC) was formed, consisting of EPA, ADEC, and the Navy. They agreed to appoint a Project Team consisting of the Navy, EPA, ADEC, together with the U.S. Fish and Wildlife Service (USFWS), The Aleut Corporation (TAC), and the Aleut/Pribilof Island Association (A/PIA) to design an Adak-unique, CERCLA-consistent approach to identifying, evaluating, and remediating sites potentially contaminated with ordnance" (Foster Wheeler 2000).

By agreement of the OU-B Project Team, none of the Sites Stats/Grid Stats statistical characterization or the OE/Certs based risk assessment approach was used as a basis for decision making. However, information gathered during those investigations was combined with the

additional information gathered to create a weight of evidence approach to determining potential hazard.

The OU-B Project Team designed the Preliminary Assessment initiated in 1999, that included the Level I Qualitative Risk Screen which was used to identify sites that should advance to the Remedial Investigation Phase. One assumption used in the preliminary assessment is that archival data can identify particular groups of ordnance-use areas that will have similar and predictable ordnance depositions and site characteristics. Each area was then validated or refuted with field data used to assess the strength of evidence that each site fits the assumptions made. Those sites having no, weak, or average evidence are advanced to the remedial investigation phase.

Ninety-eight sites were suspected or known to be contaminated with ordnance and included in the Level I Screening process. Thirteen sites were removed due to duplication of sites and sites for which no tangible evidence of ordnance contamination was found. Eighty-five sites were recommended for the Level I Screening. Each site was further divided into 184 areas of potential concern based on characteristics of the ordnance, site and physical data available. Seventy-eight (78) were determined to need "No Further Action" and were not included in the Remedial Investigation/Feasibility Study process, based upon historical and physical evidence that indicated the site posed little or no qualitative risk to future residents of Adak. Included in this group of 78 were 27 of the proposed defensive minefields on Adak, which all evidence indicates were never installed, and 15 small arms ranges, which evidence suggests were used only for the test firing of small caliber weapons. Twenty-five (25) areas were referred for Site Inspection due to a lack of evidence with which to assess potential risk. These sites include firing points and bivouac areas where no physical investigation had been performed. The known gun emplacements on Adak were also generally included in this group" (Foster Wheeler, 9/29/2000)

Seventy-seven (77) of the areas screened were referred for remedial investigation either because the available field data did not support the documented historical land use or because it did, suggesting that the site required further consideration for physical investigation or remediation. Two sites were directly recommended for the feasibility study based on previous remediation or special circumstances preventing investigation. As a result of the screening process, those sites determined to require remedial investigation, inspection, or feasibility analysis would be redesignated as areas of concern and still be forwarded to the Level II screen to determine appropriate methodologies to be applied to each site. The Level II Screen will be used to determine an appropriate remedial investigation methodology for each area.

The Navy has also determined that a small number of sites identified for inspection should move directly to remedial investigation in order to facilitate complete and efficient collection of data needed for the feasibility study. Six areas will not be carried forward in the remedial investigation process because they encompass area outside the military reservation and are the responsibility of the Army Corps of Engineers under the Formerly Used Defense Site program.

NORPAC Hill was excluded from scrap removal, geophysical, and intrusive sampling. Other areas excluded were due to terrain conditions which may include steep grades, bodies of water, streams, and wetlands. Utility areas, Metals Landfill, and areas built on concrete slabs such as playgrounds and buildings were also excluded.

The continued work on investigation design and cleanup by the Navy and the OU-B Project Team has significantly decreased the level of hazard posed by explosive and physical hazards throughout the former NAS Adak area. Because the explosive and physical hazards cannot be made 100 percent safe, institutional controls have been suggested by the Navy to reduce the opportunity for explosion accidents to occur. Dig permits (not related to explosive concerns) and land use restrictions have been suggested as a means of institutional controls in the downtown and remote areas as appears in the Draft Institutional Controls Management Plan, January 2001.

NORPAC Hill in the downtown area was not included in the intrusive sampling investigations because of the amount of debris present on NORPAC Hill. Two water tanks sit on top of NORPAC Hill and would need to be routinely inspected, maintained, and repaired. Additionally, engineering actions would also be required to stop, reduce, or prevent erosion of the hill. A sign stating "Restricted Area Keep Out" marks the access point on the road ascending the hill. Signs on the backside of NORPAC Hill on Bayshore Drive had already deteriorated beyond recognition during the June 1998 ATSDR site visit. No archival or other evidence exists to suggest past ordnance-related use, storage, disposal, or handling at NORPAC Hill. In the 1950s, Quonset huts were located on NORPAC Hill and provided housing for civilian workers on Adak (Navy Comments 10/00). The large amount of exposed debris on NORPAC Hill make this area a physical hazard to workers and people entering the area.

Although people have been living and recreating on Adak for 60 years and out of the 77,507 ordnance items recovered in the last 32 years since EOD has been keeping records, no injuries or deaths to non EOD personnel have resulted (URS 1997a,c). However, ATSDR is concerned that past situations involving strict controls of a military population may not be representative of the future civilian land users. For this reason, the extensive educational efforts, land use controls, and notification policies began by the Navy must be continuously maintained.

Summary of the Methodology Used to Detected Explosive Hazards

Navy investigation of environmental problems associated with past military practices began in 1986 with oversight from EPA Region 10 (EPA) and the State of Alaska Department of Environmental Conservation (ADEC). During years of active military activity at Adak, numerous OE/UXO items were discovered during normal activity, and were removed and disposed of in accordance with military requirements at the time. It is estimated, based on Explosive Ordnance Disposal (EOD) Detachment records that over 75,000 individual OE/UXO items were recovered between 1942 and 1996, the majority of them small arms ammunition.

Based on these records and historical archive information, the Navy began an OE/UXO investigation, removal and disposal program to meet the requirements of the Department of Defense Explosives Safety Board (DDESB), the EPA, and ADEC, take all necessary actions to

protect human health and the environment, and make the real estate suitable for transfer to TAC for the reasonably expected future land use. A complete listing of OE/UXO investigations is presented in the RI/FS reports for OUB.

To evaluate the physical hazards associated with ordnance sites, an initial screening as part of an overall hazard assessment methodology developed for OU B was completed to eliminate sites that had little or no likelihood of OE/UXO concerns. This hazard assessment methodology is an Adak-specific process developed as part of an overall framework for assessing and managing potential threats to human health and the environment. These potential threats include explosive safety hazards due to the presence of unexploded ordnance and the potential release of hazardous chemical substances related to that ordnance. Risks associated with releases from ordnance-related chemical substances are addressed through the chemical sampling and risk analysis methods developed under OU A and updated for current toxicity screening values for explosives-related chemicals.

Sites identified during the preliminary assessment screening as having little or no likelihood of OE/UXO concern were recommended for the Adak NOFA (No Further Action/Institutional Controls) alternative. During the RI/FS, site information was assessed for explosive hazard through a CERCLA-like risk evaluation process. This Adak-specific Explosives Safety Hazards Analysis (ESHA) model was developed by the OU B Project Team to evaluate explosive safety hazards to human health based on RI data.

Sites that were identified during the PA screening as having a likelihood of OE/UXO contamination were further evaluated in the OU B RI. The OU B RI methodology included three basic investigation elements: reconnaissance, site inspection, and site characterization. A reconnaissance was used to determine whether a site had potential impacts that would warrant further investigation through site inspection or site characterization. Reconnaissance for numerous firing points was accomplished by walking the approved transect spacing within the known boundaries of the area. Using archive data to establish the best location for firing points, UXO teams reacquired those points by using GPS instruments. UXO teams searched within a radius of 300 feet around each GPS point (firing point) looking for any evidence of a gun emplacement at that location.

Site inspection mode (also called "site inspection/search" mode) is a systematic search for ordnance contamination by locating areas to be investigated in more detail through a site characterization. The site inspection was performed based on historical information and other factors at sites that were either impact or discharge areas and where significant densities of ordnance were suspected.

Site characterization (also called bound and characterized mode) is a systematic search for ordnance contamination that includes bounding and characterizing contaminated areas. Site inspection and site characterization are similar in that both stages acquire geophysical and positional data, analysis of subsurface anomaly data, intrusive investigation of anomalies, and Conceptual Site Model-based sampling requirements (transect spacing). Bound and characterize methodology was performed on areas known to contain ordnance and was used to identify the

nature and extent of the contaminants in a more thorough manner. At sites that contained single or multiple OE/UXO items, the investigation consisted of 100 percent geophysical and intrusive investigation within a specified distance of the OE/UXO find.

Target anomalies were chosen for intrusive investigation using signal selection and interpretation protocols for investigated areas. Digital geophysical data were recorded, post-processed, and analyzed to identify associated signals indicative of metallic wastes, which may be ordnance-related. Post-processing refers to the analysis of geophysical data collected from the field to determine the location of potential OE/UXO anomalies to be selected for intrusive investigation.

Intrusive sampling of all valid target anomalies was performed to identify OE/UXO present from the ground surface to a depth of 4 feet bgs. Based on post-processing of subsurface geophysical data, each team received a dig package that contained all necessary information and maps to perform the assigned work. Electronic files containing target reacquisition coordinates were uploaded onto each team's Digital Global Positioning System (DGPS). UXO teams proceeded to the coordinates for each target and set up an exclusion zone to protect non-essential personnel from potential OE/UXO in the immediate area.

Exclusion zones were expanded if an OE/UXO item was encountered. The DGPS was used to locate the target area and a Vallon metal detector was used to pinpoint the target anomaly. All anomalies located within a 5-foot radius were intrusively investigated to ensure that the target area had been correctly located. OE/UXO debris and scrap (i.e., fragments, fins, and expended munitions) were inspected for signs of hazardous waste residue and disposed of properly. One criterion used in determining the proper characterization category included whether or not the item was fired, and if the item contained or ever contained energetic material.

If the ordnance item was safe to transport, it was transported to the explosives storage magazine. If the item was unsafe to move it was left in place for disposal by Navy EOD personnel. Because most of the sectors investigated were in remote areas of the island, the position of the OE/UXO was marked, photo-documented, and electronically recorded. The OE/UXO remained at the location for later disposal. All metal debris, OE/UXO scrap, and OE/UXO were documented and disposed or destroyed in accordance with Navy and DDESB requirements. Under this directive, final disposal procedures may include demolition, burning in place, or other authorized means. Inert OE/UXO scrap (containing no OE residue) from Adak ordnance operations was disposed of in Roberts Landfill.

The basis for the RI evaluations for the OU B-1 sites included all previous investigative work performed throughout the military reservation of Adak. Additional investigations will be conducted in the 2002 field season for selected sites. The evaluations of sites within OU B-1 are provided in the RI/FS Report for OU B-1 (U.S. Navy, 2001c).

Summary

ATSDR considers the UXO explosive hazard especially threatening to children because of their natural curiosity, lack of experience, and their inability to internally link their actions with consequences. ATSDR recognizes that a civilian population now inhabits Adak even though some explosive and physical hazards remain. To reduce the likelihood of serious injury or death to result from contact with explosive and physical hazards associated with living in the downtown area, the Navy plans to issue institutional controls such as deed restrictions, dig permits, and conduct educational activities. ATSDR recommends that educational efforts be maintained or increased especially for new island arrivals.

To reduce the physical hazards posed by exposed debris on NORPAC Hill, ATSDR recommends that the Navy remove the debris within 40 feet of each side of the road ascending NORPAC Hill from the bottom to the top tank area. Although the Navy states that there is no evidence that explosive ordnance was ever present on NORPAC Hill, ATSDR believes that the debris represents a physical hazard and not necessarily an explosive hazard. The Navy has not informed ATSDR of their plans to remove debris from this area.

Even though carrying out these recommendations would decrease the chance of contact with explosive and physical hazards to levels that pose a low potential risk, no amount of "clearing" would ensure a safe environment, free from potential explosive or physical injury. Therefore, the downtown area poses a low public health hazard to residents, workers, and visitors who hike, fish, play, or dig in the downtown area and those who ascend NORPAC Hill now and in the future.

Conclusions and Public Health Action Plan for Explosive and Physical Hazards (Downtown Area)

Conclusions:

1. The presence of explosive and physical hazards in the downtown area presents a health hazard, but the likelihood of people contacting those hazards during routine daily activities is low.
2. Studies, removal actions, and extensive educational efforts by the Navy since 1996 continue to reduce the chance for people to come in contact with explosive or physical hazards.
3. The amount of exposed surface debris on NORPAC Hill represents a physical hazard to workers required to frequently inspect, maintain, and repair the water tanks and the ground supporting them.

Completed Actions:

1. Navy contractors conducted unexploded ordnance investigation and intrusive sampling in the "downtown" area. Numerous metallic items, including over 44,000 Rommel stakes and U-posts were removed from these and remote areas in the summer 2000 field season.
2. The Navy has conducted numerous studies, removal actions, and extensive educational efforts for ordnance awareness since 1996.
3. The RODs for OU A and OU B-1 stipulate that the Navy implement and maintain (indefinitely) institutional controls (ICs) to address ordnance hazards. These ICs encompass the Adak Ordnance Awareness Safety Educational Program for visitors and residents.

Planned Actions:

1. Continued educational efforts through various means including videos, coloring books, refrigerator magnets.
2. Designating specific areas for Institutional Land Use Controls as outlined in the Institutional Control Management Plan, December 2001.
3. The Navy will conduct Level II Screening of identified UXO areas of concern, Remedial Investigation and Feasibility Study for OU-B, Record of Decision for OU-B.

Recommended Action:

1. Because of the exposed surface debris on NORPAC Hill, ATSDR recommends that the Navy conduct surface removal action of the debris in the area within 40 feet of each side of the road ascending NORPAC Hill from the bottom to the top tank area before the property is turned over.

B2. Residents, Workers, and Visitors (Adults and Children) Participating in Recreational Activities at or Near Metals Landfill (Site SWMU 13) in the Downtown Area - Current and Future Exposure - No Apparent Public Health Hazard

ATSDR was concerned that uncovered landfill debris and discarded debris along the length of the landfill on the eastern shore posed a physical to people who may contact them during recreational activities. Institutional controls such as posted signs, at the time of our 1998 visit did not prevent access to the landfill area. During the summer of 2000, the Navy removed physical hazards, sampled leachate, and took additional measures to prevent human contact with the landfill material. ATSDR has reassessed the area and determined that the human exposure likely to occur from recreational activities at or near the landfill pose no apparent public health hazard.

Background

Metals Landfill is bordered by Monument Hill, Bay Shore Drive, and Sandy Cove Housing area to the west, the sewage treatment plant to the south, Kuluk Bay beach to the north and Kuluk Bay to the east. The 800' x 2400' landfill was created by the infilling of Kuluk Bay with quarry material. The landfill was used from the 1940s to 1995. Wastes included scrap metals, solvents, POLs, sewage sludge, batteries, UXOs, and pesticides (URS 1998c). In the summer of 1996, Metals Landfill was closed per the CERCLA Record of Decision for the interim remedial action (URS 1998c).

Metals Landfill covers approximately 44 acres. The site is divided into three distinct sections: main, north, and east. The main section covers approximately 12 acres and received the majority of waste. The north section covers about seven acres and was filled above the original elevation. Much of the waste was pushed over the side of the original bank, a disposal practice common in the 1950s and 1960s. The east section covers about 9 acres and extends to the shoreline of Kuluk Bay. Most of the debris consisted of scrap metal (old machinery, submarine netting, and Rommel stakes) which ran the length of the landfill and sat on a rise from the shoreline to approximately a 15 feet elevation. A few areas had scattered waste including a dewatered sludge lagoon on the south end. Debris removal was conducted in the summer of 2000 (Bristol 2000).

According to the 1995 Record of Decision, evidence of surface erosion in the northeastern area of the eastern section and a significant amount of cover material has been eroded and transported into Kuluk Bay (URS 1995a).

In 1996, Metals Landfill was closed. As detailed in the Technical Memorandum 1997 Annual Landfill Monitoring report, "closure included evaluation and removal of shoreline debris, surface water erosion controls, a landfill cap, a vegetative cover, institutional control for access and land use, and long-term monitoring." There are lined surface water drainage channels on the landfill to divert rain and runoff.

During ATSDR's May 1998 site visit, we noted discrepancies between the 1997 report mentioned above and actual conditions. ATSDR noted extensive debris lining the shore of Metals Landfill from the waters edge to about 25 feet up the slope and extending approximately 200 yards to the fence surrounding the waste water treatment plant. Additionally, we noted an exposed, protruding jeep and leachate flowing down the bank adjacent to Kuluk beach. ATSDR also noted a lack of vegetative cover on the main and eastern sections of the landfill needed to retard erosion of the soil cover. Of more immediate concern were signs of recent foot traffic (including a dog's paw prints) indicating that institutional controls are inadequate to deter or prevent access.

During the summer of 2000, the Navy conducted extensive work at Metals Landfill. Work included removal of the metal debris along the shoreline, installation of "rip rap" to stabilize shoreline and cover the estimated 2 percent of metal that could not be removed, road barricade, leachate sampling, and evaluation of landfill cover (Bristol 2000).

As mandated in the Adak OU A Record of Decision signed in 2000, surface water sampling is required to occur if surface water seeps are observed emanating from the Metals Landfill. Inspection of Metals Landfill was conducted in May 2001. Water was observed draining from the soil cap; however, no seeps were observed flowing from the landfill (Appendix C of Five Year Review; US Navy 2001b). The Navy states "To date, no seeps have been noted."

Sampling

As part of the base closure efforts, the Navy conducted several rounds of sampling. Four rounds of groundwater samples were collected in July and November 1996 and May and December 1997. Two rounds of blue mussels were collected from three locations in May and November 1996. One composite rock sole fillet and one composite whole fish were collected in July 1996. No sediment samples were collected. ATSDR will discuss exposure to seafood contamination in Kuluk Bay from Metal Landfill in the following section.

Shoreline Reconnaissance at Metals Landfill was conducted in 1997 which included a detailed visual inspection of the entire shoreline of Metals Landfill to identify hazardous materials that might need to be removed. At the time, no significant potential hazardous waste sources that could impact the marine environment were identified (URS 1997a).

Metals Landfill was sampled most recently in the Fall of 2001. Results from the previous sampling round (2000) at Metals Landfill are presented in Final Technical Memorandum 2000 Annual Landfill Monitoring, Former Adak Naval Complex, Adak Island, Alaska (U.S. Navy 2001d). Under this monitoring program to date, four rounds of post construction annual monitoring (1997 through 2000) have been completed at Palisades Landfill and Metals Landfill. At Metals Landfill, there have been no exceedances of the applicable screening criteria since groundwater monitoring began in 1996.

Future monitoring at Metals Landfill includes evaluation of depth of soil cap, analysis of groundwater, surface water seeps/leachate where noted, and marine tissue (URS 2000). To

increase the probability of finding surface water seeps/leachate, ATSDR recommends inspection of the landfill yearly in the early summer or late spring when the soil is more saturated.

Human Exposure Routes and Public Health Implications

Due to the close proximity of Metals Landfill to housing currently in use and slated for future reuse, people would use the adjacent Kuluk beach area most frequently. Work completed during the summer of 2000 has resulted in a reevaluation of ATSDR's hazard category for Metals Landfill from a public health hazard to a no apparent public health hazard. The no apparent public health hazard means that human exposures may occur, but at levels not likely to result in adverse health effects.

The Adak Institutional Controls Management Plan (Navy 2001a) states that recreational activity not adversely impacting the integrity of the landfill cover (e.g., hiking and, bird watching) would not be part of the land use restrictions. The Five Year Review Report also states that the interim conveyance documents at the time of transfer would ensure that the land at Metals Landfill would remain as recreational use (Navy 2001b).

Conclusions and Public Health Action Plan for Metals Landfill (Downtown Area)

Conclusion:

1. Metals Landfill (Site SWMU 13) currently poses no apparent public health hazard to residents, workers, and visitors participating in recreational activities at or near the landfill.

Completed Actions:

1. A soil cover was overlain on Metals Landfill in 1996. A surface water drainage membrane was placed at various locations to help drain surface water runoff.
2. The Navy removed most all of the debris from shoreline and covered over the remaining amount.
3. Additional measures to reduce or prevent people from routinely accessing the landfill in order to maintain the loose soil cap are included in the Equitable Servitude/Right of Entry.

Planned Actions:

1. Navy plans to conduct annual monitoring of groundwater, surface water, and marine tissue until 2003.
2. ATSDR recommended that seep samples be collected in the late spring or early summer when the soil is saturated. The Navy reported, "As mandated in the Adak OU A ROD signed in 2000, surface water sampling is required to occur if surface water seeps are observed emanating from the Metals Landfill. The last inspection of Metals Landfill was conducted in May 2001 ("late spring"). Water was observed draining from the soil cap; however, no seeps were observed flowing from the landfill (Appendix C of Five Year Review; U.S. Navy, 2001b). To date, no seeps have been noted" by the Navy.

Recommended Action:

1. To increase the probability of finding surface water seeps/leachate, ATSDR recommends inspection of the landfill yearly in the early summer or late spring when the soil is more saturated.

B3. People (Subsistence Consumers) Eating Contaminated Resident Fish and Shellfish from Kuluk Bay - Current and Future Exposure - No Apparent Public Health Hazard

Levels of contaminants including aluminum, arsenic, cadmium, chromium, dieldrin, PCBs, and lead present in rock greenling, Pacific halibut, Pacific cod, rock sole and blue mussels from the intertidal areas of Kuluk Bay currently present no apparent public health hazard to recreational or subsistence consumers and are not likely to result in adverse health effects.

What does the term subsistence consumer mean?

Subsistence consumers are people (men, women and children) whose primary protein source comes from seafood. Typically, fishermen and their families are subsistence seafood consumers. They tend to eat more seafood than the average person in the United States. Additionally, they tend to freeze or store seafood over time.

Background

Kuluk Bay is located along the north eastern shore of Adak Island. The portion of Kuluk Bay most likely impacted by the disposal areas from the Navy Complex is between Zeto Point near the entrance of Clam Lagoon down to the southern opening of Sweeper Cove by Lucky Point. The northern most and southern most shorelines have steep cliffs. Bayshore Highway runs along the shore from the mouth of Sweeper Cove to the mouth of Clam Lagoon. A fine grain sandy beach separates the two cliff regions (URS 1997b).

Kuluk Bay is used primarily for recreational purposes including fishing, shellfishing, and beach combing. Salmon runs occur in August and September going up NAVFAC Creek and Airport Creek. Mussel beds are plentiful along the rocky shore just north of the beach area. Kuluk Bay also contains extensive Kelp Beds. Abundant rock sole, small halibut, and Pacific cod can also be caught from the shore (URS 1997b). Resident fish are those species that tend not to move over large distances away from their home area (Adak). These species include rock sole and rock greenling that may bioaccumulate or bioconcentrate contaminants originating on Adak. Migratory species, including salmon and Dolly Varden, do cover great distances and would tend not to bioaccumulate or bioconcentrate appreciable levels of contaminants from Adak. Rock sole and blue mussel were used as surrogates for resident fish and shellfish species.

Three areas have been identified by the Navy as possible sources of Kuluk Bay contamination. They are SWMU 13 - Metals Landfill, SWMU 11 - Palisades Landfill, and SWMU 65 - Contractor's Camp Fire Demolition Site. Other sites possibly contributing to the contamination in Kuluk Bay involve fuel components and are investigated under the SAERA (SWMUs 12, 61, 62, 84, and 85). Interim Remedial Actions have been installed at SWMU 11 - Palisades Landfill and SWMU 13 - Metals Landfill to prevent significant amounts of additional contaminant migration into Kuluk Bay (URS 1997b).

Sampling

In 1996, USFWS in coordination with the Biological Resource Division of the US Geological Survey sampled rock greenling (*Hexogrammos decagrammus*), Pacific halibut *(Hippoglossus stenolepis*), and Pacific cod (*Gadus macrocephalus*) from Kuluk Bay, Sweeper Cover, Finger Bay, and Bay of Islands areas of Adak Island. Analysis of these species were for 27 organochlorine compounds including PCBs. The 1997 *Interim Report: Contaminant concentrations in near shore fish from Adak Island, Alaska* reported levels of endrin, alpha chlordane, PCB 1260 were greater in fish from Kuluk Bay and Sweeper Cove than in fish from Finger Bay. Bay of Islands had higher levels of alpha chlordane, beta BHC, gamma BHC, endrin, and PCB 1242 than Kuluk Bay. Although specific data results are not presented in the report, areas with the maximum concentrations are reported. These results indicate that Bay of Islands is not an uncontaminated area of Adak Island.

Sampling as of April 1998 consisted of eleven seafood sampling locations used to represent the intertidal area of Kuluk Bay (URS 1998c). Analytes consisted of semivolatile compounds, PCB Arochlors, pesticides, and inorganics. The maximum detected concentration of aluminum was 235 ppm, arsenic was 3.4 ppm, cadmium was 1 ppm, chromium was 4.3 ppm, dieldrin was 0.001 ppm, PCB Arochlor 1254 was 0.35 ppm, PCB Arochlor 1260 was 0.014 ppm and lead was 1.68 ppm. No seafood samples were analyzed for ordnance compounds. However, analysis for ordnance compounds were conducted for sediment. Sediment levels were low and not found to be a concern because ordnance compounds are less likely to accumulated or concentrate up the food chain (URS 1998c).

According to Navy's comments, the Navy's Comprehensive Monitoring Plan (CMP) (Navy 2000b) call for the periodic monitoring of resident fish and shellfish from Kuluk Bay to document the reduction in PCB concentrations following remedial actions. Chemical analysis will only be for PCBs. The CMP (Navy 2000b) calls for annual sampling for 4 years (1999, 2000, 2001 completed; and 2002) to establish a baseline of PCB concentrations found in Kuluk Bay, Sweeper Cove, and a reference (background) area. The CMP calls for five mussel samples and five samples of each of four fish species (rock sole, Pacific halibut, gray cod, and rock greenling) to be collected from Kuluk Bay, Sweeper Cove, and the reference area during each baseline sampling year. A detailed report will be generated in 2003 presenting the results of the four baseline sampling years and the Navy, EPA, and ADEC will use this information as the basis to design a long-term monitoring plan.

Although levels of PCBs and organochlorine compounds (pesticides) are much lower than levels likely to result in adverse health effects, ATSDR is concerned that decisions about health are being made based on comparisons of the differences in contaminant levels from the areas where fish are caught and not the overall contaminant levels compared to a health guideline. This concern is based on the fact that the Bay of Islands area of Adak Island in not an uncontaminated area as indicated in some Navy reports. As stated in the CMP, "Bay of Islands area of Adak has been selected as a reference or uncontaminated site". From the 1997 report conducted by the same USGS Biological Resources Division, contaminants of fish collected from Bay of Islands has shown elevated levels of several organochlorine compounds and does not represent an

uncontaminated area. The Navy has conducted comparisons between fish contaminant levels from Bay of Islands and Kuluk and Sweeper Cove using data collected during the 1999 and 2000 sampling periods. Additionally, in the *Analysis of Results, 2000 Fish Monitoring at Adak Island, Alaska,* the Navy states "The lack of a statistically significant difference in the median rock greenling PCB concentrations between the combined Sweeper Cove/Kuluk Bay and the Bay of Islands reference area fish provides some support for concluding that the fish consumption advisory for rock greenling from both Sweeper Cove and Kuluk Bay could be removed. This is because the PCB concentrations in greenling from the vicinity of NAF Adak and an uncontaminated reference area [Bay of Islands] are not statistically distinguishable."

Comparisons should be made using contaminant concentrations and health based screening values and not based on comparisons with the Bay of Islands reference area. Based on the levels reported in available investigations, ATSDR concludes that PCBs present in fish from Kuluk Bay do not present a public health hazard because the levels detected in these area have not been shown in the scientific literature to result in adverse health effects.

ATSDR believes that inorganic contaminants in seafood could potentially present a more immediate health risk based on noncancerous effects than do PCBs. Monitoring endpoints have been proposed that are based exclusively on relative PCB concentrations. Once decreased PCB levels have been detected, seafood sampling may cease. Proposals for a reduction in monitoring appear to be based on results from 3 consecutive sampling events. While it seems reasonable in theory that contaminant levels should decrease, it does not take into account natural events such as storms or heavy tides which might cause a surge or increase in contaminant levels. For this reason, ATSDR recommends that seafood sampling be included in the five-year monitoring plan for thorough sampling a minimum of every five years for 20 years (four sampling rounds). Analytes should include semivolatile compounds, ordnance compounds, specific PCB congeners, pesticides, and inorganics. Methylmercury should also be included in this analysis. Previous sampling included only metallic mercury. While metallic mercury is typically the form of mercury that is released from a source, once in the environment, mercury changes forms. In fish, more than 95% of mercury is the methylated form (Waltras and Bloom 1992). Analysis for metallic mercury would not detect methylmercury which has been implicated in neurological and developmental deficiencies in children exposed to contaminated fish (ATSDR 1999g).

(Table 3 shows the contaminant concentrations, exposure estimates, and samples that present hazards.)

Human Health Implications

ATSDR assumed that subsistence fishing adults would ingest 4 ounces of seafood per meal, six meals per week for 30 and 70 years. Our exposure estimates are based on a mixed diet of mussels and fish and may or may not represent an overestimation of actual exposures. Based on scientific research, occupational, and epidemiological studies conducted over the last 30 years, the levels of contaminants (aluminum, arsenic, cadmium, chromium, dieldrin, PCBs, and lead) found in rock sole, rock greenling, and blue mussel collected from Kuluk Bay in 1997, 1998, 1999, and 2000

when compared to the scientific literature, present no apparent public health hazard and are not likely to cause adverse human health effects.

Because of its location, easy access within the downtown area, closeness to housing, and away from the industrial activities, Kuluk Bay represents the most likely choice for recreational and subsistence fishing for the current and future Adak community. The contaminant sources identified include SWMU 13 - Metals Landfill, SWMU 11 - Palisades Landfill, and SWMU 65 - Contractor's Camp Fire Demolition Site. Storm events generating excess surface water runoff, erosion, and tidal surges could cause unpredicted landfill contaminants to move into the tidal areas and be taken up by resident fish creating unacceptably high contaminant levels in fish. Although levels of contaminants detected do not pose a health hazard at this time, no provisions for such natural events have been made or considered. For that reason, ATSDR makes reasonable recommendations for future sampling of contaminants (disposed of in the landfill) four times over a 20-year period to protect the health of the people of Adak Island who consume fish from Kuluk Bay.

About exposure to PCBs

For most people who do not work with polychlorinated biphenyls (PCBs), consumption of PCB contaminated fish, meats, eggs and dairy products are the most common and important sources of human exposure to PCBs (ATSDR 2000b).

PCBs that are swallowed are passed from the gastrointestinal tract into the bloodstream. Once PCBs are in the body, some change into other related chemicals called metabolites and some leave the body in feces in a few days. The remaining PCBs and metabolites stay in the body and can be stored for years mainly in the body fatty tissue. PCBs also accumulate in human milk fat (ATSDR 2000b).

Everyone has some amount of PCBs in their body through environmental exposures worldwide. Since PCBs are so widespread, don't break down easily in the environment, and can accumulate in people, they have been heavily studied.

What are PCBs?

PCBs refer to polychorinated biphenyls which are a family of man-made chemicals that contain 209 individual chemical compounds with varying toxicity. Some commercial PCB mixtures are known by their industrial trade name, Arochlor. PCBs were widely used as coolants and lubricants in transformers and other electrical equipment due to their nonflammable properties. The manufacturing of PCBs has been banned since 1977. PCBs are present in low levels in air, soil, water, fish, foods, and our own bodies.

Although there have been thousands of PCB studies conducted since the 1960s, the effect of low-level exposures to PCBs on human health remain inconclusive. Most of the human studies have many limitations that make it difficult to establish a clear association between PCB exposure and health effects. In such cases, when the chemical exposure is present, a specific health effect may also be seen. Although not always seen, a certain health effect may be frequently present. Therefore, scientists say the chemical exposure is "associated" with the health effect. This terminology expresses the inherent uncertainty of trying to identify cause and effect relationships from accidental human exposures, rather than from controlled scientific studies.

Even with thousands of PCB studies done to date, strong associations to specific health effects have been limited. Here are some of the reasons why studies are not more definitive.

- People are rarely exposed to only one chemical making it hard to determine which chemical may have been associated with an observed health effect.
- Other confounders such as medications, alcohol intake, and lifestyle factors may also play a role.
- Many of the 209 individual chlorinated biphenyl compounds (known as congeners) have different ways of acting in the body and those mechanisms are not well understood.
- Most of the human studies have had high-level exposures which could have a different effect than low-level exposures.
- As always, the severity of exposures depends on the concentration of PCBs, frequency of contact, and the length of time exposed. People react differently; some severely while others may have no reaction at all.

PCB Exposure & Human Health Effects

Developmental Effects: There are no reports of structural birth defects in humans caused by PCB exposure. Several recent studies suggested that children born to mothers who ate PCB-contaminated fish during their pregnancies may have had an increased risk of developing subtle (i.e., not easily observable) nervous system delays (e.g., abnormal reflexes, motor immaturity, deficits in memory, learning, and IQ), which in some cases persisted into adolescence, but returned to normal in most cases within the first 2–4 years. These effects were only seen when large populations were studied and tended to be within the normal range of variation. The clinical relevance of these effects, particularly for individual children, is unknown. Other studies, however, did not find these associations and any changes that were observed disappeared upon later study (ATSDR 2000b).

Skin Effects: Effects seen from overexposure in occupational settings include chloracne, hyperpigmentation of the nails and skin, and skin irritation. These symptoms generally disappear when PCB exposure stops (ATSDR 2000b).

Cancers: *Some human studies provide suggestive evidence that PCBs are carcinogenic based on indications of PCB-related cancer in areas such as the liver, biliary tract, intestines, and skin (ATSDR 2000b).* Studies have shown that animals exposed to high levels of PCBs over their lifetimes developed liver and kidney tumors (ATSDR 2000b). On the basis of the observed cancer in animals, the Department of Health and Human Services, EPA, and the International Agency for Research on Cancer have determined that PCBs are probably carcinogenic to humans (ATSDR 2000b). *This designation means that a clear cause and effect relationship has not been established in humans but there is sufficient evidence to take precautions about exposure to this chemical.*

Conclusions and Public Health Action Plan for Kuluk Bay Seafood Consumption

Conclusions:

1. ATSDR determined that levels of contaminants, including aluminum, arsenic, cadmium, chromium, dieldrin, PCBs, and lead, present in rock sole, rock greenling, Pacific halibut, Pacific cod, and blue mussels from the intertidal areas of Kuluk Bay currently present no apparent public health hazard to recreational or subsistence consumers.
2. The Navy's proposals for a reduction in monitoring appear to be based on results from three consecutive sampling events. While it seems reasonable in theory that contaminant levels should decrease, the sampling does not take into account natural events such as storms or heavy tides which might cause a surge or increase in contaminant levels.

Completed Action:

1. Interim actions have been taken for Palisades and Metals Landfills. Surface water drainage membranes have been placed at various locations to help drain surface water runoff.
2. Annual seafood monitoring of Kuluk Bay through 2002.

Planned Action:

1. Future seafood monitoring plans for PCB levels will be evaluated after the 2002 results are analyzed.

Recommended Actions:

1. To ensure that contaminant levels do not increase, ATSDR recommends that future seafood monitoring in Kuluk Bay should not be limited solely to PCBs, but include analysis for methylmercury and also inorganic constituents especially aluminum, arsenic, cadmium, chromium, and lead..
2. ATSDR recommends that seafood sampling be included in Superfund Comprehensive Five-Year Review every five years for 20 years (four sampling rounds). Analytes should include semivolatile compounds, methylmercury, ordnance compounds, specific PCB congeners, pesticides, and inorganics.

B4.People Eating Contaminated Seafood from Sweeper Cove and Sweeper Creek - Current and Future Exposure - No Apparent Public Health Hazard

Contaminant levels of aluminum, arsenic, cadmium, chromium, dieldrin, PCBs, and lead, detected in rock sole, rock greenling, gray cod, Pacific halibut and blue mussels in Sweeper Cove and blue mussels and Dolly Varden in Sweeper Creek present no apparent public health hazard to recreational or subsistence consumers and are not likely to result in adverse health effects.

Background

Sweeper Cove is an estuary that encompasses approximately 450 acres at low tide. Sweeper Cove is the main center of development on Adak Island and is located adjacent to the downtown area. The north shore has been altered by construction activities since 1942 to provide large craft to port. Shipping industrial activities including port facilities, fuel storage, and distribution areas, warehouses and storage facilities, and ship repair and maintenance facilities, comprised the majority of activities in Sweeper Cove. At the western edge is a small craft boat dock and a fuel tank farm. The southern portion of Sweeper Cove is undeveloped. Access to the cove is from the east out of Kuluk Bay (URS 1997a). Future use of Sweeper Cove is expected to include fish processing and support services in addition to the industrial facilities of the piers, warehouses, public works, and fueling areas (URS 1997a).

Sweeper Cove receives surface drainage from 4,961 acres located in the Sweeper Cove drainage basin. Sweeper Creek, Happy Valley Creek, Helmet Creek, and Mitt Creek are the primary drainage streams into Sweeper Cove. The maximum depth of Sweeper Cove is around 125 feet deep, but due to tides, the depth fluctuates. The shore line varies from sandy beaches near the larger stream discharges to rocky beaches. Sweeper Cover receives large amounts of sand deposits from South Sweeper Creek, Happy Valley Creek, and Helmet Creek (URS 1997a). Subtidal regions are almost entirely sand. Tides are primarily diurnal having one high and one low tide per tidal day with an average tidal range of 4 feet (URS 1997a).

Sweeper Creek runs parallel to the west side of the airport runways. Its width at the largest point is approximately 24 feet wide, but the majority of its length is 6-8 feet. It flows year round and receives runoff from higher elevations.

Sampling

Fish common to Sweeper Cove include sand lance, Pacific herring, Pacific Ocean perch, sculpin, rockfish, sole, Pacific halibut, starry flounder, barnacles, limpet, snails, littleneck clams, cockles, soft-shelled clams, butter clams and blue mussels. Fish common to Sweeper Creek and other streams include sand lance, sculpin, Dolly Varden, rainbow trout, starry flounder, three-spine stickleback, sockeye, chum, coho, and pink salmon. The dominant fish appeared to be the rock sole due to their abundance. Other dominant invertebrate species includes the sea cucumber which was not sampled.

Fish tissue samples were collected from five locations from September to November 1992 (URS 1993). Additional sampling was collected for the Remedial Investigation and Feasibility Study (RI/FS). In 1996, for the RI/FS, rock sole (5 whole body and 5 fillets), Dolly Varden (5 whole body and 5 fillets), and blue mussel tissue samples composites of 50 -100 individual (6 samples analyzed from 3 locations) were sampled. Samples were analyzed for semivolatile organic compounds, pesticides, PCBs, and inorganics. Mercury analysis was conducted for metallic mercury. Ordnance compounds and their degradation products were not included in the analyses.

Maximum detected contaminant concentrations in Sweeper Cove resident rock sole fish include PCB Arochlor 1260 at 0.06 ppm, arsenic at 2.1 ppm, chromium at 0.25 ppm, and lead at 0.07 ppm. Blue mussels from Sweeper Cove contaminants included PCB Arochlor 1260 at 0.04 ppm, arsenic at 1.6 ppm, cadmium at 1.6 ppm, chromium at 0.42 ppm, and lead at 0.3 ppm.

Fish tissue samples collected from Sweeper Creek included juvenile Dolly Varden and contained slightly elevated levels of arsenic and lead in the whole fish and not in the fillet or solely edible portions. Arsenic was detected at a maximum of 5.2 ppm in whole Dolly Varden and then at 0.1 ppm in fillet. Lead was detected in Sweeper Creek Dolly Varden at a maximum level of 1.3 ppm. Lead mainly accumulates in the bones, which do not usually get eaten by people. Levels of PCB Arochlor 1260 were detected in Dolly Varden from Sweeper Creek at a maximum of 0.2 ppm. Chromium was detected at 0.4 ppm.

Sampling results of several years (1997, 1999 and 2000) of additional fish and shellfish sampling in Sweeper Cove were reported by the Navy (URS, 2001; 2002). Fish (rock greenling, rock sole, gray cod, Pacific halibut) and shellfish (blue mussel) analyses for PCBs (and insecticides) illustrate a generally declining trend in PCB concentrations not only in Sweeper Cove, but from all sampled locations on Adak. Blue mussel data collected during 1999 also shows that PCB concentrations are dropping in mussels from Sweeper Cove, although the decline does not appear to be as rapid in mussels as it is in fish. Table 4 shows the contaminant concentrations, exposure estimates, and comparisons with health guidelines.

Human Health Implications

ATSDR has evaluated the contaminant levels in resident fish and shellfish from Sweeper Cove and Sweeper Creek and determined that although some contaminant levels may be elevated, those levels have not been shown to produce adverse health effects in people.

As a result of the Navy's 1997 investigations and human health risk assessment, the Navy posted signs along Sweeper Creek and Sweeper Cove prohibiting consumption of fish from these areas until removal of contaminated sediment was completed. The removal has been completed. The Navy and regulators are considering if the seafood consumption advisory should be lifted for these areas.

Conclusions and Public Health Action Plan for Sweeper Cove/Creek Seafood Consumption

Conclusion:

1. ATSDR determined that elevated levels of arsenic, lead, and PCBs pose no apparent public health hazard to recreational or subsistence consumers who ingest seafood from Sweeper Cove and Sweeper Creek.

Completed Actions:

1. Sampling of several types of seafood from the Sweeper Creek and Sweeper Cove area.
2. Removal of suspected PCB sources has been completed.

Planned Action:

None noted at this time.

Recommended Action:

None.

B5. Children Exposed to Potentially Contaminated Sediments in Helmet Creek Caused by Leachate Drainage from Roberts Landfill and Various Fuel Leaks in the Area - Current and Future Exposure - No Apparent Public Health Hazard

ATSDR was concerned that children playing along Helmet Creek near the Old Roberts Housing area could ingest contaminated sediments through hand to mouth activity. Numerous spills from underground fuel storage tanks and associated piping have resulted in contamination of Helmet Creek at various times during the 1990s. Even though several upgradient USTs have been removed, and much of the associated contaminated soil upland, ATSDR was concerned that additional contaminated soil may have remained. The Navy has stated that sediment samples were collected on two separate occasions and that "sediments in Helmet Creek are not contaminated.".

Roberts Landfill has been used for more than twenty years (URS 1997s). Many leachate seeps have in the past drained and some continue to drain from the landfill into Sweeper Cove.

During ATSDR site visits, leachate from the landfill was seen flowing down into Helmet Creek. ATSDR also noted further down gradient, an oily sheen or residue in the sediments near small child-sized footprints in the creek bed. Surface water samples were collected from areas downgradient of the landfill and no elevated contaminant levels were detected (URS 1997a). However, surface water samples provide only a snapshot in time of the current leachate flowing from the landfill. Sediment samples can provide a better indication of the previous contaminants that have migrated by way of surface water or leachate from the landfill and have physically deposited or chemically adhered to soil particles at an exposure point.

According to the Navy's statements, surface water and sediment samples were collected from Helmet Creek on two occasions. In 1993, surface water and sediment samples were collected from Helmet Creek to the north of Roberts Landfill as part of the Tank Farm D investigation. These results can be found in Final Release Investigation Report Tank Farm B, Tank Farm D, Main Road Pipeline, and Steam Plant 4 USTs, (URS 1994). In 1996, two surface water and sediment samples were collected from Helmet Creek as part of the New Roberts Housing UST investigation. These results can be found in Final Site Summary Report New Roberts Housing, UST HST-7C (URS 1999). Diesel Range Organics were detected at 8.8 mg/kg and total carcinogenic PAHs were 0.2 mg/kg (benzo[a]pyrene was not detected). Roberts Landfill was capped in 1998. Roberts Landfill will be used for disposal of demolition debris in 2002 and closed thereafter.

ATSDR evaluated the levels of contaminants in sediment as stated above. We determined that children who contact sediments in Helmet Creek now or in the future are not likely to experience adverse health effects based in those levels of contaminants.

Conclusions and Public Health Action Plan for Exposure Helmet Creek Sediments

Conclusion:

1. According to the Navy, sediments in Helmet Creek downgradient of Roberts Landfill were collected in 1993 and 1996 and" indicate that sediments in Helmet Creek are not contaminated. " Therefore, children who contact Helmet Creek sediments are not likely to experience adverse health effects.

Completed Actions:

1. Surface water sampling conducted in 1993.
2. Roberts Housing area has been demolished.
3. Sediments in Helmet Creek downgradient of Roberts Landfill were collected in 1993 and 1996.

Planned Action:

None

Recommended Action:

None

II. EXPOSURE SITUATIONS OUTSIDE OF THE DOWNTOWN AREA

II. 1. Residents, Workers, and Visitors (Adults and Children) Contacting Physical Hazards (Explosives and Rommel Stakes) Throughout the "Remote Areas" Outside of the Downtown Area - Current and Future Exposure - Public Health Hazard.

Although the likelihood of people being injured or killed by unexploded ordnance materials or Rommel stakes during recreational activities in remote areas of Adak Island is extremely low, potential current and future hazards still exist and cannot be entirely eliminated. Surveys, screening, intrusive sampling, and historical information reviews have been conducted on areas of suspected ordnance contamination in the remote areas. The Navy has performed extensive investigations and removal actions that were documented in the OU B RI/FS, Proposed Plan for OU B-1, ROD for OU B-1, and After-Action Report. As described in the Environmental Baseline Survey and the draft FOST of Parcel 1A, property that has been cleaned for ordnance contamination is considered by many groups (i.e., Navy, EPA, DDESB, and NOSSA), suitable for transfer from the Navy and ultimately to TAC without the need for land use restrictions. Additional areas (in Parcel 1B) that await characterization and cleanup in the summer of 2002 will be documented similarly pending completion of field activities.

The Navy has determined (with concurrence from DDESB and NOSSA) that most of the remote areas do not pose an unacceptable hazard level to people who recreate in those areas. Certain areas where terrain or hazard density made removal too difficult will be retained by the Navy and will not be turned over. To further reduce the likelihood of people handling explosive and physical hazards, the Navy initiated, and the Adak community continues (through USFWS briefings and ordnance awareness education provided by the Adak School District), to educate people on the possible appearance of hazardous and explosive items and the procedures for notifying the correct officials when they are found. Any area of concern that requires public education to reduce the likelihood of exposure is categorized by ATSDR as a public health hazard.

Background

The Navy has recognized the need and has imposed strict safety management for the past 40 years because of Adak's history of training and defense during war time and post war time that resulted in physical and explosive hazards. Anyone who travels away from the downtown area to go hunting, fishing, or hiking is currently required to attend the ordnance education program (described in the Institutional Control Management Plan). This policy has remained in place for nearly 60 years.

Investigations

To reduce the potential hazards of contact with land mines, other unexploded ordnance, and Rommel stakes in several areas away from downtown, Navy contractors have investigated and removed all known items which pose explosive or other physical hazards. The Intrusive Sampling Study and Minefield Investigation Study for the 1998 Field Season included unexploded ordnance investigations. In the summer of 1999, the Navy conducted additional investigations as reported in the Site Investigation Study. Rommel stakes have been removed along the most popular hiking trails. During the summer of 2000, the Navy removed Rommel stakes from all known areas.

In the fall of 1999, the Navy performed site investigation and reconnaissance to identify the location of areas known to contain Rommel stakes on Adak Island. The Navy reviewed historical maps and archival information, conducted personal interviews, and performed site visits to establish and document the extent of individual Rommel stake fields. This effort resulted in the identification of 33 areas within the northern portion of Adak Island that were believed to contain Rommel stakes. These areas were the initial focus of the Navy's efforts to remove Rommel stakes during the 2000 field season on Adak. During the course of removing the Rommel stakes from these areas, additional areas containing Rommel stakes were identified. Rommel stakes were removed from these newly identified areas during the course of the 2000 field season as well. In the summer 2000 field season, approximately 44,000 Rommel stakes and U-posts were removed from areas of Adak that had potential for future recreational use. These actions are documented in the Rommel Stake Removal Project, Closure Report, prepared by NFA NW, June 2001 (NFA NW, 2001b). However, 100 percent of the physical hazards cannot be removed because it is impossible to find them all.

Conclusions and Public Health Action Plan for Explosive and Physical Hazards in "Remote Areas" outside the Downtown Area

Conclusion:

1. Although the likelihood of people being injured or killed by unexploded ordnance materials, or Rommel stakes during recreational activities in remote areas of Adak Island is extremely low, potential current and future hazards still exist and cannot be entirely eliminated.

Completed Action:

1. Navy contractors conducted Unexploded Ordnance Investigations and Intrusive Sampling in areas outside the "downtown" area.

Planned Action:

1. The Navy through an agreement with US Fish and Wildlife Service continues to offer the ordnance educational briefing to all new island arrivals.

Recommended Action:

1. Extensive and continuous educational programs in place should include clear protocol for reporting and handling possible UXOs. Additional material should address safety in the remote areas. Recreational maps should clearly mark suspected hazardous areas and be available in English and in native languages.

   In response to ATSDR's recommendation the Navy states the following: The Adak Ordnance Awareness educational program has been in place on Adak, as required by the OU A and OU B-1 RODs for over a year. This program includes clear protocols for reporting and handling of possible UXO and MEC, as well as safety in the remote areas. Recreational maps maintained by USFWS show clearly marked suspected hazardous areas and are available in English to visitors and residents.

II 2.Workers and Residents Potentially Exposed to Lead-based Paint and Asbestos from Recycling Scavenged Materials Found in Unused Structures in the Remote Areas - Future Exposure - No Apparent Public Health Hazard

Exposures from Recycling Activities

ATSDR evaluated the likelihood of health problems resulting from exposure to asbestos, lead paint, or other hazardous materials from the practice of recycling or salvaging materials from standing, partially standing, or dilapidated structures. Even with institutional controls in place, people needing building replacement parts or material may scavenge the readily-available material in good condition, rather than pay expensive shipping charges. The remote nature and hilly topography make it difficult for any authority to know when such "salvaging" activities are occurring.

Based on the level of contaminant and the duration of time to which people may be exposed, it is unlikely that the removal and reuse of building material would result in adverse health effects. Therefore, ATSDR has categorized this activity as posing no apparent public health hazard.

The Navy notes that the Blue Card Training notifies residents that old buildings are off-limits. Additionally, demolition of approximately 52 cabins is to occur during the 2002 field season. These structures are located in various areas throughout the northern portion of the island. All demolition debris from the structures is to be disposed of in Robert's Landfill in a cell specifically designated for inert demolition debris.

II3.People Potentially Eating contaminated Seafood at Various Locations Outside the Downtown Area (Clam Lagoon, Andrew Lake, and Finger Bay) - Current and Future Exposure - No Apparent Public Health Hazard

Water bodies historically have been suspected disposal areas for explosives, hazardous material, and inert waste. The northern half of the island has been divided into seven major drainage basins: Sweeper Cove, Kuluk Bay, Clam Lagoon, Andrew Lake, Andrew Bay, Finger Bay, and Shagak Bay. (See Section B4 of this document for the discussion on Sweeper Cove and Kuluk Bay)

ATSDR reviewed available information to determine the likelihood of people to experience adverse health effects from consumption of seafood containing contaminants from the shorelines outside of the downtown area. Since the Navy personnel have officially left the island, ATSDR provides a public health determination to inform the current and future residents of Adak Island. Based on sampling information reviewed by ATSDR, and a review of past use, disposal, and clean up activities to date, consumption of seafood (fish and shellfish) does not pose a public health hazard. Because people who eat seafood from these areas are exposed to contaminants at low levels, too low to result in adverse health effects, ATSDR classifies this exposure as no apparent public health hazard.

Background

The Navy contructed Adak's first operational airfield in 1942 between Clam Lagoon and Andrew Lake. The airstrip was called Albert Mitchell Field and was used until 1950. Clam Lagoon was used as a secondary seaplane base and water runway for naval amphibious patrol aircraft. Antiaircraft guns, artillery installations, fortified huts for troops, and a fuel storage tank farm were located on the western side of Clam Lagoon that was connected to the downtown area by a fuel pipeline. All support facilities have been destroyed. NSGA complex, used until 1995, consisted of 20 buildings on the north side of Clam Road and a sewage outfall pier entered Clam Lagoon on the west side.

Clam Lagoon is located on the northeastern portion of Adak adjacent to the southern slope of Mount Adagdak. It consists of sand dunes along the eastern side with Sitkin Sound (Bering Sea) just beyond. Candlestick Bridge, approximately 100 feet long, crosses over the opening of Clam Lagoon into Kuluk Bay on the south side. Clam Lagoon is tidally influenced. A poorly maintained road circles the lagoon. The lagoon is 13,500 feet long north to south and 6,500 wide (surface area 1,389 acres) having a maximum depth of 75 feet with an average of 50 feet. Most of the shoreline is rocky with sandy areas and mudflats on the southern end. Fresh water streams that feed into Clam Lagoon include CDAA Creek, Shotgun Creek, Transpo Creek, Farm Creek, Clam Creek, and East and West Range Creek.

Andrew Lake has a surface area of 2,121 acres. The deepest portion is in the northwestern corner of the lake near the outfall to Andrew Bay and range from 66 to 84 feet. The midsection of the lake ranges from 21 to 54 feet and the shoreline areas range from 1.5 to 15 feet deep. A seawall separates Andrew Lake from Andrew Bay. The lake is fresh water. Fresh water streams that feed the lake include Moffet Creek, Nurses Creek, and Mitchell Creek. Andrew Lake was formerly used as recreational area with boating and fishing. A recreation building and playground were popular spots for military personnel. The northeastern side of Mount Moffett, which slopes into Andrew Lake, was a firing range. A fence surrounds the range and signs posted along the gates state "Keep Out".

Finger Bay operated as a submarine base from the 1940s through the 1950s. The submarine base included a dry dock, painting and plating shop, and other operations for overhauling, repairing, and maintaining submarines. Since environmental regulations during that time were not as stringent as they are today, hazardous substances were most likely released untreated directly into the bay through open disposal or floor drains as was commonly the practice of the time.

Sampling

Investigations of Clam Lagoon and Andrew Lake indicate that there are low numbers of edible fish (URS 1997a). However, both Clam Lagoon and Andrew Lake have detectable levels of arsenic, cadmium, mercury, and vanadium, PCBs, and bis(2-ehtylhexyl)phthalate above background. Fish common to Clam Lagoon include sand lance, Pacific herring, Pacific Ocean perch, coastal range sculpin, rockfish, Pacific halibut, starry flounder, barnacles, limpet, snails, littleneck clams, cockles, soft-shelled clams, butter clams and blue mussels. Dolly Varden, sockeye, pink salmon, coho, and chum as well as rainbow trout have been identified in streams. The RI/FS investigation collected samples of rock sole (1 whole fish), Pacific sand-lance (5 composite whole) and blue mussels (2 samples consisting of between 50 -100 mussels). Investigators determined that there was not an abundance of either fish or shellfish in Clam Lagoon perhaps due to the larger otter and seal populations present there. Levels of bis(2-ehtylhexyl)phthalate have been discounted in the final Navy reports as being erroneous. Mercury analysis was conducted for metallic mercury.

Fish common to Andrew Lake include Dolly Varden, rainbow trout, and three-spine stickleback. The RI/FS investigation collected samples of Dolly Varden (5 whole body and 5 fillet composite). The samples were analyzed for semivolatile organic compounds, pesticides, PCBs, inorganic, and petroleum hydrocarbons. Table 5 shows the contaminant concentrations, exposure estimates, and comparisons to health guidelines.

In 1996, USFWS in coordination with the Biological Resource Division of the US Geological Survey sampled rock greenling (*Hexogrammos decagrammus*), Pacific halibut *(Hippoglossus stenolepis*), and Pacific cod (*Gadus macrocephalus*) from Finger Bay, Kuluk Bay, Sweeper Cover, and Bay of Islands areas of Adak Island. Analysis of these species were for 27 organochlorine compounds including PCBs. The *Interim Report: Contaminant concentrations in near shore fish from Adak Island, Alaska* reported levels of oxychlordane, heptochlor, alpha BHC, and PCB 1242 were greater in Finger Bay fish than in fish from Kuluk Bay or Sweeper Cove. Yet levels of

endrin, alpha chlordane, and PCB 1260 were greater in fish from Kuluk Bay and Sweeper Cove than in fish from Finger Bay. These results indicate that contaminants were released to Finger Bay.

Human Health Implications

The Navy investigators have concluded that subsistence fishing could not be supported by Clam Lagoon and Andrew Lake based on the low numbers of fish they were able to collect. Additionally, the distance of these areas from the downtown area make subsistence consumption from these water bodies unlikely. Because levels of certain contaminants (arsenic, cadmium, mercury, and vanadium, PCBs, and bis(2-ehtylhexyl)phthalate) are above some screening levels, ATSDR compared detected levels with levels shown to cause adverse heath effects in both humans and animals. Contaminant levels of arsenic, cadmium, mercury, and vanadium, PCBs, and bis(2-ehtylhexyl)phthalate detected in fish and shellfish from Clam Lagoon, Andrew Lake, and Finger Bay are much lower than levels shown to result in adverse health effects. Therefore, those contaminant levels in fish and shellfish do not present a public health hazard to fish and shellfish consumers.

Conclusions and Public Health Action Plan for Contaminated Seafood from Clam Lagoon, Andrew Lake, and Finger Bay

Conclusion:

1. Based on information in the scientific literature, ATSDR determined that levels of arsenic, cadmium, mercury, vanadium, PCBs, and bis(2-ehtylhexyl)phthalate in seafood collected from the remote areas on the former base have not been shown to result in adverse health effects and therefore, present no apparent public health hazard.

Completed Action:

1. Sampling of seafood from Clam Lagoon, Andrew Lake, and Finger Bay.

Planned Action:

None

Recommended Action:

None

CHEMICAL MIXTURES

In general, humans are continuously exposed to low levels of chemical mixtures by a variety of routes and for varying lengths of time. Interactions may occur among chemicals in the mixture that alter their toxicity. Possible effects that are greater than, less than, or equal to the sum of the effects of the individual components of the mixture can theoretically occur. ATSDR evaluated the likelihood of combined effects of the chemicals on the exposures people would experience at Adak. Again, we used the maximum contaminant concentration values and totaled the estimated exposure doses for each exposed group of people. Scientific literature has documented that adverse effects are unlikely to occur when the individual components in the mixture are present at levels well below their respective thresholds. Therefore, the combined effects of the chemicals that are present on Adak were evaluated. ATSDR determined that subsistence fish consumers are at greatest risk for adverse health effects from the chemical contaminants present in fish.

ATSDR CHILD HEALTH INITIATIVE

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to hazardous substances emitted from waste sites and emergency events. They are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are shorter than adults, which means they breathe dust, soil, and heavy vapors close to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

ATSDR evaluated the likelihood for children living in the downtown area on Adak to be exposed to contaminants at levels that pose a health hazard. ATSDR identified several situations in which children are or could in the future be exposed to physical or chemical contaminants likely to result in adverse health effects. Those include: (1) ingesting lead in tap water in Sandy Cove and Eagle Bay homes, (2) breathing JP-5 fuel related contaminants in indoor air in Sandy Cove homes, (3) contact with physical hazards throughout the downtown and remote areas, (4) contact with potentially contaminated sediments in Helmet Creek, and (5) subsistence consumption of seafood from Clam Lagoon, Andrew Lake, Andrew Bay, and Finger Bay. Each scenario is evaluated in detail in the body of this document.

HEALTH OUTCOME DATA

ATSDR conducts a review of existing health outcome data (e.g., birth and death certificates, birth defects registries, cancer registries, etc.), when available, if people have been exposed to site contaminants at levels likely to cause adverse health effects or if the community has concerns related to specific health outcomes. ATSDR did not evaluate health outcome databases in conjunction with the Naval Air Facility Adak Public Health Assessment because no one is being exposed to contaminants at levels likely to result in adverse health effects.

COMMUNITY HEALTH CONCERNS

1. Community members have expressed concern about possible radioactive areas of Adak.

The Radiological Affairs Support Office (RASO) conducted a radiological survey of Adak in 1997 to identify undocumented radioactive material that may have been disposed of on the island. The survey included the disposal of medical and instrument waste as well as wastes associated with military operations. The survey did not find any radiological contamination. (BRAC Cleanup Plan 11/97).

2. Community members have expressed concern that the Chemical Warfare Material disposed in an off-shore area of Adak may wash ashore.

Adak was used as a major staging area for bombing against the Japanese on the islands of Attu and Kiska during WWII. At the end of the war, remaining munitions and chemical warfare materials were disposed of by burning, detonation, burial, and open ocean dumping. Several hundred one-ton containers of chemical warfare material (i.e., Lewisite) were disposed 10 miles north of Adak Island at a depth of greater than 1000 meters (US AAF 1945). It is most likely that the containers imploded and released their contents more than 50 years ago on the ocean floor, although there is no official confirmation of this.

3. Residents and community members have reported fuel odors from areas at or near 160-D in Sandy Cove housing area.

In 1996, people staying in or adjacent to Sandy Cove unit 160-D reported fuel-type odors. The unit was made off-limits. The Navy has reported that they have conducted a survey of the unit and discovered a heating oil fuel leak; and removed the heating oil tank. The Navy also states that in 2000, additional work was done to cleanup the spill. The piping lines from the tank containing more than 50 gallons of heating oil were cleaned out. Additionally, the Navy removed soil adjacent to the piping and beneath the house down two feet deep and replaced the contaminated soil with clean soil. The Navy reports that home should be reopened in the near future.

Other Concerns

ATSDR has addressed many of the community concerns in the body of this report. Here are concerns citizens expressed to ATSDR which are included in earlier sections.

- The community has expressed concern to ATSDR regarding the physical hazards such Rommel stakes and explosives that will remain on the island.
- The community has expressed concerns about asbestos in the high school tile floor.
- The community has expressed concerns about the safety of people who must access NORPAC Hill.

- The community has expressed concerns about the safety of fish caught from Sweeper Cove.
- The community has expressed concerns about the safety of Sandy Cove housing area playgrounds.

If anyone has additional health concerns they would like to relay to ATSDR, they should direct them to:

Program Evaluation, Records, and Information Services Branch
RE: Adak Naval Air Facility
ATSDR, Division of Health Assessment and Consultation
1600 Clifton Road, MS E-56
Atlanta, GA 30333
1-888-42-ATSDR

BASE REDEVELOPMENT AND PUBLIC HEALTH

The Naval Air Facility, Adak was closed in 1995 as mandated by the Defense Base Closure and Realignment Commission under the Defense Base Closure and Realignment Act of 1990. The preferred alternative for reuse of the base property is an aviation-mixed use scenario that includes a civilian airport, seaport, light industrial, commercial, recreational and residential development.

ATSDR has evaluated potential future public health issues on Adak Island by integrating the land uses described in the preferred alternative for redevelopment with information on the types and concentrations of hazardous substances, explosive and physical hazards that will be left in the soils, sediments, groundwater, and surface waters. Our evaluation places emphasis on areas proposed for residential or public/recreational reuse activities that are more likely to bring people into contact with waste materials.

There is uncertainty associated with this evaluation. ATSDR has assumed that while the details of the specific type of activity on a parcel of land may vary, the basic land use category will remain stable. However, future changes in the preferred redevelopment plan may result from economic realities, the success of marketing efforts, and other factors. These changes cannot be predicted. Therefore, ATSDR recommends that changes in the base redevelopment plan trigger re-evaluation of potential public health issues. Specifically, the Navy, EPA, Alaska State Department of Environmental Conservation, and the Aleut Corporation should carefully evaluate any significant changes in the redevelopment plan that would result in new areas being used for (1) residential or public recreational activities that could bring people into contact with environmental contamination, explosive and physical hazards, or (2) utilization of the shallow groundwater resources which are contaminated in several areas of Adak.

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GLOSSARY

Action Levels
Regulatory levels recommended by EPA to warrant action or trigger a response under Superfund.

Acute
Occurring over a short time, usually a few minutes or hours. An acute exposure (0-14 days) can result in short-term or long-term health effects.

Adverse Health Effect
Adverse health effects are deleterious consequences in a biological system. Adverse health effects can range in severity from no apparent result to obvious frank illness. Adverse health effects can include some enzyme changes in the body which may not be noticeable even to the individual, to acute illness such as vomiting, or long-term illnesses such as cancer.

Ambient
Surrounding. For example, ambient air is usually outdoor air (as opposed to indoor air).

Background Level
A typical or average level of a chemical in the environment. Background often refers to naturally occurring or uncontaminated levels but can include contaminants so widespread in the environment that no specific source is apparent.

Cancer Risk
The theoretical based assumptions from a linear multi-stage model used to calculate a theoretical risk of developing cancer over a lifetime (70 years) of daily exposure. True risk is usually much lower and may even be zero.

Carcinogen
Any substance that may produce cancer.

Comparison Values
Estimated contaminant concentrations in specific media that are not likely to cause adverse health effects, given a standard daily assumptions i.e., ingestion rate and standard body weight. Comparison values are calculated from the scientific literature available on exposure and health effects.

Concentration
The amount of one substance dissolved or contained in a given amount of another. For example, sea water contains a higher concentration of salt than fresh water.

Contaminant
Any substance or material that enters a system (e.g., the environment, human body, food, etc.) where it is not normally found.

Database
A collection of various data stored in an electronic format.

Dermal contact
Contact with the skin. Refers to absorption through the skin as a route of exposure.

Dose
The amount of substance to which a person is exposed. Dose often takes body weight into account.

Downgradient
Refers to a location toward which groundwater will flow.

Environmental Media
Groundwater, surface water, air, soil, sediment, and biota.

Environmental Transport
Movement of contaminants from the source to points where human exposure can occur.

Epidemiology
The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. Investigators try to determine if any factor is associated with the health effect.

Exposure
Contact with a chemical by swallowing, breathing, or direct contact (such as through the skin or eyes). Exposure may be short term (acute) or long term (chronic).

Exposure Investigation
The collection and analysis of site-specific information to determine if human populations have been exposed to hazardous substances. The site-specific information may include environmental sampling, exposure-dose reconstruction, biologic (i.e., urine, blood) or biomedical testing and evaluation of medical information.

Exposure Pathway
An exposure pathway is the process by which an individual is exposed to contaminants that originate from some source of contamination. It consists of five elements: 1) Source of Contamination, 2) Environmental Media/Transport, 3) Point of Exposure, 4) Route of Exposure and 5) Receptor Population.

Feasibility Study
A study that must be completed before any remedial cleanup can begin. It evaluates different methods of handling the issue and selects a method that will effectively protect public health and the environment.

Groundwater
Water contained in the spaces between soil and rock below the water table. This water can be in shallow (overburden) aquifers or deep bedrock aquifers.

Health Consultation
A response to a specific question or request for information pertaining to a hazardous substance, facility, or one exposure. It often contains a time-critical element that necessitates a rapid response; therefore, it is a more limited response than a public health assessment.

Ingestion
Swallowing (such as eating or drinking). Chemicals can get into or on food, drink, utensils, cigarettes, or hands where they can then be ingested. After ingestion, chemicals can be absorbed into the blood and distributed throughout the body.

Inhalation
Part of the breathing process. Exposure can occur by inhaling contaminants which can then be deposited in the lungs, taken into the blood, or both.

Inorganic Chemicals
Inorganic chemical consist of minerals without a carbon basis. Inorganic chemicals include manganese, salts (i.e., sodium chloride), and metals (i.e., iron, lead) .

Lowest Observed Adverse Effect Level (LOAEL)
The LOAEL is the lowest dose at which an adverse health effect is seen in a particular study. The LOAEL is often used to derive RfDs.

Maximum Contaminant Level (MCL)
The MCL is a regulatory limit set by the Environmental Protection Agency (EPA) for contaminants in drinking water. If an MCL is exceeded, regulatory action is required under the Safe Drinking Water Act. MCLs are not always strictly health based, but can consider technological or economic feasibility.

Media
Soil, sediment, water, air, plants, animals, or any other parts of the environment that can contain contaminants.

Medical Monitoring
The periodic medical testing to screen people at significant increased threat of disease.

Minimal Risk Level (MRL)
Minimal Risk Levels (MRLs) are levels of chemical exposure below which non-cancer effects are not expected. MRLs are derived by the Agency for Toxic Substances and Disease Registry. An MRL is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and provide added health protection.

National Priorities List (NPL)
The Environmental Protection Agency's (EPA) listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose an immediate threat to persons living or working near the hazardous chemical release. These sites are most in need of cleanup.

National Toxicology Program (NTP)
NTP conducts toxicological testing on those substances most frequently found at sites on the National Priorities List, and which also have the greatest potential for human exposure.

National Exposure Registry
A listing of persons exposed to hazardous substances. This listing consists of chemical-specific subregistries. The primary purpose of the registry program is to create a large database of similarly exposed persons. This database is to be used to facilitate epidemiology research in ascertaining adverse health effects of persons exposed to low levels of chemicals over long periods of time.

No Apparent Public Health Hazard
An ATSDR hazard category used when human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below levels likely to result in adverse health effects.

No Observed Adverse Effect Level (NOAEL)
The NOAEL is the highest dose from a study that did not find any adverse health effects. The NOAEL is often used to derive MRL and RfDs.

No Public Health Hazard
An ATSDR hazard category used when data indicate that no current, past and potential for future exposure exists and, therefore, no health hazard exists.

Oral Reference Dose (RfDo)
Oral Reference Doses (RfD) are levels of chemical exposure, derived by the Environmental Protection Agency, below which non-cancer effects are not expected. An RfD is derived by dividing a LOAEL or NOAEL by "safety factors" to account for uncertainty and provide added health protection.

Point of Exposure
A location of potential or actual human contact with a contaminated medium (e.g., drinking water well, residential yard, playground, etc.)

Potential/Indeterminate Public Health Hazard
An ATSDR hazard category used when no conclusions about public health hazard can be made because environmental and/or toxicological data are lacking.

Public Availability Session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public Health Assessment
The evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects; also, the document resulting from that evaluation.

Public Health Hazard
An ATSDR hazard category used when human exposure to contaminated media is occurring or has occurred in the past, at levels likely to cause adverse health effects as the result of long-term exposures to hazardous substances.

Receptor Population
Persons who are exposed or potentially exposed to the contaminants of concern at a point of exposure.

Record of Decision (ROD)
A public document approved by the participating parties of the federal facilities agreement: Navy, EPA, and Alaska Department of Environmental Conservation (in this case). The ROD outlines the cleanup method that will be used at a superfund site. It includes the responses to public comments on the Feasibility Study and the Proposed Plan.

Risk
In risk assessment, the theoretical probability that something will cause injury, combined with the potential severity of that injury. Actual risk may be as little as zero.

Route of Exposure
The way in which a person may contact a chemical substance. For example, drinking (ingestion) and bathing (skin contact) are two different routes of exposure to contaminants that may be found in water.

Semi-Volatile Organic Compounds (SVOCs)
SVOCs are compounds similar in composition to VOCs. However, SVOCs are less volatile than VOCs and have less potential to move in the environment. SVOCs have boiling points from 240-400°C. They include coal tar components such as PAHs.

Soil Gas
Gaseous compounds that occur in the small spaces between particles of the earth and soil. Such gases can move through or leave the soil or rock, depending on changes in pressure.

Source (Environmental)
Origin of a contaminant release into the environment, or, if the source is unknown, the environmental media through which contaminants are presented at a point of exposure.

Source (Reference)
Research studies, health studies, epidemiological studies, occupational studies, animal studies, exposure investigations, health evaluations, computer models, exposure models, etc. which provide reference for previous work and knowledge.

Superfund
Another name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which created ATSDR.

Volatile Organic Compounds (VOCs)
Substances that easily become vapors or gases (boiling points from 50-260°C) and contain carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen. Many VOCs are commonly used as solvents (paint thinners, lacquer thinner, degreasers, and dry cleaning fluids).

RESPONSE TO PUBLIC COMMENTS

ATSDR received comments from the Navy, USEPA, and the Alaska Community Action on Toxics during the Public Comment Period. Below are ATSDR's response to those comments. Comments regarding errors in factual information or formatting were corrected in the text.

General Comments:

NAVY: The report does not include all of the available data and studies that were conducted.

ATSDR: While a summary document of all the available data and studies that were conducted would be nice, it would be impractical for a public health assessment to contain the numerous volumes of documents the Navy, ADEC, and EPA maintain. ATSDR includes data and study information relevant to contaminants to which people are exposed. During the public health assessment process, additional data collection and studies have been conducted. Although we have tried to include the most current information available, the public health assessment represents only a snapshot in time. Clean up activities and environmental investigation continue on Adak Island. All the data and information regarding cleanup efforts may not have been included in this report at the time of printing.

In this report, we make public health recommendations based on information we have been able to obtain. If we make recommendations to protect people from contaminants in an area that is being cleaned of contaminants, then our recommendations represent prudent public health practice; we err on the side of protecting public health. We follow up our recommendations to determine if they are carried out.

A. EXPOSURES FROM UNAVOIDABLE DAILY ACTIVITIES

A1. Residents Exposed to Lead in Tap Water in Sandy Cove and Eagle Bay Homes - Current and Future Exposure - Public Health Hazard

NAVY: The Navy agrees that lead concentrations in tap water may be a health concern, but requests that the information in the PHA report be changed to accurately reflect past sampling efforts and future plans. Specifically, these issues need to be addressed: flushing and stagnant times recommended in the text are not consistent with U.S. Environmental Protection Agency (EPA) and State regulations; the report does not include all of the available data and studies that were conducted; the list presented in the report of completed and on-going actions to reduce exposure to lead is incomplete; and the planned actions listed in the report are incomplete. The flushing and stagnant times recommended in the text are not consistent with EPA and State regulation. According to State and Federal requirements (18 AAC 80.540 and 40 CFR 141.85), the flushing times are 15 to 30 seconds.

USEPA: EPA has reviewed the comments submitted by the Navy to ATSDR for the Adak Island PHA on April 18, 2002. EPA fully supports the Navy's comments, technical analyses, conclusions and recommendations. EPA encourages ATSDR to undertake a critical re-evaluation of the PHA that includes a thorough technical analysis of the data and conclusions.

ATSDR: According to state and federal requirements (18 AAC 80.540 and 40 CFR 141.85), the flushing times that are recommended are 15 to 30 seconds, but both guidelines also state that flushing times may need to be longer to reduce the lead level in taps where water has been standing in pipes (unused) for six hours. ATSDR's recommendation for 2 to 3 minutes of flushing is based on the past sampling results and results of lead present at levels of health concern even after flushing for 30 seconds. According to additional samples collected at Sandy Cove, 3-minute flushing times greatly reduced lead levels. Therefore, ATSDR's recommendations are clearly consistent with state and federal requirements.

Alaska Community Action on Toxics: ATSDR should recommend that an alternative water source be used in Sandy Cove and Eagle Bay homes.

ATSDR: The drinking water comes from Lake Bonnie Rose. Although Lake Bonnie Rose water is free from contaminants, the water is somewhat corrosive. When allowed to sit in pipes containing lead solder or brass components, the water causes the lead (and copper) to leach from the plumbing material into the water. The longer the water is allowed to remain in the pipes, the greater the likelihood lead levels will increase. So it is not the drinking water itself that is the problem, but the pipes. The Navy is considering alternative piping and will be following up on this situation.

A2. Residents Possibly Exposed to Jet Propellant -5 (JP-5) in Sandy Cove Homes - Current and Future Potential Exposure - Indeterminate Public Health Hazard

NAVY: The highest concentration of the most toxic volatile constituents (BTEX), with vapor pressures significantly above other JP-5 fuel constituents, were not found to exceed one part per million in the soil. It is anticipated that the levels of VOCs attributable to JP-5 in the breathing zone of building occupants would be nondetectable.

ATSDR: Bacteria that attack hydrocarbons generate carbon dioxide under aerobic conditions and methane under anaerobic conditions (Wiedemeier et al., 1995; Newell et al., 1995). These biogenic gases (methane and carbon dioxide) can occur at dangerous levels especially in confined spaces. New or modified building characteristics can contribute to the groundwater off-gassing into the buildings. ATSDR is unaware of a groundwater concentration at which anaerobic degradation reduces the potential biogenic gases to migrate indoors. Because many factors influence the travel path for contaminants (e.g., gasses can diffuse directly though foundations through cracks, gaps, footers, foundation floors and walls below grade level, poor seals around utility entry points), each situation should be evaluated individually. Not only do bacterial activities occur, but percent levels of carbon dioxide and methane are often generated. Biogenic methane and carbon dioxide data,

generally can be used for mapping the distribution of contaminated soils; even when the contamination is very old and the lighter hydrocarbon volatiles are nearly absent (ETI 1998). Therefore, ATSDR continues to recommend that indoor air in homes in Sandy Cove be tested.

Alaska Community Action on Toxics: ATSDR should consider the potential health effects of JP-5 additives such as biocides and other chemicals. ATSDR should recommend removal of fuel spills and other sources of contamination that affect people in their homes.

ATSDR: ATSDR reviewed the information regarding additives to JP-5. Although the exact additives and their concentrations are considered proprietary information, we did contact several JP-5 manufacturers to get a general list of the various chemical additives and a concentration range that may be present in the JP-5 that was released through spills and pipeline leaks. Additionally, we reviewed the laboratory sampling methods used to analyze the various media to determine if the laboratory methods could possibly detect various additives.

Typical additives to jet fuels include antioxidants, metal deactivators, static dissipator, corrosion inhibitors, fuel system icing inhibitors, octane enhancers, ignition controllers, and detergents/dispersants. These additives are used only in specified amounts, as governed by the military and which may include 2,6-di-tert-butyl-4-methylphenol and tert-butyl-2,4-dimethylphenol among other chemical additives. These additives typically would move through and disperse in groundwater very rapidly and would not likely be detectable 10 years after release.

Other Comments

Alaska Community Action on Toxics: Although ATSDR cites the Radiological Affairs Support Office's (RASO) 1997 radiological survey, the assessment does not properly evaluate the limitations of the survey. The RASO survey was grossly deficient. It is irresponsible for ATSDR to conclude that no radiological contamination exists. ATSDR should recommend that an independent and comprehensive radiological study be conducted on the island and surrounding marine waters to assess radiological hazards from nuclear submarine operations, nuclear weapons transport and storage, and other operations.

ATSDR: ATSDR reviewed the RASO report as well as numerous declassified archived information including memos, letters, and reports dating back to 1943 to determine the locations and types of radioactive material that has been used on Adak Island. We evaluated the ways in which people could come in contact with areas where radioactive material was used, stored, and disposed. The medical facility is the only current area where people can come in contact with radioactive material which is strictly regulated by the National Radiation Commission and the Medical Waste Tracking Act. ATSDR did not identify any other areas where people could come in contact with media at areas previously used to store, dispose, or use radioactive material.

Alaska Community Action on Toxics: ATSDR should generate independent environmental and public health data and not simply review the limited and biased Navy contractor data for this analysis. The document does not discuss the implications of recent peer-reviewed scientific articles that demonstrate that people living in the vicinity of landfills have a greater risk of health problems than people living in more distant locations.

ATSDR: ATSDR does not routinely conduct environmental data instead, we rely on data generated by the military under scrutiny by EPA and state agencies. In rare cases, when data gaps are identified that require immediate sampling not conducted by other agencies, ATSDR can step in to perform that sampling. At Adak, ATSDR did not identified the need to step in to conduct sampling. We make recommendations for sampling modifications to the Navy's plans.

ATSDR has reviewed the information presented in several articles regarding the health problems in people who live near landfills. The studies reviewed, are ecological studies that use disease data bases and overlay census tract information about the people living nearby. These studies do not evaluate whether people living near landfills come in contact with contaminants at the landfill or migrating from the landfill. In most studies, there are limitations or confounders that are sometimes not factored into the evaluation. Confounders often include socio-economic status and access to medical care, or individual risk factors such as smoking or hazardous occupations.

In this report, ATSDR has evaluated whether people are actually coming in contact with contaminants migrating from the landfill on island and determined that people are not likely to experience sickness from living near the Adak landfills.

Table 3 - Kuluk Bay Resident Fish and Shellfish Exposure Estimates

Biota Type	Biota Portion	Contaminant	Location	Maximum Contaminant Value	Units	Fish RBC (mg/kg)	Effect	EPAs Reference Dose (mg/kg/d)	Estimated Noncancer Dose (mg/kg/day)	ATSDR Conclusion for Noncancerous Health	Estimated Cancer Dose (mg/kg/day)	Cancer Slope Factor	Cancer Risk Estimate	ATSDR Conclusion for Cancer Risk	Lowest Observed Adverse Effect Level (mg/kg/day)
SOLE	ALL,WET	ALUMINUM	13/612	235 ppm		1353.000000 N		1.0E+00	4.056E-01	No Hazard					
SOLE	WHOLE, WET	ALUMINUM	13/612	235 ppm		1353.000000 N		1.0E+00	4.056E-01	No Hazard					
SOLE	FILLET, WET	ALUMINUM	13/612	38.3 ppm		1353.000000 N		1.0E+00	6.611E-02	No Hazard					
MUSSEL	ALL,WET	AROCLOR 1254	11/103	0.004 ppm		0.001600 C		2.0E-05	2.082E-06	No Hazard	8.924E-07	2	1.785E-06	No Hazard	
MUSSEL	ALL,WET	AROCLOR 1254	13/609	0.018 ppm		0.001600 C		2.0E-05	9.370E-06	No Hazard	4.016E-06	2	8.031E-06	No Hazard	
MUSSEL	ALL,WET	AROCLOR 1254	13/610	0.02 ppm		0.001600 C		2.0E-05	1.041E-05	No Hazard	4.462E-06	2	8.924E-06	No Hazard	
MUSSEL	ALL,WET	AROCLOR 1254	13/611	0.024 ppm		0.001600 C		2.0E-05	1.249E-05	No Hazard	5.354E-06	2	1.071E-05	No Hazard	
SOLE	ALL,WET	AROCLOR 1254	13/612	0.35 ppm		0.001600 C		2.0E-05	6.041E-04	EXCEEDS	2.589E-04	2	5.178E-04	EXCEEDS	No Adverse Effect
SOLE	WHOLE, WET	AROCLOR 1254	13/612	0.35 ppm		0.001600 C		2.0E-05	6.041E-04	EXCEEDS	2.589E-04	2	5.178E-04	EXCEEDS	No Adverse Effect
SOLE	FILLET, WET	AROCLOR 1254	13/612	0.011 ppm		0.001600 C		2.0E-05	1.899E-05	No Hazard	8.137E-06	2	1.627E-05	No Hazard	
SOLE	ALL,WET	AROCLOR 1260	13/612	0.014 ppm		0.001600 C		2.0E-05	2.416E-05	EXCEEDS	1.036E-05	2	2.071E-05	No Hazard	
SOLE	FILLET, WET	AROCLOR 1260	13/612	0.014 ppm		0.001600 C		2.0E-05	2.416E-05	EXCEEDS	1.036E-05	2	2.071E-05	No Hazard	
MUSSEL	ALL,WET	ARSENIC	11/103	1.8 ppm		0.002103 C		3.0E-04	9.370E-04	EXCEEDS	4.016E-04	1.5	6.023E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	ARSENIC	11/104	1.6 ppm		0.002103 C		3.0E-04	8.329E-04	EXCEEDS	3.569E-04	1.5	5.354E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	ARSENIC	13/609	1 ppm		0.002103 C		3.0E-04	5.205E-04	EXCEEDS	2.231E-04	1.5	3.346E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	ARSENIC	13/610	1.6 ppm		0.002103 C		3.0E-04	8.329E-04	EXCEEDS	3.569E-04	1.5	5.354E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	ARSENIC	13/611	1.8 ppm		0.002103 C		3.0E-04	9.370E-04	EXCEEDS	4.016E-04	1.5	6.023E-04	EXCEEDS	No Adverse Effect
SOLE	ALL,WET	ARSENIC	13/612	3.4 ppm		0.002103 C		3.0E-04	5.868E-03	EXCEEDS	2.515E-03	1.5	3.773E-03	EXCEEDS	No Adverse Effect
SOLE	FILLET, WET	ARSENIC	13/612	3.4 ppm		0.002103 C		3.0E-04	5.868E-03	EXCEEDS	2.515E-03	1.5	3.773E-03	EXCEEDS	No Adverse Effect
SOLE	WHOLE, WET	ARSENIC	13/612	1.7 ppm		0.002103 C		3.0E-04	2.934E-03	EXCEEDS	1.258E-03	1.5	1.886E-03	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	CADMIUM	11/103	0.636 ppm		1.351851 N		1.0E-03	3.311E-04	No Hazard	1.419E-04				
MUSSEL	ALL,WET	CADMIUM	11/104	0.621 ppm		1.351851 N		1.0E-03	3.233E-04	No Hazard	1.385E-04				
MUSSEL	ALL,WET	CADMIUM	13/609	0.617 ppm		1.351851 N		1.0E-03	3.212E-04	No Hazard	1.376E-04				
MUSSEL	ALL,WET	CADMIUM	13/610	0.819 ppm		1.351851 N		1.0E-03	4.263E-04	No Hazard	1.827E-04				
MUSSEL	ALL,WET	CADMIUM	13/611	0.988 ppm		1.351851 N		1.0E-03	5.143E-04	No Hazard	2.204E-04				
MUSSEL	ALL,WET	CHROMIUM	11/103	0.92 ppm		2000.000000 N		1.5E+00	4.789E-04	No Hazard	2.052E-04				
MUSSEL	ALL,WET	CHROMIUM	11/104	0.76 ppm		2000.000000 N		1.5E+00	3.956E-04	No Hazard	1.695E-04				
MUSSEL	ALL,WET	CHROMIUM	13/609	1.6 ppm		2000.000000 N		1.5E+00	8.329E-04	No Hazard	3.569E-04				
MUSSEL	ALL,WET	CHROMIUM	13/610	4.25 ppm		2000.000000 N		1.5E+00	2.212E-03	No Hazard	9.481E-04				
MUSSEL	ALL,WET	CHROMIUM	13/611	1.79 ppm		2000.000000 N		1.5E+00	9.318E-04	No Hazard	3.993E-04				
SOLE	ALL,WET	CHROMIUM	13/612	1.06 ppm		2000.000000 N		1.5E+00	1.830E-03	No Hazard	7.841E-04				
SOLE	WHOLE, WET	CHROMIUM	13/612	1.06 ppm		2000.000000 N		1.5E+00	1.830E-03	No Hazard	7.841E-04				
SOLE	FILLET, WET	CHROMIUM	13/612	0.63 ppm		2000.000000 N		1.5E+00	1.087E-03	No Hazard	4.660E-04				
MUSSEL	ALL,WET	DIELDRIN	13/610	0.0007 ppm		0.000200 C		5.0E-05	3.644E-07	No Hazard	1.562E-07	16	2.499E-06	No Hazard	
MUSSEL	ALL,WET	DIELDRIN	13/611	0.0006 ppm		0.000200 C		5.0E-05	3.123E-07	No Hazard	1.339E-07	16	2.142E-06	No Hazard	
SOLE	ALL,WET	DIELDRIN	13/612	0.001 ppm		0.000200 C		5.0E-05	1.726E-06	No Hazard	7.397E-07	16	1.184E-05	No Hazard	
SOLE	WHOLE, WET	DIELDRIN	13/612	0.001 ppm		0.000200 C		5.0E-05	1.726E-06	No Hazard	7.397E-07	16	1.184E-05	No Hazard	
MUSSEL	ALL,WET	LEAD	11/103	0.304 ppm				8.9E-04	1.582E-04	No Hazard	6.782E-05				
MUSSEL	ALL,WET	LEAD	11/104	0.209 ppm				8.9E-04	1.088E-04	No Hazard	4.663E-05				
MUSSEL	ALL,WET	LEAD	13/609	0.367 ppm				8.9E-04	1.910E-04	No Hazard	8.187E-05				
MUSSEL	ALL,WET	LEAD	13/610	0.325 ppm				8.9E-04	1.692E-04	No Hazard	7.250E-05				
MUSSEL	ALL,WET	LEAD	13/611	1.68 ppm				8.9E-04	8.745E-04	No Hazard	3.748E-04				
SOLE	ALL,WET	LEAD	13/612	0.165 ppm				8.9E-04	2.848E-04	No Hazard	1.221E-04				
SOLE	WHOLE, WET	LEAD	13/612	0.165 ppm				8.9E-04	2.848E-04	No Hazard	1.221E-04				
SOLE	FILLET, WET	LEAD	13/612	0.077 ppm				8.9E-04	1.329E-04	No Hazard	5.696E-05				
MUSSEL	ALL,WET	PCBs	11/103	0.004 ppm		0.001600 C		2.0E-05	2.082E-06	No Hazard	8.924E-07	2	1.785E-06	No Hazard	
MUSSEL	ALL,WET	PCBs	13/609	0.018 ppm		0.001600 C		2.0E-05	9.370E-06	No Hazard	4.016E-06	2	8.031E-06	No Hazard	
MUSSEL	ALL,WET	PCBs	13/610	0.02 ppm		0.001600 C		2.0E-05	1.041E-05	No Hazard	4.462E-06	2	8.924E-06	No Hazard	
MUSSEL	ALL,WET	PCBs	13/611	0.024 ppm		0.001600 C		2.0E-05	1.249E-05	No Hazard	5.354E-06	2	1.071E-05	No Hazard	
SOLE	ALL,WET	PCBs	13/612	0.35 ppm		0.001600 C		2.0E-05	6.041E-04	EXCEEDS	2.589E-04	2	5.178E-04	EXCEEDS	No Adverse Effect
SOLE	WHOLE, WET	PCBs	13/612	0.35 ppm		0.001600 C		2.0E-05	6.041E-04	EXCEEDS	2.589E-04	2	5.178E-04	EXCEEDS	No Adverse Effect
SOLE	FILLET, WET	PCBs	13/612	0.025 ppm		0.001600 C		2.0E-05	4.315E-05	EXCEEDS	1.849E-05	2	3.699E-05	No Hazard	

ATSDR selected contaminants for this table based on it relative hazard and ability to bioaccumulate or bioconcentrate. This is not the complete data set.
ATSDR used the Alaska Department of Environmental Conservation, IDM Consulting 1997, Establishing Alaska Specific ExposureScenarios for ingestion of marine (nonsalmon) fish at 126 g/day and shellfish at 38 g/day shellfish
ATSDR used EPA Reference Dose for all chemicals excluding lead. For lead ATSDR used a calculated refercence dose specific to this document based on scientific literature and EPA's IEUBK model for lead uptake.
LOAEL for PCBs (total Arochlors) 0.001 mg/kd/day
LOAEL for Arsenic is 0.005 mg/kd/day

This table does not include the 1999 and 2000 annual monitoring data for PCB analysis because only summary data was provided to ATSDR.
PCB data from 1999 and 2000 showed lower levels than those presented here.

Table 4 - Sweeper Cove and Sweeper Creek Resident Fish and Shellfish Exposure Estimates

Biota Type	Biota Portion	Contaminant	Location	Maximum Contaminant Value	Units	Fish RBC (mg/kg)	Effect	EPA Reference Dose (mg/kg/d)	Estimated Noncancer Dose (mg/kg/day)	ATSDR Conclusion for NonCancerous Health Effects	Estimated Cancer Dose (mg/kg/day)	Cancer Slope Factor	Cancer Risk Estimate	ATSDR Conclusion for Cancer Risk	Lowest Observed Adverse Effect Level (mg/kg/day)
MUSSEL	ALL,WET	AROCLOR 1260	SWEEPCOV/718	0.0306	ppm	0.0016	C	2.0E-05	1.593E-05	No Hazard	6.827E-06	2	1.365E-05	No Hazard	
MUSSEL	ALL,WET	ARSENIC	SWEEPCOV/718	1.47	ppm	0.0021	C	3.0E-04	7.652E-04	EXCEEDS	3.279E-04	1.5	4.919E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	CADMIUM	SWEEPCOV/718	1.26	ppm	1.3519	N	1.0E-03	6.559E-04	No Hazard	2.811E-04				
MUSSEL	ALL,WET	CHROMIUM	SWEEPCOV/718	0.415	ppm	2000.0000	N	1.5E+00	2.160E-04	No Hazard	9.258E-05				
MUSSEL	ALL,WET	PCBs	SWEEPCOV/718	0.0306	ppm	0.0016	C	2.0E-05	1.593E-05	No Hazard	6.827E-06	2	1.365E-05	No Hazard	
MUSSEL	ALL,WET	AROCLOR 1260	SWEEPCOV/719	0.0332	ppm	0.0016	C	2.0E-05	1.728E-05	No Hazard	7.407E-06	2	1.481E-05	No Hazard	
MUSSEL	ALL,WET	ARSENIC	SWEEPCOV/719	1.29	ppm	0.0021	C	3.0E-04	6.715E-04	EXCEEDS	2.878E-04	1.5	4.317E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	CADMIUM	SWEEPCOV/719	1.48	ppm	1.3519	N	1.0E-03	7.704E-04	No Hazard	3.302E-04				
MUSSEL	ALL,WET	CHROMIUM	SWEEPCOV/719	0.317	ppm	2000.0000	N	1.5E+00	1.650E-04	No Hazard	7.072E-05				
MUSSEL	ALL,WET	LEAD	SWEEPCOV/719	0.3	ppm			8.9E-04	1.562E-04	No Hazard	6.693E-05				
MUSSEL	ALL,WET	PCBs	SWEEPCOV/719	0.0332	ppm	0.0016	C	2.0E-05	1.728E-05	No Hazard	7.407E-06	2	1.481E-05	No Hazard	
MUSSEL	ALL,WET	AROCLOR 1260	SWEEPCOV/720	0.0376	ppm	0.0016	C	2.0E-05	1.957E-05	No Hazard	8.388E-06	2	1.678E-05	No Hazard	
MUSSEL	ALL,WET	ARSENIC	SWEEPCOV/720	1.55	ppm	0.0021	C	3.0E-04	8.068E-04	EXCEEDS	3.458E-04	1.5	5.187E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	CADMIUM	SWEEPCOV/720	0.961	ppm	1.3519	N	1.0E-03	5.002E-04	No Hazard	2.144E-04				
MUSSEL	ALL,WET	CHROMIUM	SWEEPCOV/720	0.331	ppm	2000.0000	N	1.5E+00	1.723E-04	No Hazard	7.384E-05				
MUSSEL	ALL,WET	LEAD	SWEEPCOV/720	0.195	ppm			8.9E-04	1.015E-04	No Hazard	4.350E-05				
MUSSEL	ALL,WET	PCBs	SWEEPCOV/720	0.0376	ppm	0.0016	C	2.0E-05	1.957E-05	No Hazard	8.388E-06	2	1.678E-05	No Hazard	
SOLE	ALL,WET	AROCLOR 1260	SWEEPCOV/722	0.061	ppm	0.0016	C	2.0E-05	1.053E-04	EXCEEDS	4.512E-05	2	9.025E-05	No Hazard	
SOLE	WHOLE, WET	AROCLOR 1260	SWEEPCOV/722	0.061	ppm	0.0016	C	2.0E-05	1.053E-04	EXCEEDS	4.512E-05	2	9.025E-05	No Hazard	
SOLE	ALL,WET	ARSENIC	SWEEPCOV/722	2.12	ppm	0.0021	C	3.0E-04	3.659E-03	EXCEEDS	1.568E-03	1.5	2.352E-03	EXCEEDS	No Adverse Effect
SOLE	WHOLE, WET	ARSENIC	SWEEPCOV/722	2.12	ppm	0.0021	C	3.0E-04	3.659E-03	EXCEEDS	1.568E-03	1.5	2.352E-03	EXCEEDS	No Adverse Effect
SOLE	ALL,WET	CHROMIUM	SWEEPCOV/722	0.252	ppm	2000.0000	N	1.5E+00	4.350E-04	No Hazard	1.864E-04				
SOLE	WHOLE, WET	CHROMIUM	SWEEPCOV/722	0.252	ppm	2000.0000	N	1.5E+00	4.350E-04	No Hazard	1.864E-04				
SOLE	ALL,WET	LEAD	SWEEPCOV/722	0.0686	ppm			8.9E-04	1.184E-04	No Hazard	5.075E-05				
SOLE	WHOLE, WET	LEAD	SWEEPCOV/722	0.0686	ppm			8.9E-04	1.184E-04	No Hazard	5.075E-05				
SOLE	ALL,WET	PCBs	SWEEPCOV/722	0.061	ppm	0.0016	C	2.0E-05	1.053E-04	EXCEEDS	4.512E-05	2	9.025E-05	No Hazard	
SOLE	WHOLE, WET	PCBs	SWEEPCOV/722	0.061	ppm	0.0016	C	2.0E-05	1.053E-04	EXCEEDS	4.512E-05	2	9.025E-05	No Hazard	
DOLLY VARDEN	ALL,WET	ALUMINUM	SWEEPCREEK/721	151	ppm	1353.0000	N	1.0E+00	2.606E-01	No Hazard					
DOLLY VARDEN	WHOLE, WET	ALUMINUM	SWEEPCREEK/722	151	ppm	1353.0000	N	1.0E+00	2.606E-01	No Hazard					
DOLLY VARDEN	ALL,WET	AROCLOR 1260	SWEEPCREEK/723	0.226	ppm	0.0016	C	2.0E-05	3.901E-04	EXCEEDS	1.672E-04	2	3.344E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	WHOLE, WET	AROCLOR 1260	SWEEPCREEK/724	0.226	ppm	0.0016	C	2.0E-05	3.901E-04	EXCEEDS	1.672E-04	2	3.344E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	FILLET, WET	AROCLOR 1260	SWEEPCREEK/725	0.149	ppm	0.0016	C	2.0E-05	2.572E-04	EXCEEDS	1.102E-04	2	2.204E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	ALL,WET	ARSENIC	SWEEPCREEK/726	5.02	ppm	0.0021	C	3.0E-04	8.665E-03	EXCEEDS	3.713E-03	1.5	5.570E-03	EXCEEDS	No Adverse Effect
DOLLY VARDEN	WHOLE, WET	ARSENIC	SWEEPCREEK/727	5.02	ppm	0.0021	C	3.0E-04	8.665E-03	EXCEEDS	3.713E-03	1.5	5.570E-03	EXCEEDS	No Adverse Effect
DOLLY VARDEN	FILLET, WET	ARSENIC	SWEEPCREEK/728	0.0937	ppm	0.0021	C	3.0E-04	1.617E-04	No Hazard	6.931E-05	1.5	1.040E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	ALL,WET	CHROMIUM	SWEEPCREEK/729	0.443	ppm	2000.0000	N	1.5E+00	7.646E-04	No Hazard	3.277E-04				
DOLLY VARDEN	WHOLE, WET	CHROMIUM	SWEEPCREEK/730	0.443	ppm	2000.0000	N	1.5E+00	7.646E-04	No Hazard	3.277E-04				
DOLLY VARDEN	FILLET, WET	CHROMIUM	SWEEPCREEK/731	0.23	ppm	2000.0000	N	1.5E+00	3.970E-04	No Hazard	1.701E-04				
DOLLY VARDEN	ALL,WET	DIELDRIN	SWEEPCREEK/732	0.00087	ppm	0.0002	C	5.0E-05	1.502E-06	No Hazard	6.436E-07	16	1.030E-05	No Hazard	No Adverse Effect
DOLLY VARDEN	FILLET, WET	DIELDRIN	SWEEPCREEK/733	0.00087	ppm	0.0002	C	5.0E-05	1.502E-06	No Hazard	6.436E-07	16	1.030E-05	No Hazard	No Adverse Effect
DOLLY VARDEN	ALL,WET	LEAD	SWEEPCREEK/734	1.3	ppm			8.9E-04	2.244E-03	EXCEEDS	9.616E-04				
DOLLY VARDEN	WHOLE, WET	LEAD	SWEEPCREEK/735	1.3	ppm			8.9E-04	2.244E-03	EXCEEDS	9.616E-04				
DOLLY VARDEN	ALL,WET	PCBs	SWEEPCREEK/736	0.226	ppm	0.0016	C	2.0E-05	3.901E-04	EXCEEDS	1.672E-04	2	3.344E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	WHOLE, WET	PCBs	SWEEPCREEK/737	0.226	ppm	0.0016	C	2.0E-05	3.901E-04	EXCEEDS	1.672E-04	2	3.344E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	FILLET, WET	PCBs	SWEEPCREEK/738	0.149	ppm	0.0016	C	2.0E-05	2.572E-04	EXCEEDS	1.102E-04	2	2.204E-04	EXCEEDS	No Adverse Effect

ATSDR selected contaminants for this table based on it relative hazard and ability to bioaccumulate or bioconcentrate. This is not the complete data set.

ATSDR used the Alaska Department of Environmental Conservation, IDM Consulting 1997, Establishing Alaska Specific ExposureScenarios for ingestion of marine (nonsalmon) fish at 126 g/day and shellfish at 38 g/day shellfish

ATSDR used EPA Reference Dose for all chemicals excluding lead. For lead ATSDR used a calculated refercence dose specific to this document based on scientific literature and EPA's IEUBK model for lead uptake.

LOAEL for PCBs (total Arochlors) 0.001 mg/kd/day
LOAEL for Arsenic is 0.005 mg/kd/day

This table does not include the 1999 and 2000 annual monitoring data for PCB analysis because only summary data was provided to ATSDR.
PCB data from 1999 and 2000 showed lower levels than those presented here.

Table 5 - Clam Lagoon and Lake Andrew Resident Fish and Shellfish Exposure Estimates

Biota Type	Biota Portion	Contaminant	Location	Maximum Contaminant Value	Units	Fish RBC (mg/kg)	Effect	EPA Reference Dose (mg/kg/d)	Estimated Noncancer Dose (mg/kg/day)	ATSDR Conclusion for NonCancerous Health Effects	Estimated Cancer Dose (mg/kg/day)	Cancer Slope Factor	Cancer Risk Estimate	ATSDR Conclusion for Cancer Risk	Lowest Observed Adverse Effect Level (mg/kg/day)
DOLLY VARDEN	ALL,WET	ALUMINUM	ANDREWLK/101	132	ppm	1353.000000	N	1.0E+00	2.278E-01	No Hazard					
DOLLY VARDEN	WHOLE, WET	ALUMINUM	ANDREWLK/101	132	ppm	1353.000000	N	1.0E+00	2.278E-01	No Hazard					
DOLLY VARDEN	ALL,WET	AROCLOR 1260	ANDREWLK/101	0.0166	ppm	0.001600	C	2.0E-05	2.865E-05	EXCEEDS	1.228E-05	2	2.456E-05	No Hazard	
DOLLY VARDEN	WHOLE, WET	AROCLOR 1260	ANDREWLK/101	0.0166	ppm	0.001600	C	2.0E-05	2.865E-05	EXCEEDS	1.228E-05	2	2.456E-05	No Hazard	
DOLLY VARDEN	ALL,WET	ARSENIC	ANDREWLK/101	0.0582	ppm	0.002103	C	3.0E-04	1.005E-04	No Hazard	4.305E-05	1.5	6.458E-05	No Hazard	
DOLLY VARDEN	WHOLE, WET	ARSENIC	ANDREWLK/101	0.0582	ppm	0.002103	C	3.0E-04	1.005E-04	No Hazard	4.305E-05	1.5	6.458E-05	No Hazard	
DOLLY VARDEN	ALL,WET	CHROMIUM	ANDREWLK/101	0.25	ppm	2000.000000	N	1.5E+00	4.315E-04	No Hazard	1.849E-04				
DOLLY VARDEN	WHOLE, WET	CHROMIUM	ANDREWLK/101	0.25	ppm	2000.000000	N	1.5E+00	4.315E-04	No Hazard	1.849E-04				
DOLLY VARDEN	ALL,WET	DIELDRIN	ANDREWLK/101	0.000352	ppm	0.000200	C	5.0E-05	6.076E-07	No Hazard	2.604E-07	16	4.166E-06	No Hazard	
DOLLY VARDEN	WHOLE, WET	DIELDRIN	ANDREWLK/101	0.000352	ppm	0.000200	C	5.0E-05	6.076E-07	No Hazard	2.604E-07	16	4.166E-06	No Hazard	
DOLLY VARDEN	ALL,WET	PCBs	ANDREWLK/101	0.0166	ppm	0.001600	C	2.0E-05	2.865E-05	EXCEEDS	1.228E-05	2	2.456E-05	No Hazard	
DOLLY VARDEN	WHOLE, WET	PCBs	ANDREWLK/101	0.0166	ppm	0.001600	C	2.0E-05	2.865E-05	EXCEEDS	1.228E-05	2	2.456E-05	No Hazard	
DOLLY VARDEN	ALL,WET	AROCLOR 1260	ANDREWLK/102	0.0764	ppm	0.001600	C	2.0E-05	1.319E-04	EXCEEDS	5.652E-05	2	1.130E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	FILLET, WET	AROCLOR 1260	ANDREWLK/102	0.0764	ppm	0.001600	C	2.0E-05	1.319E-04	EXCEEDS	5.652E-05	2	1.130E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	ALL,WET	ARSENIC	ANDREWLK/102	0.0555	ppm	0.002103	C	3.0E-04	9.579E-05	No Hazard	4.105E-05	1.5	6.158E-05	No Hazard	
DOLLY VARDEN	FILLET, WET	ARSENIC	ANDREWLK/102	0.0555	ppm	0.002103	C	3.0E-04	9.579E-05	No Hazard	4.105E-05	1.5	6.158E-05	No Hazard	
DOLLY VARDEN	ALL,WET	DIELDRIN	ANDREWLK/102	0.000259	ppm	0.000200	C	5.0E-05	4.470E-07	No Hazard	1.916E-07	16	3.065E-06	No Hazard	
DOLLY VARDEN	FILLET, WET	DIELDRIN	ANDREWLK/102	0.000259	ppm	0.000200	C	5.0E-05	4.470E-07	No Hazard	1.916E-07	16	3.065E-06	No Hazard	
DOLLY VARDEN	ALL,WET	PCBs	ANDREWLK/102	0.0764	ppm	0.001600	C	2.0E-05	1.319E-04	EXCEEDS	5.652E-05	2	1.130E-04	EXCEEDS	No Adverse Effect
DOLLY VARDEN	FILLET, WET	PCBs	ANDREWLK/102	0.0764	ppm	0.001600	C	2.0E-05	1.319E-04	EXCEEDS	5.652E-05	2	1.130E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	ARSENIC	CLAMLG/620	1.57	ppm	0.002103	C	3.0E-04	8.173E-04	EXCEEDS	3.503E-04	1.5	5.254E-04	EXCEEDS	No Adverse Effect
MUSSEL	ALL,WET	CADMIUM	CLAMLG/620	1.7	ppm	1.351851	N	1.0E-03	8.849E-04	No Hazard	3.793E-04				
SAND LANCE	ALL,WET	AROCLOR 1260	CLAMLG/640	0.0082	ppm	0.001600	C	2.0E-05	1.415E-05	No Hazard	6.066E-06	2	1.213E-05	No Hazard	
SAND LANCE	ALL,WET	ARSENIC	CLAMLG/640	0.564	ppm	0.002103	C	3.0E-04	9.735E-04	EXCEEDS	4.172E-04	1.5	6.258E-04	EXCEEDS	No Adverse Effect
SAND LANCE	ALL,WET	CHROMIUM	CLAMLG/640	0.334	ppm	2000.000000	N	1.5E+00	5.765E-04	No Hazard	2.471E-04				
SAND LANCE	ALL,WET	PCBs	CLAMLG/640	0.0082	ppm	0.001600	C	2.0E-05	1.415E-05	No Hazard	6.066E-06	2	1.213E-05	No Hazard	

ATSDR selected contaminants for this table based on it relative hazard and ability to bioaccumulate or bioconcentrate. This is not the complete data set.

ATSDR used the Alaska Department of Environmental Conservation, IDM Consulting 1997, Establishing Alaska Specific ExposureScenarios for ingestion of marine (nonsalmon) fish at 126 g/day and shellfish at 38 g/day shellfish

ATSDR used EPA Reference Dose for all chemicals excluding lead. For lead ATSDR used a calculated refercence dose specific to this document based on scientific literature and EPA's IEUBK model for lead uptake.

LOAEL for PCBs (total Arochlors) 0.001 mg/kd/day
LOAEL for Arsenic is 0.005 mg/kd/day

This table does not include the 1999 and 2000 annual monitoring data for PCB analysis because only summary data was provided to ATSDR.
PCB data from 1999 and 2000 showed lower levels than those presented here.

APPENDIX A - ATSDR Public Health Assessment Conclusion Categories

Category	Definition	Criteria
A. Urgent public health hazard	This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.	• evidence exists that exposures have occurred, are occurring, or are likely to occur in the future**AND** • estimated exposures are to a substance(s) at concentrations in the environmentthat, upon **short-term exposures**, can cause adverse health effects to any segment of the receptor population **AND/OR** • community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention **AND/OR** • physical hazards at the site pose an imminent risk of physical injury
B. Public health hazard	This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.	• evidence exists that exposures have occurred, are occurring, or are likely to occur in the future **AND** • estimated exposures are to a substance(s) at concentrations in the environment that, upon **long-term exposures**, can cause adverse health effects to any segment of the receptor population **AND/OR** • community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention
C. Indeterminate (potential) public health hazard	This category is used for sites with incomplete information.	• limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects; data or information are not available for all environmental media to which humans may be exposed **AND** • there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health
D. No apparent public health hazard	This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.	• exposures do not exceed an ATSDR chronic MRL or other comparable value **AND** • data are available for all environmental media to which humans are being exposed **AND** • there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health
E. No public health hazard	This category is used for sites that do not pose a public health hazard.	• no evidence of current or past human exposure to contaminated media **AND** • future exposures to contaminated media are not likely to occur **AND** • there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health

Adak Island, Alaska

BERING SEA

Mt. Adagdak

Andrew Bay

Sitkin Sound

Andrew Lake

Mt. Moffett

Clam Lagoon

Downtown Area

Kuluk Bay

Shagak Bay

Sweeper Cove

Little Thumb Bay

Finger Bay

Thumb Bay

Mt. Reed

Expedition Harbor

Military Reservation Boundary

Legend

- Road
- Elevation Contour
- Water Body
- Downtown Area
- Remote Area

0.5 0 0.5 1 1.5 2 Miles

General Vicinity Map
Adak Naval Air Facility

Adak Island, Alaska

CERCLIS No. AK4170024323

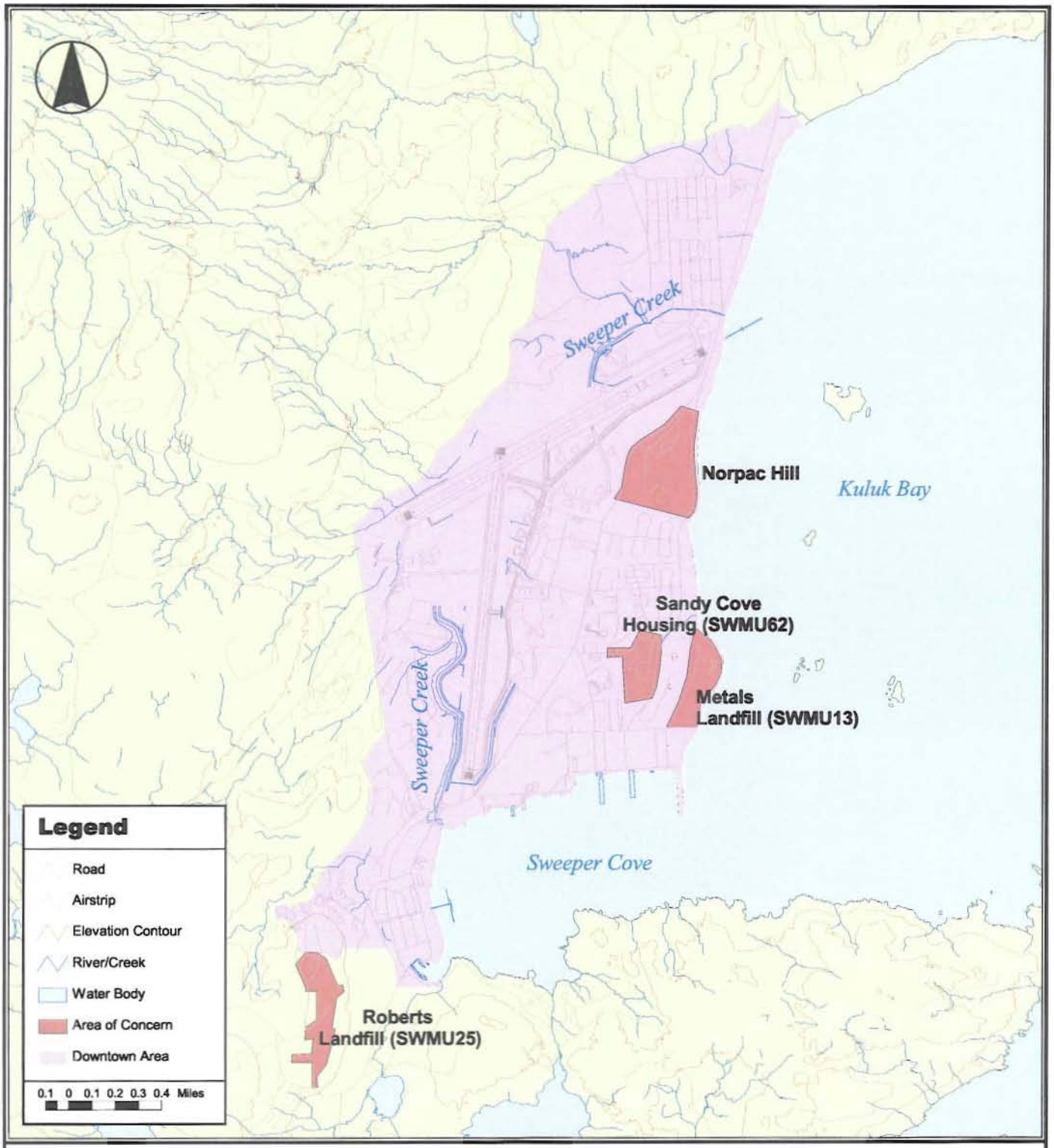
VICINITY MAP

Source: Foster Wheeler Consulting

Aleutian Islands County, Alaska

SAAGIS

ALD06142000



Downtown Areas of Concern
Adak Naval Air Facility

Adak Island, Alaska

CERCLIS No. AK4170024323

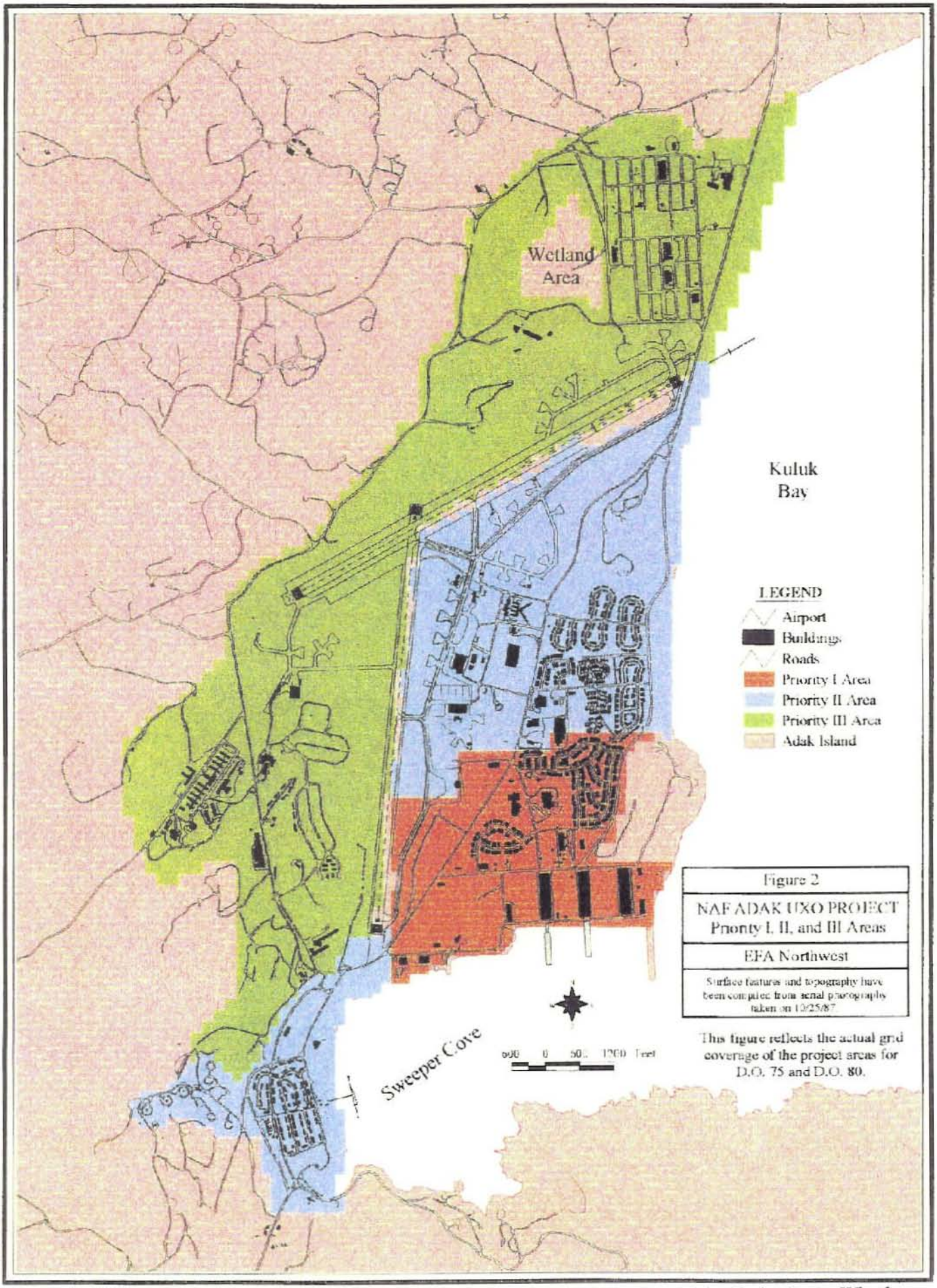
VICINITY MAP

Source: Foster Wheeler Consulting

Aleutian Islands County, Alaska

SAAGIS

ALD06142000



Source: Unexploded Ordnance Investigation Summary Report, Naval Air Facility, Adak, Alaska. Foster Wheeler Environmental Corporation, Anchorage, Alaska, October 16, 1998