Health Consultation

NORTHEAST CAPE FORMERLY USED DEFENSE SITE (FUDS)

ST. LAWRENCE ISLAND, ALASKA

EPA FACILITY ID: AKD981765984

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Community Health and Hazard Assessment
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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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HEALTH CONSULTATION

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Prepared By:

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Summary

INTRODUCTION	The Native Village of Savoonga (NVS) requested the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate human exposure to chemicals at the Northeast Cape Formerly Used Defense Site (FUDS), identify potential health impacts, and advise the NVS on actions needed to reduce exposures, if necessary. The site is a former military surveillance and communications station located on St. Lawrence Island, Alaska. While the site is currently used as a seasonal fishing camp, it formerly supported a community of tribal members who later relocated to Savoonga. Members of the NVS would like to re-establish a Native Village of Northeast Cape in the future. ATSDR used environmental data collected by the NVS, US Army Corps of Engineers, Alaska Community Action on Toxics, Alaska Division of Public Health, and input from Tribal officials and community members to evaluate several exposure scenarios.
CONCLUSIONS	ATSDR recognizes the many health benefits that come from Tribal members continuing their traditional practices, including fishing, harvesting, and eating natural foods from the traditional seasonal fishing and hunting grounds at Northeast Cape. Therefore, we assessed possible exposures associated with substances detected in environmental samples collected at Northeast Cape using protective, yet reasonable exposure assumptions to draw these conclusions:
Conclusion 1	Eating fish from Northeast Cape in the summer for three months in the past was not expected to harm people's health because contaminant levels were too low to cause harm if eaten as suggested by the Tribe. The data are too limited to evaluate long-term exposures to the variety of fish available.
Basis for Conclusion	The levels of contaminants measured in fish collected in 2001 from the estuary are not expected to be harmful if eaten for three months a year. Contaminants were measured in egg, head and fillet samples of blackfish, Dolly Varden, char and pink salmon. Blackfish are not eaten, but the polychlorinated biphenyls (PCBs) levels were low enough to not be harmful. However, blackfish, an indicator species, had PCBs; therefore, more information is needed to estimate risks from eating species of fish other than those reported here.
Next Steps	Though blackfish are not a preferred fish and, therefore, are not eaten by Tribal members, these very small fish are found in the estuary and upstream. More recent data show them to be contaminated with PCBs. If Northeast Cape becomes a year-round community in the future,

	ATSDR recommends collecting additional edible fish samples and analyzing exposure over 12 months, versus the three months examined in this health consultation. These fish should be collected from multiple sites at Northeast Cape, analyzed for chemicals of concern, and the fish should be determined to be resident or anadromous
Conclusion 2	Eating greens and berries from Northeast Cape year-round in the past was not expected to harm people's health. The data are too limited to evaluate long-term exposures to the variety of plants available.
Basis for Conclusion	The concentration of chemicals analyzed did not exceed our non-cancer health effects Minimal Risk Levels (MRL) for ingestion. Additionally, theoretical cancer doses and lifetime cancer risks were calculated and showed a low additional cancer risk. There were very few plant samples analyzed and, except for berries, the analysis included plant parts that are not edible along with the edible portions; therefore, these conclusions may not accurately represent the actual risk from eating greens and berries from Northeast Cape.
Next Steps	ATSDR recommends that Tribal members discard outer leaves of greens (if possible), wash hands well after harvesting plants from the soil, and thoroughly rinse plants before eating or processing them to reduce their potential risk. If Northeast Cape becomes a year-round community in the future, ATSDR recommends collecting additional edible plant samples.
Conclusion 3	Accidentally ingesting soil for the half of the year that the soil is exposed and drinking Suqitughneq (Suqi) River surface water year-round, are not expected to harm people's health.
Basis for Conclusion	Contaminant levels in soil (pre- or post-remediation) or Suqi River surface water are too low to be harmful.
Next Steps	If Northeast Cape becomes a year-round community in the future, ATSDR recommends collecting and analyzing additional Suqi River surface water samples for all water quality parameters before the river is used as a permanent and continuous drinking water source.
Conclusion 4	ATSDR asked the Alaska Department of Health and Social Services (ADHSS) to analyze their databases and obtain the number of birth defects and cancer cases for Gambell and Savoonga. They found that cancer rates in Savoonga and Gambell were higher than expected (when combined) due to lung cancer. Birth defect rates were not significantly different from rates in the entire Southwest Alaska Region. Therefore, there is little evidence that exposures from Northeast Cape are contributing to cancer and birth defect rates.

Basis for Conclusion	ADHSS found that lung cancer was by far the most common type of cancer death (from 1996 – 2013), accounting for 45% of all cancer deaths (the statewide average for Alaska Native people is 28%). As tobacco use is the greatest risk factor for lung cancer, the smoking prevalence for St. Lawrence Island was reviewed and found to be more than twice the state average, with an estimated 53.4% of adults being current smokers. The cases of birth defects among St. Lawrence Island communities during 1996 through 2011 are not statistically different from the entire Southwest Region of Alaska.
Next Steps	St. Lawrence Island residents are encouraged to stop smoking. ADHSS will work with the community of Gambell to continue examining the prevalence of cancer and birth defects for the more recent years. The next ADPH report will include an update from the prevalence study to include the most current data available.
FOR MORE INFORMATION	If you have questions or comments, you can call ATSDR toll-free at 1-800-CDC-INFO and ask for information on the Northeast Cape site. Detailed information about the toxicology of arsenic is available ATSDR's Toxicological Profile and Addendum for arsenic at https://www.atsdr.cdc.gov/ToxProfiles/tp2.pdf and https://www.atsdr.cdc.gov/toxprofiles/Arsenic_addendum.pdf; the Toxicological Profile for polychlorinated biphenyls (PCBs) is available at https://www.atsdr.cdc.gov/ToxProfiles/tp17.pdf; and the Toxicological Profile for polycyclic aromatic hydrocarbons (PAHs) is available at https://www.atsdr.cdc.gov/ToxProfiles/tp69.pdf.

Purpose and Health Issues

In October 2011, the President of the Native Village of Savoonga requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct a public health assessment or health consultation on the Formerly Used Defense Sites (FUDS) of Gambell and Northeast Cape on St. Lawrence Island. The President requested that ATSDR assess health implications from these FUDS, as well as levels of globally deposited persistent organic pollutants and all sources of toxic exposures that Arctic Indigenous Peoples are disproportionately exposed to (NVS 2011). ATSDR determined that there were data available to evaluate exposures to contaminants at the Northeast Cape and Gambell FUDS, regardless of the origin of the source of those contaminants, to make appropriate recommendations to reduce or eliminate the exposures. In the 2012 response letter, ATSDR noted that it would not be possible to definitively determine exposures from the global transport and deposition of pollutants in the environment (ATSDR 2012a).

In February 2012, ATSDR agreed to conduct two health consultations. These health consultations focus on assessing the available data to determine whether exposure to contaminants from the Gambell or Northeast Cape sites may be harmful to St Lawrence Island residents. The focus of this health consultation, initiated in April 2014, is the Northeast Cape FUDS. This health consultation adds new data and evaluation to a previous evaluation of the same area published in 2006 entitled, "Polyaromatic Hydrocarbons and Polychlorinated Biphenyls in Fish from the Suqitughneq River" (ATSDR 2006).

Background

Site Description and History

Northeast Cape is located on St. Lawrence Island in the Bering Sea, approximately 135 miles southwest of Nome, Alaska (see Figure 1). It is the site of former military surveillance and White Alice communications stations, which operated from about 1954 to 1972. The Northeast Cape FUDS is approximately 4,800 acres or 7.5 square miles and is bounded by Kitnagak Bay to the northeast, Kangighsak Point to the northwest, and the Kinipaghulghat Mountains to the south (Shannon & Wilson 2005). Currently, the Native Village of Northeast Cape (NVNC) is mainly used by the residents of the Native Village of Savoonga (NVS) as a traditional summertime fishing, hunting, and food-gathering camp. It is also used as a rest stop to wait out storms (NVS IRA Council 2012). The area formerly supported the NVNC before tribal members relocated to Savoonga.

Demographics

The nearest community to the Northeast Cape site is Savoonga, approximately 60 miles to the northwest. There are currently no year-round residents in the vicinity of the Northeast Cape FUDS; however, people lived in the NVNC in the past. Residents of St. Lawrence Island would like to reestablish a community at Northeast Cape in the future. Seasonal dwellings on Kitnagak Bay, at the end of Cargo Beach Road (see Figure 2), are used for subsistence hunting, gathering, and fishing during the summer months (Shannon & Wilson 2005). The NVNC site and surrounding areas are owned in common by Sivuqaq, Inc. and Kukulget, Inc., which consist of Tribal members of the Native Village of Savoonga and the Native Village of Gambell (NVS IRA Council 2009).

Remedial and Cleanup Activity

In recent years there have been many removal actions and remedial activities at Northeast Cape (see Table 1). Between 1994 and 2004, four remedial investigations evaluated 34 specific locations on the site and found contaminants at some, but not all, locations (USACE 2009). In September 2006, the Department of Defense (DoD) signed a "Project Closure Report" and "No DoD Action Indicated" for containerized hazardous, toxic, and radioactive waste (CON/HTRW) at the Northeast Cape FUDS (USACE 2006). The US Army Corps of Engineers (USACE) released a Decision Document in 2009, which presented the selected remedies for the 34 sites at Northeast Cape (USACE 2009). Since then, USACE has been implementing the selected remedial actions at each of the identified sites (see USACE 2016 for a summary).

The NVS conducted several cleanup actions at the Fish Camp area of concern in Northeast Cape. In December 2009, the NVS published a Site Investigation Report that focused on sampling and screening of building materials in July 2009 for the presence of asbestos-containing materials and lead-based paint (NVS IRA Council 2009). In April 2012, the NVS published a Removal Action Report detailing several actions including the removal of asbestos-containing materials and wood painted with lead-based paint, on-site burning of non-painted wood debris, staging and containment of suspect CON/HTRW, and staging of metallic and non-burnable debris for removal later. These activities took place between August and October 2011 (NVS IRA Council 2012).

In January 2013, the NVS published a Removal Action/Site Investigation (RA/SI) Report detailing removal and burning of remaining non-painted wood debris; and removal of wastes previously staged or contained (i.e., scrap metal and non-burnable debris, lead-contaminated burner ash, wood debris containing lead-based paint, and CON/HTRW). The site investigation concluded that contaminants such as diesel-range organics (DRO), residual-range organics (RRO), polycyclic aromatic hydrocarbons (PAHs), arsenic, cadmium, chromium, lead, and polychlorinated biphenyls (PCBs) were present, although not widespread, in soil, sediment, and surface water. This report contained PCB congener-specific soil data, which was evaluated for this health consultation. The RA/SI Report recommended additional RA/SI activities for the Northeast Cape site to further investigate, abate, and remove remaining environmental hazards (NVS IRA Council 2013).

Figure 1. Location of Northeast Cape Formerly Used Defense Site (FUDS) on St. Lawrence Island, AK

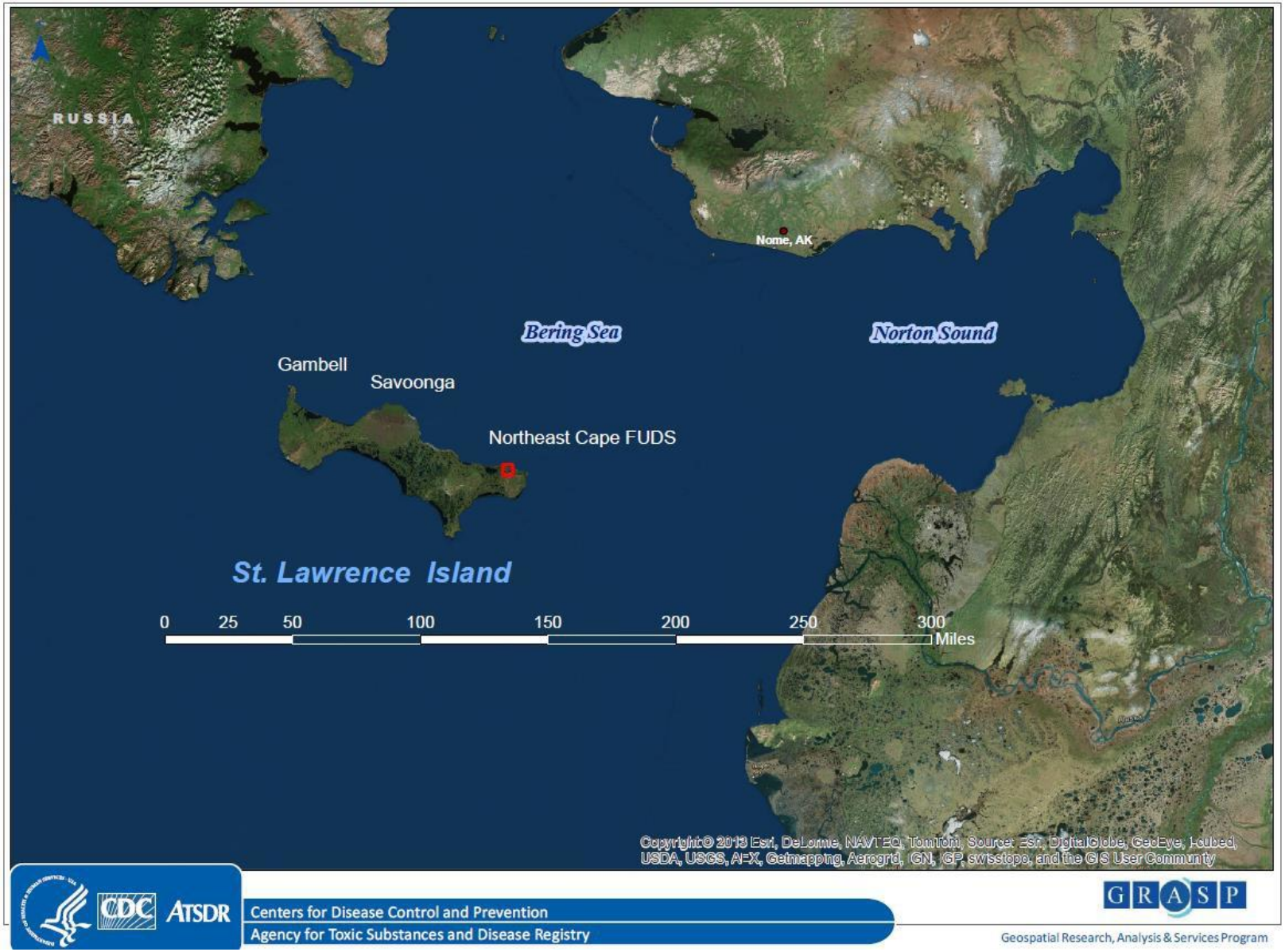


Figure 2. General Map of the Northeast Cape FUDS, St. Lawrence Island, Alaska

Table 1. Removal Actions and Remedial Activities at Northeast Cape FUDS

Year	Activity
1990	The Navy and a contractor removed transformers, drums, tanks, fire extinguishers, and other containerized hazardous wastes.
1994	Contractor removed all electrical transformers and their contents from Northeast Cape.
1999	Contractor demolished buildings, removed debris (60 tons) and containerized hazardous and toxic wastes, cleaned above ground storage tanks, and removed a fuel pipeline.
2001	Contractor cleaned above ground storage tanks, decommissioned underground storage tanks, demolished and packaged 3,303 tons of building debris, excavated PCB- and petroleum/oil/lubricant (POL)-contaminated soil, and decommissioned potable water wells. Demolished about half of the buildings in the Air Force Station main operations area.
2003	Contractor demolished and removed the remaining buildings and other structures; removed or decommissioned drums and tanks of hazardous waste; gathered power and communication poles, wires, and cables for disposal; and transported fuel lines off-island. Shipped over 5,000 tons of waste and debris off-island for disposal.
2005	Contractor demolished and removed the tramway towers and wire; and removed metal and wooden poles, power and communications wire and cable, 26 tons of debris from Kangukhsam Mountain, and PCB-contaminated concrete and soil. Shipped 1,500 tons of waste and debris off-island for disposal.
2009	Contractor constructed a landfill cap; removed POL-containing drums; and performed a chemical oxidation study.
2010	Contractor excavated POL-, PCB-, and arsenic-contaminated soil; capped a landfill; collected soil, groundwater, and surface water samples; hauled debris off-island for disposal; and monitored a site for natural attenuation.
2011	Contractor excavated diesel range organic- (DRO-), PCB-, and arsenic- contaminated soil; collected additional soil, sediment, and groundwater samples; and removed 34 tons of metal and miscellaneous debris.
2012	Contractor removed POL-, PCB-, arsenic-, ethylene glycol-, and tetrachloroethene (PCE)-contaminated soil; removed over 1,000 gallons of liquid from drums, 15 tons of debris, and 158 poles; decommissioned six monitoring wells; and collected soil samples along the radar dome road.
2013	Contractor removed POL- and arsenic-contaminated soil, contaminated soil and sediment, drums, and pole stumps; abandoned 12 monitoring wells.
2014	Contractor removed PCB-, arsenic-, and POL-contaminated soil, debris, and tar and tar-contaminated soil; abandoned two monitoring wells, reconditioned eight monitoring wells, and installed seven new monitoring wells; excavated two test pits; and collected surface water and soil samples.

Source: USACE 2009, 2011, 2013a, 2013b, 2016

ATSDR Site Visits and Community Outreach

Native Village of Savoonga Tribal Council President Ronnie Toolie wrote, "ATSDR needs to learn what people on our island know about FUDS and what concerns they may have about the sites' impact on the health of our Yupik people," in the petition letter he sent to ATSDR in October 2011. ATSDR visited St. Lawrence Island seven times, including visits to Savoonga twice before receiving the petition, and five times after receiving the petition. The description of the visits after receiving the petition are as follows:

- The first site visit was in March 2013. The health education specialist from ATSDR's field office in Seattle, Washington and the regional representative from Anchorage, Alaska traveled to Savoonga and Gambell to meet with community members and gather community knowledge and concerns regarding the FUDS at Northeast Cape and Gambell.
- A second site visit was conducted in August 2013 by the lead health assessor from ATSDR headquarters in Atlanta, Georgia and the regional representative from Anchorage, Alaska. During this visit, ATSDR representatives toured Northeast Cape to see the remaining portions of the FUDS and gather firsthand knowledge from tribal members who were present when the sites were in operation. ATSDR also held community meetings to explain its plans, and to continue to gather any additional knowledge and concerns from Savoonga residents regarding the potential exposures to contaminants from the Northeast Cape FUDS.
- A third site visit occurred in September 2014. ATSDR regional representative, Alaska Office, and preventive medicine physician, Centers for Disease Control and Prevention (CDC), visited the villages of Savoonga and Gambell. The main purpose was to describe and discuss the State Cancer Registry studies for Savoonga and Gambell. In addition, the team wanted to gather knowledge from the people on the occurrence of cancer in the communities. They met with Angie Gorn, CEO/Executive Director of the Norton Sound Health Corporation (NSHC) and the health corporation board to discuss cancer incidence on St. Lawrence Island and cancer prevention outreach to the villages.
- A fourth visit to the villages of Savoonga and Gambell took place in September 2015. The lead health assessor from ATSDR headquarters in Atlanta, Georgia and the regional representative from Anchorage, Alaska met with the tribal council of Savoonga and tribal members to present the preliminary findings of ATSDR's draft of the Northeast Cape health consultation.
- A fifth visit to Gambell and Savoonga took place in July 2017. The ATSDR Regional Representative, Alaska Office and the ATSDR Region 10 Director presented a summary of findings from the public comment draft of this Northeast Cape health consultation to the tribal council and people of Savoonga.

In addition to the village visits, ATSDR was an active participant in the St. Lawrence Island Dialogue Group (2012-2013). This group was convened by the Environmental Protection Agency (EPA) and facilitated by a public policy mediator. It brought together the villages, non-governmental organizations, and government agencies in an effort to find common ground to address the former military sites contaminant impacts.

In response to the knowledge and health concerns expressed by community members of Gambell and Savoonga, ATSDR convened the St. Lawrence Island Healthcare and Public Health Providers Working Group (2013-2014). The Working Group's primary goal was to coordinate the public health and healthcare response to community concerns regarding the impact of contaminants on health. The co-facilitators for the group were Joe Sarcone, ATSDR Regional Representative, Alaska Office and Vi Waghiyi, tribal member Native Village of Savoonga and Environmental Health & Justice Program Director, Alaska Community Action on Toxics (ACAT).

Community Health Concerns

Members of the Native Village of Savoonga who use Northeast Cape as a seasonal fishing and hunting village have several health concerns. People described local knowledge and concerns about cancer, heart disease, stroke, thyroid disease, immune system disorders, and negative birth outcomes such as miscarriages, stillbirth, low birth weight, and birth defects. Tribal members are also concerned about radiation at Northeast Cape.

The village is very remote and there is limited healthcare available on St. Lawrence Island. Tribal members would like to see expanded healthcare services on St. Lawrence Island. The Norton Sound Health Corporation is partnering with the Tribe to improve early detection and treatment of common cancers such as lung, colorectal, breast, and prostate. Residents are concerned because some scientific literature suggests that Tribal members from the Village of Savoonga previously living at, or still visiting, Northeast Cape are more at risk for developing cancer (Hoover et al. 2012). In addition, some biomonitoring studies suggest that some Savoonga residents visiting Northeast Cape have higher levels of PCBs in their blood (Carpenter et al. 2005, Miller et al. 2013). Tribal members believe their exposures to contamination from the former military site at Northeast Cape contributed to, or will contribute to, these cancers. The Health Outcome Data Analysis section below details what is known about cancer and birth defects on St. Lawrence Island.

Since 2000, residents of the Native Villages of Savoonga and Gambell have partnered with the non-profit Alaska Community Action on Toxics (ACAT) and academic researchers through a series of federally funded community-based participatory research activities at Northeast Cape and Gambell. The activities have been directed by the SLI Working Group, established in 2011, which includes community leaders, parents, elders, youth, and community health professionals. The publications that have emerged from these partnerships report on source contamination, exposures, and potential impacts on health of the Yupik community living on St. Lawrence Island. Through their research, ACAT believes that exposures from the military sites are still occurring and have affected multiple generations. ACAT would like to see ATSDR employ the precautionary principle like some countries in the European Union, rather than retain the uncertainty in the scientific paradigm which US agencies are more prone to use.

Discussion

ATSDR's public health evaluations are driven by exposure to, or contact with, environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure.* People can only be exposed to a contaminant if they come into contact with that contaminant—if they breathe, eat, drink, or have skin contact with a substance containing the contaminant. If no one comes into contact with a contaminant, then no exposure occurs, and thus no health effects could occur.

Often the general public does not have access, or has limited access, to the source area of contamination or areas where contaminants are moving through the environment. This lack of access to these areas becomes important in determining whether people could come into contact with the contaminants. Northeast Cape is located in a very remote area of St. Lawrence Island which is 60 miles from the closest residence and only visited by a few families who utilize fishing camps in the summer (see demographics).

The route of a contaminant's movement to a point of exposure is the pathway. ATSDR identifies and evaluates exposure pathways by considering how people might come into contact with a contaminant. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical contaminant. There are five pathways of exposure directly addressed in this assessment; four of them are possible if the community were to live at the Northeast Cape site (Table 2). These pathways are addressed along with the most significant chemicals of concern are addressed in the next section.

Chemicals of Concern

When the Department of Defense abandoned the Northeast Cape installation in the 1970s, members of NVNC utilized building materials—including lumber, paint, wiring, and insulation—left by the military. At the time, people were not aware of the potential danger posed by some of the materials, which are now known to contain asbestos and/or lead-based paint (NVS IRA Council 2009). Much of the material was reused as building material for homes.

Contamination from polychlorinated biphenyls (PCBs), petroleum-based fuels, volatile organic compounds (VOCs), pesticides, heavy metals, and polycyclic aromatic hydrocarbons (PAHs) has also been identified at Northeast Cape (NVS IRA Council 2012). In addition to contamination by operations at the site, approximately 180,000 gallons of diesel fuel spilled in 1969, impacting the nearby Suqi River drainage (ATSDR 2006). According to Tribal elders in Savoonga, this release impacted the health of the fishery in the surrounding vicinity which resulted in a decrease and demise of the local seal population.

In the time since the site was abandoned, media such as soil, sediment, surface water, groundwater and biota have been sampled for contaminants including VOCs, SVOCs, PAHs, metals, pesticides, herbicides, PCBs, and dioxin/furans. ATSDR reviewed all the available sampling data that met quality assurance/quality control standards. Contaminants of concern identified through the health consultation process include arsenic, PCBs, and PAHs. These chemicals were identified as contaminants of concern because they exceeded comparison values (CVs) in soil and surface water,

or health guidelines in soil, surface water and biota. In 1996, the Army Corps of Engineers conducted a radiological survey at 15 sites at Northeast Cape, including the subsistence hunting and fishing camp. The survey determined that there is no evidence of elevated radiation levels at Northeast Cape (Montgomery Watson 1999). ATSDR examined non-cancer and cancer health effects from contaminants of concern. The only effects discussed in this health consultation are those of potential health concern at Northeast Cape. Appendix B contains fact sheets with "frequently asked questions" about the contaminants of concern.

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Fish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful and has no effect on people at concentrations found in most marine fish (ATSDR 2007).

Total arsenic measurements were available for soil, fish, and plants from Northeast Cape. In this analysis, we assumed that all the arsenic found in soil was inorganic; that all the arsenic in fish was organic; and that 20% of the arsenic found in plants was inorganic (ATSDR 2007). Several studies have shown that ingestion of elevated concentrations of inorganic arsenic in drinking water can increase the risk of skin cancer and cancer of the liver, bladder, and lungs (ATSDR 2007).

PCBs are a mixture of individual chemicals that are no longer produced in the United States but are still found in the environment because they do not dissolve or degrade easily. PCBs are either oily liquids or solids that are colorless to light yellow when stored. They look like oil spills in the soil but drop to the bottom when spilled in water. Because they don't burn easily and are good insulating materials, PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. There are no known natural sources of PCBs in the environment. Some commercial PCB mixtures are known in the United States by their industrial trade name, Aroclor.

Although there is evidence for endocrine effects in humans exposed to dioxin-like PCBs, these are not the most sensitive endpoints. Immunological and developmental effects are the most sensitive endpoints; therefore, they were used to derive the MRL (ATSDR 1998, 2012b). The MRL was used as the health guideline in this health consultation and is believed to be protective of immunological and developmental endpoints, as well as less sensitive endpoints such as endocrine effects.

A few studies of workers indicate that exposure to PCBs is associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract (ATSDR 2000). Additional human studies found exposure to PCBs associated with an increased risk of non-Hodgkin's lymphoma, prostate cancer, malignant melanoma, and breast cancer (ATSDR 2011, IARC 2015). A recent study also suggests that exposure to PCBs may increase risk of cardiovascular disease (Petriello et al 2016). The International Agency for Research on Cancer (IARC) classifies PCBs as a known human carcinogen.

PAHs are a group of over 100 different chemicals that are formed during the incomplete combustion of coal, oil and gas, garbage, or other organic substances like tobacco, charbroiled meat, or grains. Some PAHs are manufactured. PAHs are found in coal tar, crude oil, creosote, and roofing tar. Some people who have breathed or touched mixtures of PAHs and other chemicals for

long periods of time have developed cancer. Some PAHs (e.g., benzo(a)pyrene) have caused cancer in laboratory animals when they ingested them in food (stomach cancer) or had them applied to their skin (skin cancer) (ATSDR 1995). Many samples are collected with the goal of evaluating contamination near potential contamination sources rather than to determine what people are most likely to be exposed to. In the absence of ideal exposure date, we used the available data that most likely represents potential exposure. The most significant chemicals of concern identified in the possible exposure pathways at Northeast Cape are summarized in the conceptual site model below (Table 2).

Environmental Media—Where contaminants are found in the environment?

ATSDR uses media-specific CVs to screen contaminants of concern in environmental media such as water, air, and soil. ATSDR develops CVs for acute (14 days or less), intermediate (15- 364 days), and chronic exposure (365 days or more). ATSDR develops CVs for non-cancer health effects, such as Environmental Media Evaluation Guides (EMEG) and Reference dose Media Evaluation Guides (RMEG), as well as Cancer Risk Evaluation Guides (CREG). Similarly, EPA develops Regional Screening Levels (RSLs), which are also considered to be protective of human health. ATSDR uses RSLs when other CVs are not available.

Contaminants with maximum values exceeding CVs were examined more closely by calculating the 95th percentile upper confidence level (UCL) of the average. These 95UCL values were used to calculate exposure doses using site-specific assumptions. The 95UCL should only be calculated for those chemicals with eight or more detected samples. If fewer than eight samples were detected, the maximum value was used to calculate exposure doses. These exposure doses were then compared to Minimal Risk Levels (MRLs).

An MRL is an ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), non-carcinogenic effects. If an exposure dose is higher than the MRL, it does not necessarily follow that harmful health effects will occur. It simply indicates to ATSDR that further evaluation is required before a conclusion can be drawn. This process enables ATSDR to weigh the available evidence in light of uncertainties and offer perspective on the plausibility of harmful health outcomes under site-specific conditions.

The MRL is based on the No Observed Adverse Effect Level (NOAEL), which is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects in people or animals; or the Lowest Observed Adverse Effect Level (LOAEL), which is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. *Estimated exposure doses less than the MRL are not considered to be of health concern; doses greater than the MRL are evaluated more closely using site-specific exposure information and the LOAEL or NOAEL to determine the likelihood for harmful effects to occur.* Cancer doses are calculated similarly to exposure doses, and are used to evaluate whether the exposure, over time, could add significantly to a person's lifetime risk of developing cancer. Cancer risk estimates are a mathematical tool that public health professionals use to determine whether recommendations are needed to protect health; they are not a measure of the actual cancer in a community and only guide public health decision making.

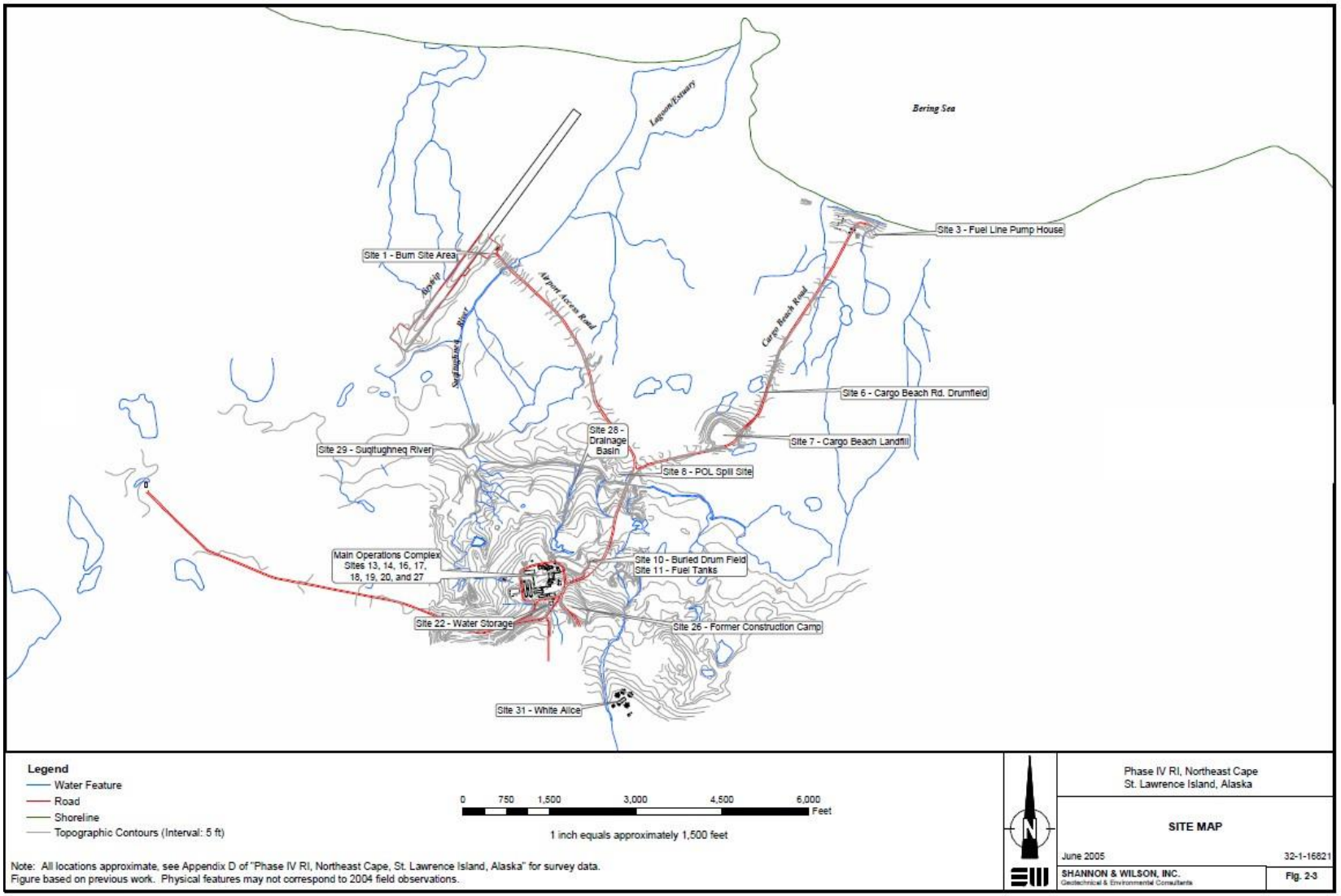
Table 2. Pathways people may be exposed to contaminants from Northeast Cape FUDS, AK

Source	Environmental Medium and Chemical(s) of Concern	Exposure Point	Exposure Route(s)	Potentially Exposed Population*	ATSDR Evaluation
Past releases of oil or chemical spills, leaching of treated wood of bridge, and migration of contaminates from soil into surface water of Suqi river	Surface water (PAHs) (data limited to chemicals and not water quality parameters)	Surface water from river may be used for drinking; however, visitors report using water upriver from the contaminated area.	Ingestion	Past and current visitors to fish camp (3 months) Future year-round resident (potential)	No harm to future residents (or visitors): Poses a very low cancer risk (from PAHs only, Table A-3) Caution using surface water source because of biological contamination. Recommend sampling to find permanent water source for future residents
Past releases of oil or chemical spills, leaching of treated wood of bridge, and migration of contaminates from soil into sediment of Suqi river	Sediment (PAHs, PCBs, metals)	Bottom of very cold river from June to October (frozen the rest of the year)	Ingestion from hand to mouth after touching bottom (highly unlikely)	Past and current visitors and future residents are not likely to ingest sediment from the bottom of very cold river	Not evaluated, pathway is incomplete; data used to evaluate potential sources

Source	Environmental Medium and Chemical(s) of Concern	Exposure Point	Exposure Route(s)	Potentially Exposed Population*	ATSDR Evaluation
Past releases of oil or chemical spills, leaching of treated wood of bridge, and migration of contaminates from soil into Suqi river	Surface water and sediment contaminates accumulating in Fish (PCBs, Arsenic, and PAHs)	Fish in Suqi river and Estuary	Ingestion of some species (unlikely for blackfish)	Past and current visitors catch and eat fish from the Suqi river estuary Future resident (potential)	No harm for past fish eaters: Poses very low cancer risk (most of risk from PCBs and PAHs, Table A-4 and Appendix C)** Current visitors likely no harm based on past evaluation. Recommend sampling fish for future resident.
Chemicals in soil as a result of past spills and migration from other sources	Soil (PCBs, Arsenic)	Topmost soil from June to October (frozen rest of year)	Ingestion	Past and current fish camp users could access and inadvertently ingest soils	No Harm: Poses a very low cancer risk (most of risk from PCBs, Table A-2)
Chemicals in soil as a result of past spills and migration from other sources	Berries, Plants (PCBs)	Topmost soil	Ingestion	Past and current visitors to fish camp eat local plants	No Harm: Poses a very low cancer risk (most of risk from PCBs, Table A-4) Recommend washing and collecting berries away from previous installations

* A few families from Savoonga and Gambell travel the 60 miles to Northeast Cape for a number of weeks. We used exposure assumptions for 3 months and up to years where possible. Fish, berries, and plants are seasonally available. Should people wish to stay longer, additional exposure data is needed.
** While people do not report eating blackfish, they do contain PCBs which may accumulate up the food chain; larger species might have more than previously sampled. Past fish sampling showed little PCB impact, but they do not represent all the possible aquatic foods.

Figure 3 Site Features at Northeast Cape FUDS, St. Lawrence Island, AK



Source: Shannon & Wilson 2005

Many environmental studies have been conducted at Northeast Cape since it was abandoned in the 1970s. In June 2005, the US Army Corps of Engineers published their Phase IV Remedial Investigation (RI) Report. This RI consisted of soil, sediment, groundwater, and surface water data collected from 15 discrete sites within the installation (see Figure 3). Samples were analyzed for gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), aromatic organic compounds (BTEX), PAHs, PCBs, pesticides, semi-volatile organic compounds, and total metals. Background samples were also collected outside the installation boundary (Shannon and Wilson 2005). None of the background concentrations exceeded ATSDR CVs.

In January 2013, the Native Village of Savoonga IRA Council published their Native Village of Northeast Cape Removal Action/Site Investigation (RA/SI) Report. This RA/SI consisted of soil, sediment, and surface water data collected from the site. Samples were analyzed for petroleum hydrocarbons, including GRO, DRO, and RRO, metals, VOCs, PAHs, PCBs, pesticides/herbicides, and dioxins/furans (NVS IRA Council 2013). ATSDR evaluated these data within this health consultation. Additional soil, sediment, and surface water samples have also been collected during the recent remedial activities.

In this health consultation, ATSDR evaluated exposures to contaminants in the surface and subsurface soil (less than 12") for half of the year and Suqi River surface water year-round, as well as from eating plants year-round, and fish in the summer. From 2010 to present, the average temperature was below freezing from November to May and the warmest month was July with an average of 48 degrees Fahrenheit. These colder temperatures may impact the direct interaction of people with land and water. More clothing and closed shoes will be worn (as opposed to going barefoot or extended bare-handed contact with the soil, sediment or water).

ATSDR prefers to use topsoil (0-3") to estimate exposures because most exposures to surface soil usually go this deep. Only soil concentrations from samples 0-12" deep were available for this evaluation. Some contaminants spilled on the surface migrate fast while others migrate slowly to the deeper soil. Therefore, the soil concentrations (0-12") may over- or under-estimate the surface soil contamination depending on the contaminant. PCBs will likely be more concentrated in the topsoil, indicating that these samples will underestimate exposure to PCBs. ATSDR evaluated a 6-month soil exposure scenario.

During key informant interviews about their exposure habits, current fish camp visitors to Northeast Cape reported little to no contact with sediment of the Suqi River. Because of the low, often below freezing temperatures and the remote location of the Suqi river, and reports of activities of the visitors, we conclude that contact with sediment would be rare and extremely unlikely. However, the sediment data is important ecologically (along with blackfish and other fish data) when evaluating fate and transport. Therefore, ATSDR did not evaluate the sediment pathway further.

The shallow tundra groundwater was never used as drinking water via wells by the Tribal members, nor is it expected to be a potential future drinking water source (USACE 2009). Contaminated groundwater in the shallow tundra is present at numerous sites in Northeast Cape which will require institutional controls (no future wells) and monitoring into the future. Therefore, shallow tundra groundwater is not evaluated in this health consultation because there is no exposure to this medium.

Tribal visitors to the fish camps at Northeast Cape use surface water as a source of drinking water. The surface water spring in the foothills of the Kangukhsam Mountain, upstream of the contaminated areas, has been used as a drinking water source in the past. Currently, Tribal members collect drinking water from the Suqi River upstream of contamination at the Main Operations Complex when spending time at Northeast Cape. As a precaution, ATSDR evaluated a worst-case, drinking water scenario for people at Northeast Cape using the contaminated areas of surface water as a drinking source year-round as travel to upstream locations for water is difficult and time consuming.

Soil

Soil from Northeast Cape contained PCBs, dioxins, arsenic, and several polycyclic aromatic hydrocarbons (PAHs) with maximum values exceeding ATSDR's lowest CVs or EPA's RSLs (see Table). CVs are substance concentrations set well below levels that are known or anticipated to result in adverse health effects. When CVs are not available, ATSDR uses RSLs to screen contaminants. 3 shows the contaminants found above CVs during the 2005 RI and 2013 RA/SI. The chemicals with 95UCL values exceeding CVs are bolded in Table . Exposure doses are calculated for contaminants with 95UCL values exceeding CVs.

Some chemicals analyzed in the soil samples collected for the RI had practical quantitation limits (PQLs), also known as detection limits, which exceeded ATSDR's lowest CVs. These included some SVOCs, PCBs, and PAHs. There is no way to know if the actual value exceeded the CV or was something much lower. The CVs that were below quantitation limits were mostly Cancer Risk Evaluation Guides (CREGs). CREGs are very conservative screening tools intended for exposure over a lifetime.

Sometimes it is not technically or practically possible for laboratory equipment to detect and quantify chemicals at levels as low as ATSDR CVs. The difference between ATSDR's CVs and the laboratory's detection limits (PQL) is a limitation of this analysis. When soil, sediment, and surface water samples are analyzed in the future, it would be helpful to set quantitation limits below ATSDR CVs whenever possible.

Exposure to soil at the site by tribal members utilizing the seasonal fishing camp is possible up to six months of the year; therefore, exposure doses were calculated for the chemicals in bold in Table 2. Aroclor 1260 was the only contaminant (and only PCB detected) in surface soil with a 95UCL concentration exceeding CVs in the 2005 RI. The Department of Health and Human Services (HHS) has classified PCBs as "reasonably anticipated to be a carcinogen" and the IARC classifies PCBs as a known human carcinogen.

We calculated the lifetime increased risk of cancer from exposure to Aroclor 1260 PCB in soil pre-remediation (Appendix A). We first calculated an exposure dose that assumed daily exposure to soil for half of the year for 60 years (from the opening of the site in 1954 to the clean-up of the site by 2014) using ATSDR's conservative, default assumptions to represent a past exposure dose. The exposure dose was then multiplied by the EPA cancer slope factor to generate the theoretical increased cancer risk estimate (see Appendix A). The calculated increased lifetime cancer risk for PCBs in soil at the site in the past was about 2 or 3 additional cancer cases in 100,000 people. ATSDR considers this a low increased lifetime risk of getting cancer above a person's background risk of 40,000 of every 100,000 people.

Table 3. Chemicals in soil exceeding ATSDR or EPA comparison values

Chemical	#detected/ #samples	Max (ppm)	95UCL (ppm)	CV (ppm)	CV Type
Total PCBs (Aroclor 1260) (2005)	9/12	50.8	**12**	0.19	CREG
Total PCBs (2013)	35/60	29	**2.7**	0.19	CREG
Dioxin-like PCBs (2,3,7,8-TCDD equivalent) (2013)	8/8	0.000023	**0.000015**	0.000003	CREG
Total HxCDD (2013)	6/8	**0.00037**	N/A	0.0001	RSL
Arsenic (2013)	33/33	42	13	16	RMEG (child)
PAHs benzo(a)pyrene equivalent (2013)	17/33	1.226	**0.261**	0.11	CREG
Dibenzo(a,h) anthracene (2013)	2/33	**0.17**	N/A	0.11	RSL

Sources: Shannon & Wilson 2005, NVS IRA Council 2013; Surface water (MWH 2002 and Shannon & Wilson 2005)
Bold values have 95UCL (or maximum if no 95UCL) which exceed the CV.
Abbreviations: **CREG**, Cancer Risk Evaluation Guide; **CV**, comparison value; **ppb,** parts per billion; **95UCL,** 95th percentile upper confidence level of the average, **N/A**, Not applicable—95UCL should not be calculated for sample sizes <8; **RSL**, Regional Screening Level; **PCBs,** polychlorinated biphenyls; **PAHs,** Polycyclic Aromatic Hydrocarbons; **HxCDD,** Hexachlorodibenzo-p-dioxin

Additionally, this cancer risk is an overestimate since only the detected PCBs were included in the calculation. These cancer risk estimates, while theoretical, indicate that health effects are unlikely and no public health actions are necessary.

Since the remedial investigation (RI), contractors have removed thousands of tons of PCB-contaminated soil and sediment from Northeast Cape (USACE 2016). Soil and sediment with concentrations greater than the cleanup level (1 ppm for soil; 0.7 ppm for sediment) have been removed from Sites 13, 16, 21, 28, and 31 (USACE 2011, 2013b; USACE 2009, 2015). The calculated lifetime increased cancer risk for PCBs in soil at the 1ppm cleanup level presents no apparent increased risk (about 3 additional cancer cases in one million people).

ATSDR reviewed post-cleanup soil data from the 2013 RA/SI. Exposure doses were calculated for the chemicals in bold in Table 2. These calculations represent current and future exposure scenarios. The calculated increased lifetime cancer risk for PCBs in soil at the site is about 5 to 7 additional cancer cases in 1,000,000 people. The calculated increased lifetime cancer risk for dioxin-like PCBs in soil at the site is about 1 to 2 additional cancer cases in 1,000,000 people, and the hazard quotient is below one for all age ranges.

The calculated increased lifetime cancer risk for total Hexachlorodibenzo-p-dioxin (HxCDD) in soil at the site is about 1 to 2 additional cancer cases in 1,000,000 people. This cancer risk was calculated with the maximum concentration, since there were not enough samples to calculate a 95UCL; therefore, this is an overestimate of the cancer risk. The calculated increased lifetime cancer risk for PAHs in soil at the site is about 2 additional cancer cases in 10,000,000 people to 1 additional cancer cases in 1,000,000 people, and the hazard quotient is well below one for all age ranges. The calculated increased lifetime cancer risk for dibenzo(a,h)anthracene in soil at the site is about 5 to 6 additional cancer cases in 1,000,000 people. All of these increased cancer risks and hazard quotients represent very low or no apparent increased risks and are within EPA's acceptable risk range.

Surface Water

Surface water samples were also taken from the Suqi River in 2001 and 2004 as part of the Phase III and IV RIs, respectively (MWH 2002; Shannon & Wilson 2005). These samples were analyzed for GROs, DROs, RROs, BTEX, PAHs, and PCBs. During remedial activities, additional surface water samples were collected from sites with surface water that flows into the Suqi River (USACE 2012, 2013b; USACE 2016). Many of these samples did not exceed Practical Quantitation Limits (PQLs), also known as detection limits. Of the contaminants detected in the Suqi River with CVs available, only benzo(a)pyrene and several other PAHs exceeded ATSDR's lowest CV.

Although Suqi River water from the area within the Main Operations Complex is not thought to be used for drinking water currently, it was reported to have been used occasionally in the past (prior to contamination). No use of this part of the Suqi River for current drinking water was reported to ATSDR by visiting community members; however, one source (Alaska Community Action on Toxics) identifies it as a drinking water source. Additionally, Tribal members would like to use it for drinking water in the future. For these reasons, the Suqi River water samples were compared to drinking water CVs. The surface water spring in the foothills of the Kangukhsam Mountain (upgradient of the Main Operations Complex) has been used as a drinking water source in the past. Currently, Tribal members collect drinking water from the Suqi River upgradient of the Main Operations Complex when spending time at Northeast Cape.

Only one of the seven Suqi River water samples had detections of PAHs that were above the detection limits (PQLs). This is insufficient number of samples to provide a reliable calculation of exposure. At least eight samples are required to calculate a 95^{th} percentile upper confidence limit (95UCL), therefore a 95UCL was not calculated, and the maximum values were used (instead) to represent a reasonable maximum (health protective) value. The sample location was downstream of the Lower Suqi Bridge.

The bridge is constructed of creosote-treated wood, which could explain the detected PAHs. Other surface water samples collected from areas that flow into the Suqi River had mostly non-detect results for PAHs.

Since some PAHs are known or possible carcinogens, we calculated the increased lifetime cancer risk associated with drinking Suqi River water containing the maximum level of benzo(a)pyrene equivalent PAHs shown in Table 4. Although we know there were periods of time when the Suqi River was not used as a water source and that conditions would have been different prior to the fuel spill in 1969, we assumed people would be drinking the water over a 78-year lifetime. Specific assumptions for different age ranges can be found in Appendix A. The total lifetime increased cancer risk from drinking water containing the maximum amount of PAHs in the Suqi River was 2 to 5 additional cancer cases in 1,000,000 people (based on the maximum detected sample). The calculated increased lifetime cancer risk for dibenzo(a,h)anthracene in surface water at the site is about 7 additional cancer cases in 1,000,000 people to 1 additional cancer case in 100,000 people. These theoretical increased cancer risk values are considered very low to low increased risks. Given that the majority of samples were non-detect, the maximum concentration was used for calculations instead of averaging this value with the non-detect levels, and the cancer risk calculations assumed that people will be drinking the river water daily over their entire lifetime, harmful health effects are not expected from the PAHs in Suqi River water.

Table 4. Chemicals in surface water of Suqi River exceeding ATSDR and EPA Comparison Values

Chemical	#detected/ #samples	Max[a] (ppb)	CV[a] (ppb)	CV Type
PAHs benzo(a)pyrene equivalent (2005)	1/7	**0.057462**	0.012	CREG
Dibenzo(a,h) anthracene (2005)	1/7	**0.0324**	0.0034	RSL
PAHs benzo(a)pyrene equivalent (2013)	1/11	**0.0949**	0.012	CREG

Source: Shannon & Wilson 2005, NVS IRA Council 2013
Bold values have maximum value which exceeds the CV.
Abbreviations: **CV**, comparison value; **CREG**, Cancer Risk Evaluation Guide; **ppb,** parts per billion; **RSL**, EPA Regional Screening Level; **PAHs,** Polycyclic Aromatic Hydrocarbons]
Note: ATSDR Comparison Values (i.e., CREGs, EMEGs, RMEGs) were used for screening, when available. In their absence, ATSDR used EPA Regional Screening levels (RSL) which are alternative CVs.
[a] Comparison values used for surface water are based on drinking water or tap water comparison values.

Plants

In 2002, 2006, and 2007 sediment core and plant sampling was conducted at Northeast Cape and control sites to attempt to determine if PCBs and pesticides were derived from military sites or long-range transport (Scrudato et al. 2012). Plants collected in the vicinity of the main operation complex at Northeast Cape had the highest concentrations of PCBs. The authors concluded that the excess contamination came from cleanup activities redistributing PCB-contaminated dust onto the plants (Miller et al. 2013; Scrudato et al. 2012).

Plant sampling was conducted as part of the Phase III RI, which was published in March 2003. Seventeen plant tissue samples representing 15 different species were collected from five areas within the Drainage Basin. The species sampled included berries and greens, which are used as subsistence foods, and willows and lichens that reindeer graze on. Samples of three plant species were also collected from a location upgradient (uphill) of the Drainage Basin on the east side of Cargo Beach Road. The plants were analyzed for PAHs, PCBs, and metals (including arsenic). Except for berries, all plant parts (roots, stems, leaves, flowers, and non-berry fruits) were analyzed together (MWH 2002). Samples were accompanied by specific handling instructions which stated that, "Plant roots are to be free from soil before sample preparation has begun" (MWH 2003). ATSDR focused the health evaluation on the plants eaten by people—berries and greens. These data are somewhat limited because they include only 7 of the 20 samples but provide enough information to inform health conclusions.

ATSDR CVs are not available for biota, so ATSDR calculated exposure doses for PAHs, PCBs, and metals (including arsenic). The exposure doses were calculated similarly to those for environmental media; however different site-specific exposure assumptions were made regarding ingestion of food, versus soil or surface water. Exposure dose calculations can be found in Appendix A.

ATSDR used a total plant ingestion rate of 42 grams/day for adults and 21 grams/day for children. This ingestion rate was derived from a January 2003 community survey of subsistence fishers, hunters, and gathers. In the summertime (three months), survey respondents estimated that adults eat approximately four 8-ounce meals per week and children eat approximately four 4-ounce meals per week. During the non-summer (nine) months, survey respondents estimated that they eat about one meal every other week (MWH 2004). The ingestion rates ATSDR used may result in overly conservative exposure doses.

The only chemical detected in plants with calculated exposure doses exceeding ATSDR's minimal risk levels (MRLs) was Aroclor 1254. The calculated exposure doses for Aroclor 1254 exceeded ATSDR chronic MRLs (Table 5). An MRL is an ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), non-carcinogenic effects. The PCB chronic MRL is based on the lowest observed adverse effect level (LOAEL), which is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in animals. The calculated exposure doses did not exceed the LOAEL for PCBs. Additionally, since the ingestion rate assumed for these calculations is very high and the maximum concentration was used, the exposure dose could be even lower. Therefore, non-cancer health effects are not expected from exposure to PCBs in edible plants.

Table 5. Plant contaminant exposure doses for arsenic and Aroclor 1254

Chemical	#detected/ #samples	Maximum Concen-tration (mg/kg)	Exposed population	Ingestion Rate (kg/day)	Body Weight (kg)	Dose (mg/kg/ day)	Minimal Risk Level (chronic)	Basis for Minimal Risk Level
Arsenic	2/7	0.112	Adult*	0.042	80	5×10^{-5}	3×10^{-4}	8×10^{-4} (NOAEL)
Aroclor 1254	7/7	0.228	Adult	0.042	80	1.2×10^{-4}	2×10^{-5}	5×10^{-3} (LOAEL)

Source: MWH 2002
* Adult chronic doses were highest value; arsenic doses were all below MRLs but retained for cancer risk evaluation.
LOAEL – Lowest observed adverse effect level from animal studies.
NOAEL – No observed adverse effect level from human study.

A cancer risk was also calculated for Total PCBs. This included detected concentrations of Aroclor 1254 and Aroclor 1260. The calculated increased lifetime cancer risk for Total PCBs in plants at the site is about 8 additional cancer cases in 100,000 people to 2 additional cancer cases in 10,000 people. This a low to moderate increased lifetime risk of getting cancer above a person's background risk of 4,000 of every 10,000 people. While the total past increased cancer risk (1.8×10^{-4}) exceeds EPA's cancer risk range of 1×10^{-6} to 1×10^{-4} slightly, this is an overestimate of the cancer risk because there were not enough samples to calculate a 95UCL, therefore the maximum value was used in the calculation. For all plant cancer risk calculations, the exposure period was assumed to be 60 years because of soil remediation.

Based on the literature, the bioavailability of arsenic from ingested plants was assumed to be 20% (ATSDR 2007) and the bioavailability of benzo(a)pyrene from ingested plants was assumed to be 58% (ATSDR 1995). The calculated increased lifetime cancer risk for PAHs in plants at the site is about 3-5 additional cancer cases in 100,000 people. These are considered low increased lifetime risks. ATSDR emphasizes that a subsistence lifestyle has been shown to be healthier than the alternative western diet (ADHSS 2001). It must also be emphasized that the analysis of the seven plant samples included all plant parts, and one would expect that the non-edible roots would absorb more chemicals than what would be transported to the edible leaf portion (MWH 2003). In addition, the maximum level detected was used to calculate cancer risk, therefore, these conclusions overestimate the actual risk from eating greens and berries from Northeast Cape.

Fish

In 1969, diesel fuel from a punctured tank at the military site spilled into a tributary of the Suqi River. This spill contaminated the river's drainage basin with PAHs. The widespread contamination caused by the spill dramatically reduced the river's fish population. Members of the Savoonga Tribe remember times when there were no fish to eat in the Suqi River. Additionally, Tribal members recall that the loss of fish in the Suqi River led to the demise of the seal rookery at Northeast Cape. This contributed to food insecurity at Northeast Cape, which was very detrimental to the community there. Routine military activities at Northeast Cape also resulted in accidental spills of other chemicals such as PCBs. PAHs and PCBs are of concern because they can be taken up by fish and potentially harm people who eat them (ATSDR 2006).

As a result of the scarcity of fish in the Suqi River following the 1969 fuel spill, subsistence fishing was not possible for many years. Fish have begun to come back to the river and Tribal members are once again using the area as a seasonal fishing camp (ATSDR 2006). Blackfish, Dolly Varden char, and pink salmon were collected as part of the Phase III RI in 2001. The fish were analyzed for PAHs, PCBs, and metals (including arsenic) (MWH 2002). There are no subsistence resource fish species living full time in the upper drainage basin. Dolly Varden were collected from the lagoon/estuary downstream of the Airport Bridge Road in the Suqi River. Dolly Varden and pink salmon were also collected from the Tapisagahak River, which is considered a background, uncontaminated location (MWH 2003). Both species are migratory and spend much of their life eating in open waters of the Bering Sea. In addition, these samples were collected prior to remediation which may have released contaminants, particularly PCBs, into the ecosystem from sediments.

ATSDR calculated exposure doses for the Dolly Varden and pink salmon, which are species eaten by Tribal members in the main assessment. Blackfish are not a species that is eaten by Tribal members (Byrne et al. 2015), as such data is more appropriately evaluated for ecological purposes. Blackfish are lower down on the food chain and have been found to contain PCBs that may bioaccumulate in higher trophic fish (vonHippell et al., 2018). PCBs were also found in the resident blackfish (MWH 2002, Byrne et al. 2015). In response to community questions and comments, ATSDR assessed the PCB data in blackfish using exposure assumptions for the edible fish (Appendix C). The edible fish species data are dated and limited but provide enough information to inform health conclusions. If additional edible fish samples are collected and analyzed in the future, they should be collected from multiple sites at Northeast Cape, analyzed for chemicals of concern, and the fish should be determined to be resident or anadromous.

ATSDR used the same fish ingestion rates in this health consultation that were used in ATSDR's 2006 health consultation for Northeast Cape. Because Northeast Cape is used as a seasonal fishing camp, ATSDR assumed people would eat these fish for three months of the year. ATSDR assumed adults would eat 108 grams per day, which is equal to about one 8-ounce meal every other day (ATSDR 2006). A child's ingestion rate was assumed to be half that of an adult. Egg, head, and fillet samples were analyzed because Tribal members eat all those parts. None of the calculated exposure doses exceeded ATSDR MRLs. Therefore, eating Dolly Varden fish from the Suqi River at the calculated ingestion rate in the past was not expected to cause harmful non-cancer health effects. Some Dolly Varden may spend their whole life in the estuary. The fish caught in 2001 were not identified as resident or anadromous.

Resident fish may be identified through laboratory techniques but in general a fisher would not know the difference between the two (Von Hippel, personal communication 2018).

Cancer risk was calculated for Total PCBs and PAHs (benzo(a)pyrene equivalents) in Dolly Varden fish using EPA cancer slope factors. The maximum benzo(a)pyrene equivalent concentrations was 0.0133 mg/kg in fish from Northeast Cape. PAHs can be found naturally in smoked and grilled meat. For comparison, in a study of uncontaminated, commercially available grilled and smoked meat products, total average concentrations of the carcinogenic PAHs (benzo[a]anthracene, benzo[b]fluoranthene, benzo[a]pyrene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene) ranged from non-detectable in several meat products to 0.0074 mg/kg in grilled pork chops; and from 0.0002 mg/kg in trout to 0.016 mg/kg in salmon (Gomaa et al. 1993).

Cancer dose is calculated like exposure dose; however, for an adult, the calculation used a lifetime risk of 78 years (USEPA 2011) rather than the standard 30 years, and 21 years for children. Multiplying the cancer dose by the EPA slope factor generates the possible cancer risk estimate. The calculated cancer risk and calculations from Northeast Cape fish can be found in Appendix A.

The calculated increased lifetime cancer risk for Total PCBs in fish at the site is about 3 additional cancer cases in 1,000,000 people to 1 additional cancer cases in 100,000 people. The calculated increased lifetime cancer risk for PAHs in fish at the site is about 3-4 additional cancer cases in 1,000,000 people. All cancer risks for fish presented a low increased risk (1×10^{-5} range; or one additional cancer case for every 100,000 people) or no apparent increased risk (1×10^{-6} range; or one additional cancer case for every 1,000,000 people). For context, one in two American males will develop cancer in their lifetime, and one in three American females will develop cancer in their lifetime (ACS 2013). While the blackish are not eaten, the dose calculations in Appendix C suggest that the PCBs concentrations are low enough to pose little or no risk if several meals are eaten. This dose information cannot be used to determine exposures from other fish species.

Other Traditional Foods

A large portion of Tribal members' diet consists of mammals such as seal, walrus, whale, caribou and reindeer including the meat, blubber, and rendered oil. In 2000, the U.S. Army Center for Health Promotion and Preventative Medicine (CHPPM) collected 41 samples from caribou at St. Lawrence Island. These samples were analyzed for PCBs, pesticides, and PAHs in muscle tissue, fat and serum. A total of 1,540 discrete analyses were performed. PCBs were not detected in any of the field samples of caribou. The majority of the pesticide analytes were undetected; however, several were flagged for estimated values. These samples were flagged as estimated quantities, indicating the accuracy or precision of the reported value is uncertain. Two samples had detected values. The majority of the PAH analytes were undetected; however, some were flagged for estimated values, and several serum samples had detected values (USACHPPM 2001a). Additional serum samples were collected from 13 caribou and analyzed for PAHs. All 220 PAH analytes were undetected, save one sample for benzo(a)anthracene, which was estimated to be 10 µg/L (USACHPPM 2001b). These results suggest that the caribou were mostly unaffected by PCB, pesticide, and PAH contamination on St. Lawrence Island.

From 2005-2009, Yupik community field researchers collected samples from a variety of fresh and prepared traditional foods on St. Lawrence Island (Miller et al. 2013; Welfinger-Smith et al. 2011). Samples were analyzed for PCBs, seven metals, and three chlorinated pesticides. The study authors compared the levels detected to EPA fish consumption advisories. This comparison showed that PCBs in rendered oil and blubber from all marine mammals were at levels that trigger consumption advisories; while reindeer meat and organs were safe to eat in any amount. The lowest concentrations of contaminants were found in plants, reindeer meat, and meat from marine mammals. The authors stressed the importance of preserving the culture associated with a traditional subsistence lifestyle, as well as providing Tribal members with information they need to make informed decisions. They concluded that it is necessary to "reduce exposures where possible and eliminate sources of PCB, chlorinated pesticides, and metals through state, national, and international policy actions" (Welfinger-Smith et al. 2011).

Biomonitoring – Contaminants in People

A biomonitoring project conducted from 2001-2003 found that the Yupik people of St. Lawrence Island had higher body burdens of PCBs than populations in the lower 48 states and Canada (Carpenter et al. 2005). The authors suggest that the long-range transport to this northern region is the cause of the elevated PCB blood serum levels of the people of Savoonga and Gambell. In the study there were higher levels among those Savoonga residents who spent significant time at Northeast Cape, compared with residents of Gambell. The authors believe this suggests added exposures to contamination from the Northeast Cape military site (Carpenter et al. 2005, Miller et al. 2013). However, the Alaska Division of Public Health (ADPH) reviewed these same data and concluded that PCB concentrations and PCB profiles detected in St. Lawrence Island village residents were similar to other Alaska Native populations (ADPH 2003). The discrepancy between these two analyses is the result of treating the data differently with respect to age. When similar age groups are compared to one another, St. Lawrence Island residents do **not** have significantly higher serum PCBs than other Alaska Native populations.

Because PCBs bioaccumulate over time, older people are expected to have higher levels; therefore, similar age groups must be compared for a valid assessment. Additionally, ADPH concluded that the PCB concentrations in the blood of St. Lawrence Island residents would not be expected to cause adverse health effects (ADPH 2003). They concluded that these concentrations are in the expected range for a population with a healthy northern subsistence lifestyle centered on fish and marine mammal consumption (AMAP 1998).

Enough serum remained from 71 participants in the above biomonitoring study to also analyze organochlorine pesticides (Byrne et al. 2015). The authors controlled for sex and age in their multivariate models and found a significant rise in serum hexachlorobenzene concentrations in participants with ties to Northeast Cape compared to those from Gambell (Byrne et al. 2015). The authors also compared their results to the general U.S. population (using the 2001-2002 National Health and Nutrition Examination Survey (NHANES) data on human exposures to environmental chemicals) and other Alaska Native groups and First Nations of Canada. Residents of St. Lawrence Island appear to be more exposed to organochlorine pesticides than the general U.S. population, but similarly exposed as other Alaska Native groups and First Nations of Canada. Exposure is predominantly through eating traditional foods that have accumulated pesticides through long-range transport (Byrne et al. 2015).

Benefits May Outweigh Risks

Before changing subsistence patterns, it is important to consider the risks of the contaminants against the nutritional and cultural benefits of the subsistence lifestyle.

The Alaska Department of Health and Social Services studied contaminants in subsistence foods in the Western Alaska Coastal Region (ADHSS 2011). The study notes that subsistence foods provide 24 – 98% of the energy, protein, omega-3 fatty acids, iron, and vitamin A and B12 requirements for the village residents studied.

Further, store bought foods also contain trace levels of contaminants and are generally not likely to be as healthful, available, or diverse as subsistence foods.

Health Outcome Data

ATSDR representatives attended public meetings with residents from both villages (Gambell and Savoonga) to listen to local knowledge and concerns about the two FUDS on St. Lawrence Island. Many of the concerns were about the health of the communities and the number of cancer cases and birth defects within the communities. ATSDR asked the Alaska Department of Health and Social Services, Division of Public Health (ADPH) to analyze their databases and obtain the number of birth defects and cancer cases for Gambell and Savoonga; ADHSS produced a number of reports that are available upon request [ABDR 2012; ACR 2014a, 2014b, 2015a, 2015b, 2017].

The leading cause of death in Alaska Natives is cancer (ANTHC 2006). Many of these cancer cases are preventable by maintaining a healthy traditional diet and lifestyle and reducing or eliminating tobacco use and the consumption of alcohol. For example, smoking accounts for at least 30% of all cancer deaths, and 87% of lung cancer deaths in the US (ACS 2013). More specifically, during the most recent time period of 2011-2013, 21.8% of all Alaska adults were smokers, compared to 43.7% in the Nome census area, which is the area that includes St. Lawrence Island.

Additionally, the increasing age of the population may contribute to more cancer cases on St. Lawrence Island, with no apparent increase in cancer rates. Between 2000 and 2010 there was a 43.6% increase in the 50-year-old and older population in Savoonga, and a 22.5% increase in the 50-year-old and older population in Gambell. The incidence of cancer increases with age [ACS 2013]. While the statistical analyses of the cancer data adjust for the difference in rates by age, it is understandable how members of the community would look at the number of cancer *cases* and not the cancer rate.

Cancer

Cancer registry data review cannot provide a cause-and-effect evaluation related to the chemicals identified at the site; however, it provides an idea of the burden of disease in Savoonga relative to other Alaska Native communities. ATSDR asked the ADPH to review the cancer registry information [ACR 2014a, 2014b, 2015a, 2015b, 2017]. The Alaska Cancer Registry is a database that contains information on the number of cancer cases diagnosed in Alaska since 1996. This work was completed by Alaska Department of Public Health (and not ATSDR specifically).

They found that the number of observed cancer cases for Savoonga (41) is very similar to the number of expected cases (40); and the number of observed cases for Gambell and Savoonga communities combined (85) exceeded the number of expected cases (77) for the period 1996 to 2013. These differences are not statistically significant as reported in the previous draft of this report [ACR 2015a, 2015b]; however, the revised report included 1996-2014, was found to be statistically significant with low confidence [ACR 2017], due to lung cancer. Table 6 provides the number of observed cancer deaths along with the Standard Mortality Ratio (SMR) for the individual and combined populations. A full assessment is provided in the companion assessment that addresses exposures to all populations living in the Native Village of Gambell (Evaluation of Environmental Exposures at the Gambell Formerly Used Defense Site (FUDS) Native Village of Gambell [Gambell FUDS PHA]).

Table 6. Cancer deaths for all cancer sites combined between 1996 to 2014 on St. Lawrence Island, AK

Cancer Type	Location	Number of Observed Cancer Deaths 1996-2014	Number of Expected Cancer Deaths 1996-	Difference (Observed minus Expected)
All Cancer Sites Combined	Savoonga	24	19	+ 5
	Gambell	**31**	**17**	**+14**
	St. Lawrence Is.	**55**	**36**	**+19**
Cancer Type	Location	Standard Mortality Ratio (SMR)	Lower Confidence Interval	Upper Confidence Interval
All Cancer Sites Combined	Savoonga	129.6	77.7	181.4
	Gambell	**186.6**	**120.9**	**252.3**
	St. Lawrence Is.	**156.5**	**115.2**	**197.9**

Source: Alaska Cancer Registry 2017
Bold values are statistically significant (due to lung cancer)

There were additional cancer deaths for each population; so the ADPH used the SMR statistical test to determine if the additional observed cases were possibly due to chance. When the lower confidence interval is above 100, the additional cases are not statistically significant and possibly due to chance (100 indicates that the observed = expected number of cancer deaths). The lower confidence level SMR (77.7) for Savoonga suggests that the additional cases are not statistically significant for Savoonga only. The more cancer deaths in Gambell and all of St Lawrence are greater than expected and the SMR lower confidence intervals for are above 100. Therefore, the additional observed number of cancer deaths for these communities are considered to be statistically significant, suggesting a real increase in cancer mortality and not just due to chance.

ADPH then evaluated all reported cancers in a manner similar to that described above. They discovered that the significant increase of all cancers was due to lung cancer. Table 7. Provide the cancer deaths by year along with the related SMRs for lung cancer and all other cancers. (Further assessment is provided in the Companion Gambell FUDS PHA report.)

Table 7. Deaths from lung cancer and all other cancer sites except lung between 1996 to 2014 on St. Lawrence Island, AK

Cancer Type	Location	Number of Observed Cancer Deaths 1996-2014	Number of Expected Cancer Deaths 1996-2014	Difference (Observed minus Expected)
Lung	Savoonga	11	5	+ 6
	Gambell	**14**	**5**	**+ 9**
	St. Lawrence Is.	**25**	**10**	**+15**
All Cancer Sites Combined Except Lung	Savoonga	13	13	0
	Gambell	17	12	+ 5
	St. Lawrence Is.	30	25	+ 5
Cancer Type	Location	Standard Mortality Ratio (SMR)	Lower CI	Upper CI
Lung	Savoonga	206.2	84.3	328.1
	Gambell	**300.7**	**143.2**	**458.3**
	St. Lawrence Is.	**250.3**	**152.2**	**348.4**
All Cancer Sites Combined Except Lung	Savoonga	98.6	45.0	152.1
	Gambell	142.2	74.6	209.8
	St. Lawrence Is.	119.3	76.6	162.0

Source: Alaska Cancer Registry 2017
Bold values are statistically significant (due to lung cancer)
CI – confidence interval

The SMR statistical tests the Gambell and total St. Lawrence Island population have as significant number of increased lung cancer cases, as the lower confidence level of lung cancer for Gambell and for St. Lawrence Island are both above 100. By contrast, the SMRs for deaths for all cancers combined except lung are much lower than for lung cancer and the lower confidence intervals are less than 100, indicating that any increased rates could be due to chance.

In addition to the concerning rate of cancer deaths, the Alaska Cancer Registry found the smoking rate and the number of lung cancer cases was elevated (ACR 2017). Likewise, lung cancer cases accounted for 27.1% of cases on St. Lawrence Island compared to 16.2% among Alaska Natives statewide. According to a survey conducted across Alaska, the smoking prevalence for St. Lawrence Island (53.4%) is more than twice the state average. Additional statistics are provided in the companion Gambell report and in ACR 2017.

Birth Defects

The National Birth Defects Prevention Network (NBDPN) has defined 45 major birth defects (congenital anomalies) [NBDPN 2016]. For birth defects, the Alaska Birth Defects Registry at the Alaska Department of Public Health analyzed only the prevalence of non-alcohol-related birth defects (ABDR 2012). The summary of the analysis is presented here.

Birth defects are rare events. When they occur in a small population, rate calculations can be statistically unreliable. For the analysis completed by the Alaska Birth Defects Registry (ABDR 2012), all major anomalies were examined by summing the cases in 5-year intervals. Even after summing the cases in 5-year increments, the confidence intervals were extremely wide. The wide confidence intervals indicate a high level of uncertainty.

The data can include diagnostic bias, whereby some health-care providers might have more sophisticated equipment or clinical specialists, and better report some of the birth defects. Birth defects are reportable up to age six years. The prevalences presented are indexed to 10,000 live births to allow for comparison with other communities; and include all reports for children born during 1996-2011 that were received before January 1, 2012.

St. Lawrence Island is within the Southwest Region category of the Alaska census database. During 1996–2011, the prevalence (standardized per 10,000 live births) of major, non-alcohol–related defects among infants born to St. Lawrence Island residents (666.7, CI: 457.4-875.9) was higher than the prevalence rate for the remainder of the Southwest Region (602.3, CI: 560.5–644.1). However, the confidence intervals (CI) for St. Lawrence Island fit within the confidence intervals of those other census areas, indicating that the difference could be due to chance. The St. Lawrence Island prevalence is more similar to census areas with predominately Alaska Native populations, as well as the Anchorage Native population group [ABDR 2012]. The complete report is provided in the companion Gambell report and includes data for other regions. A summary table of the analysis for just the Northern, the Southwest, and the St Lawrence Island communities are provided in the table below.

Table 8. Prevalence of major congenital anomalies, excluding alcohol-related anomalies on St. Lawrence Island and a few other regions in Alaska, 1996-2011

Region of Alaska	Prevalence per 10,000 Live Births	Lower CI	Upper CI
Northern	598.3	547.9	648.8
Southwest (incl. SLI)	602.3	560.5	644.1
St Lawrence Isl (SLI)	666.7	457.4	875.9

Source: Alaska Birth Defects Registry, 2012
CI = Confidence Interval

According to staff at the Alaska Department of Fish and Game, in general, communities in the census areas of Dillingham, Nome, North Slope Borough, and Wade Hampton (renamed "Kusilvak" Census Area in 2015) have diets that include marine mammals (whales and walrus) more similar to communities on St. Lawrence Island. The birth defects data indicate that there is no statistically significant difference in overall prevalence among those communities [ABDR 2012].

Some of the anomalies include, but are not limited to, cardiovascular, alimentary tract, genitourinary, central nervous system, eye and ear, musculoskeletal, and chromosomal defects. During 1996–2011, major congenital anomalies, including alcohol-related defects, affected approximately 6% of Alaskan live births annually. This rate is twice the national average.

Further analysis indicated the prevalence of major congenital anomalies was higher among Alaska Native children than among non-native children.

Many Alaska Natives live in remote areas, such as St. Lawrence Island. It may be harder to obtain folic acid supplements in these areas. Folic acid supplements are recommended before and during pregnancy; but are especially important in the early days and weeks of pregnancy to prevent neural tube defects (https://www.cdc.gov/ncbddd/folicacid). Providing vitamins containing 400 mg of folic acid to women of childbearing age on St. Lawrence Island would be a prudent public health practice.

Data limitations do exist. Some birth defects undergo medical records abstraction and case verification. During this analysis, ADPH based the prevalence of cases on the number of cases reported under the qualifying International Classification of Diseases (ICD)-9 codes, regardless of case verification.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical and physiological differences between children and adults demand special emphasis. Children are at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If some chemical exposures are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

Lead exposure is a special concern in children as there is no known safe level of blood lead. The average level of lead in Dolly Varden in the Suqi River fish was 0.004731 mg/kg, and the average level of lead in edible greens and berries from Northeast Cape was 1.366 mg/kg. Lead- based paint was present in some of the former military building materials but has since been abated. ATSDR supports the Centers for Disease Control and Prevention (CDC) and American Academy of Pediatrics recommendations for childhood blood lead screening at ages 1 and 2 (CDC 2012). The cost of the test is covered under Medicaid and many private insurance policies nationwide.

ATSDR specifically evaluated exposures to children in this health consultation. Risks presented in the document reflect the children as the most sensitive population. These exposures include the following:

1. Eating fish from Northeast Cape in the summer (3 months).
2. Eating greens and berries from Northeast Cape year-round.
3. Exposure to the soil at Northeast Cape and Suqi River surface water.

Limitations

The fish and plant data ATSDR used in this health consultation was very limited but provide enough information to inform health conclusions. Currently, Northeast Cape is used as a seasonal fishing camp—there are no year-round residents. If Northeast Cape becomes a year- round community, it would be prudent to collect and evaluate additional biota sampling data to determine if health effects could result from exposure to contamination.

Conclusions

ATSDR recognizes the many health benefits that come from Tribal members continuing their traditional practices, including eating fish and other natural foods from the traditional seasonal fishing and hunting grounds at Northeast Cape. Therefore, we assessed possible exposures associated with substances detected in environmental samples collected at Northeast Cape using protective, yet reasonable exposure assumptions to draw these four conclusions:

1. ATSDR concludes that eating fish from Northeast Cape in the summer for three months in the past was not expected to harm people's health because contaminant levels were too low to cause harm if eaten as suggested by the Tribe. The data are too limited to evaluate long-term exposures to the variety of fish available

2. ATSDR concludes that eating greens and berries from Northeast Cape year-round in the past was not expected to cause harmful health effects. The data are too limited to evaluate long-term exposures to the variety of plants available.

3. ATSDR concludes that accidentally ingesting soil for the half of the year that the soil is exposed and drinking Suqitughneq (Suqi) River surface water year-round, are not expected to harm people's health because contaminant levels are too low.

4. ATSDR asked the Alaska Department of Health and Social Services to analyze their databases and obtain the number of birth defects and cancer cases for Gambell and Savoonga. They found that cancer rates in Savoonga and Gambell were higher than expected (when combined) because of lung cancer. Birth defect rates were not significantly different from rates in the entire Southwest region. Therefore, there is little evidence that exposures (other than from cigarettes) from Northeast Cape are contributing to cancer and birth defect rates.

Recommendations

If Northeast Cape becomes a year-round community or a year-round food source, ATSDR recommends the following:

1. Collect additional edible fish samples. These fish should be collected from multiple sites at Northeast Cape, analyzed for chemicals of concern, and the fish should be determined to be resident or anadromous

2. Collect samples from multiple varieties of plants. To minimize any potential local contamination, collect berries from several different locations; discard outer leaves (if possible); wash hands well after harvesting plants from the soil, and thoroughly rinse plants before eating or processing.

3. Regularly test Suqi River surface water (for all water quality parameters) before the river is used as a drinking water source.

Public Health Action Plan

1. ATSDR met with members of the Native Village of Savoonga to present the results of this health consultation and to receive their comments. Comments are addressed in Appendix C.

2. Tribal members would like to see expanded healthcare services on St. Lawrence Island. ATSDR recommends that the Norton Sound Health Corporation continue to partner with the Tribe to set up screening for early detection and treatment of common cancers such as lung, colorectal, breast, and prostate.

3. If Tribe-approved marine mammal ingestion rates and marine mammal chemical data are made available to ATSDR, ATSDR may calculate exposure doses for these subsistence foods, upon request.

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Appendix A. Dose and Cancer Risk Calculations

The equations and assumptions used to calculate exposure doses, non-cancer risk, and increased lifetime cancer risk estimates for the following ingestion pathways. Assumptions are in Table A-1. Media specific increased lifetime cancer risk calculations for this site can be found in Tables A-2 to A-4.

Exposure Dose Calculations

The formula used to calculate an exposure dose is as follows:

$$Dose = \frac{C \times CF \times IR \times EF \times ED}{BW \times AT}$$

Where:

Dose = exposure dose (mg/kg-day)

C = contaminant concentration (ppb=µg/L; or mg/kg), chemical specific

CF = conversion factor for units

IR = ingestion rate of contaminant (L/day or kg/day)

EF = frequency of exposure (days/year)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (years x days/year)

Increased Lifetime Cancer Risk Calculations

The estimated increased lifetime cancer risk calculation is:

$$Cancer\ Risk = Dose \times CSF \times ADAF$$

Where:

Cancer Risk = Expression of the cancer risk (unitless)

Dose = Site-specific dose of carcinogen (mg/kg/day)

CSF = Cancer Slope Factor in $(mg/kg/day)^{-1}$, a measure of cancer potency

ADAF = Age dependent adjustment factor (for carcinogens that are mutagens)

Table A-1. Assumptions for the ingestion cancer and non-cancer risk calculations

Age Group	Soil Ingestion Rate (IR) (mg/day)	Water Ingestion Rate (IR) (L/day)	Plant Ingestion Rate (IR) (kg/day)	Fish Ingestion Rate (IR) (kg/day)	Body Weight (BW) (kg)	Exposure duration (ED) (years)	Age Dependent Adjustment Factor (ADAF)*
Childbirth to <1 year	150	0.504	--	--	7.8	1	10
Child 1 to <2 years	200	0.308	0.021	--	11.4	1	10
Child2 to <6 years	200	0.376	0.021	0.054	17.4	4	3
Child 6 to <11 years	200	0.511	0.021	0.054	31.8	5	3
Child 11 to <16 years	100	0.637	0.021	0.054	56.8	5	3
Child 16 to <21 years	100	0.770	0.021	0.054	71.6	5	1
Adult > 21 years	100	1.227	0.042	0.108	80	39, 60, 58	1

*ADAF only applied to mutagenic chemicals; of the chemicals of concern, polycyclic aromatic hydrocarbons (PAHs) are considered mutagenic

Other assumptions:

- Exposure frequency (EF) for soil is 183 days/year, for water is 365 days/year, for plants is 4-days/week in summer and 1 day/week for remaining weeks for 365 days, for fish is 90 days/year
- Total lifetime is 78 years, unless estimating past exposures for 60 years (1954-2014)
- Averaging time (AT) for non-cancer effects is EF/365 and for cancer effects is 28,835 days

Table A-2. Increased cancer risk calculations for soil exposures, Northeast Cape FUDS, AK

Chemical	Number Detected/ Number Sampled	Concentration (ppm) (95UCL or maximum)	Cancer Slope Factor $(mg/kg\text{- }day)^{-1}$	Child Cancer Risk (21 years exposed)	Lifetime Cancer Risk (78 years exposed) *
Total PCBs 2005 (Aroclor 1260 only)*	9/12	12.011 (95UCL)	2	3.1×10^{-5} (past exposure)	1.8×10^{-5} (past exposure)
Total PCBs 2013	35/60	2.078 (95UCL)	2	7.0×10^{-6}	5.4×10^{-6}
Dioxin-like PCBs (2,3,7,8-TCDD toxicity equivalent) 2013	8/8	0,000015 (95UCL)	130000	1.8×10^{-6}	1.4×10^{-6}
Total HxCDD 2013	6/8	0.00037 (maximum)	6200	2.1×10^{-6}	1.6×10^{-6}
Carcinogenic PAHs 2013 (benzo(a)pyrene equivalents)	17/33	0.261 (95UCL)	1	1.5×10^{-6}	2.5×10^{-7}
Dibenzo(a,h) anthracene 2013	2/33	0.17 (maximum)	4.1	5.1×10^{-6}	5.7×10^{-6}

Source: Shannon and Wilson 2005, MWH 2002, NVS IRA Council 2013
Abbreviations: HXCDD – hexachlorinated diobenzo dioxin, mg/kg – milligrams chemical per kilogram, PAH – polycyclic aromatic hydrocarbons, PCB – polychlorinated biphenyl, ppm – parts per million or mg/kg soil, TCDD – tetrachlorinated dibenzo dioxin, 95UCL – 95th upper confidence limit of the mean
*Past exposure calculated on pre remediation soil samples for total PCBs and includes 20 years as child and 40 years as an adult (60 years).

Table A-3. Increased cancer risk calculations for surface water exposures, Northeast Cape FUDS, AK

Chemical	Number detected/ Number of samples	Concen-tration (ppb) (maximum)*	Cancer Slope Factor $(mg/kg\text{- }day)^{-1}$	Child Cancer Risk (21 years exposed)	Lifetime Cancer Risk (78 years exposed)**
Carcinogenic PAHs 2005 (benzo(a)pyrene equivalents)	1/7	0.057462	1	3.1×10^{-6}	2.2×10^{-6}
Carcinogenic PAHs 2013 (benzo(a)pyrene equivalents)	1/11	0.0949	1	5.2×10^{-6}	3.7×10^{-6}
Dibenzo(a,h)anthracene 2013	1/7	0.0324	4.1	7.1×10^{-6}	1.1×10^{-6}

Source: Shannon and Wilson 2005, MWH 2002, NVS IRA Council 2013
Abbreviations: mg/kg/day – dose unit, milligrams contaminate per kilogram bodyweight per day, PAH – polycyclic aromatic hydrocarbon, ppb – parts per billion or micrograms per liter.
*Since only one surface water sample had detectable concentrations of these PAHs, ATSDR used the maximum concentration because of uncertainty in calculating an average based on non- detected levels.
**Risk calculations represent the worst-case scenario of drinking surface water from contaminated area.

Table A-4. Increased cancer risk calculations for ingestions of plants and fish, Northeast Cape FUDS, AK

Chemical	Number detected/ Number of samples	Concentration (ppm) (maximum or 95UCL)	Cancer Slope Factor (mg/kg-day)-1	Child Cancer Risk (20 years exposed)	Lifetime Cancer Risk (78 years exposed)*
Arsenic (plants) †	2/7	0.112 (maximum)	1.5	2.9×10^{-5}	6.8×10^{-5} (past exposure)
Carcinogenic PAHs (benzo[a]pyrene equivalents in plants) ‡	6/7	0.0715 (maximum)	1	4.6×10^{-5}	2.9×10^{-5} (past exposure)
Total PCBs (plants)	7/7	0.228 (maximum)	2	7.8×10^{-5}	1.8×10^{-4} (past exposure)
Carcinogenic PAHs (benzo(a)pyrene equivalents) (fish) ‡	6/13	0.0133 (maximum)	1	3.4×10^{-6}	4.4×10^{-6}
Total PCBs (fish)	13/13	0.018 (95UCL)	2	3.4×10^{-6}	1.2×10^{-5}

Source: Shannon and Wilson 2005, MWH 2002
Abbreviations: PAH – polycyclic aromatic hydrocarbon, PCB – polychlorinated biphenyl, ppm – parts per million wet weight, UCL – 95th upper confidence level on the mean
*Past exposure calculations used data from samples collected prior to remediation and include 20 years as child and 40 years as an adult (60 years, 1954 to 2014) and assumed child did not eat plants the first year.
† Bioavailability of arsenic from ingesting plants assumed to be 20%.
‡ Bioavailability of benzo(a)pyrene from ingesting plants assumed to be 58%.

Table A-5. Cumulative cancer risk from multiple pathways, pre-remediation, Northeast Cape FUDS, AK

Chemical	Pathway	People	Cumulative Risk
Total PCBs	soil, plants, fish	child lifetime	1.1×10^{-4} 2.1×10^{-4}
PAHs (benzo(a)pyrene equivalent)	surface water, plants, fish	child lifetime	5.3×10^{-5} 3.6×10^{-5}

Table A-6. Toxic Equivalency (TEQ) for dioxin in soil, post-remediation, Northeast Cape FUDS, AK

Chemical	TEF	SL01 Conc/TEF (pg/g)	SL19 Conc/TEF (pg/g)	SL38 Conc/TEF (pg/g)	SL54 Conc/TEF (pg/g)	SL57 Conc/TEF (pg/g)	SL67 Conc/TEF (pg/g)	SS02 Conc/TEF (pg/g)	SS05 Conc/TEF (pg/g)
1,2,3,4,6,7,8-HpCDD	0.01	540/5.4	320/3.2	330/3.3	930/9.3	12/0.12	13/0.13	15/.015	12/0.12
1,2,3,4,6,7,8-HpCDF	0.01	200/2	68/0.68	77/0.77	340/3.4	3.3/0.033	3.9/0.039	5.1/0.051	4.5/0.045
1,2,3,4,7,8,9-HpCDF	0.01	13/0.13	4.1/0.041	ND	11/0.11	ND	ND	ND	0.28/0.0028
1,2,3,4,7,8-HxCDD	0.1	ND	ND	ND	12/1.2	ND	ND	0.32/0.032	0.34/0.034
1,2,3,4,7,8-HxCDF	0.1	33/3.3	4.3/0.43	ND	9.1/0.91	ND	ND	0.23/0.023	ND
1,2,3,6,7,8-HxCDD	0.1	21/2.1	8.1/0.81	ND	35/3.5	ND	ND	0.48/0.048	0.84/0.084
1,2,3,6,7,8-HxCDF	0.1	ND	ND	ND	ND	ND	ND	0.23/0.023	0.18/0.018
1,2,3,7,8,9-HxCDD	0.1	ND	4.8/0.48	ND	22/2.2	ND	ND	0.24/0.024	0.7/0.07
1,2,3,7,8,9-HxCDF	0.1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDD	1	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDF	0.03	ND	ND	ND	ND	ND	ND	0.15/0.0045	ND
2,3,4,6,7,8-HxCDF	0.1	ND	ND	ND	ND	ND	ND	0.35/0.035	ND
2,3,4,7,8-PeCDF	0.3	13/3.9	ND	ND	ND	ND	ND	0.18/0.054	ND
2,3,7,8-TCDD	1	ND	ND	ND	ND	ND	ND	ND	ND
2,3,7,8-TCDF	0.1	2.7/0.27	0.85/0.085	ND	2/0.2	ND	ND	0.37/0.037	ND

Chemical	TEF	SL01 Conc/TEF (pg/g)	SL19 Conc/TEF (pg/g)	SL38 Conc/TEF (pg/g)	SL54 Conc/TEF (pg/g)	SL57 Conc/TEF (pg/g)	SL67 Conc/TEF (pg/g)	SS02 Conc/TEF (pg/g)	SS05 Conc/TEF (pg/g)
OCDD	0.0003	4900/1.47	2900/0.087	3200/0.96	7600/2.28	100/0.03	110/0.033	140/0.042	93/0.0279
OCDF	0.0003	490/0.147	290/0.087	300/0.09	730/0.219	10/0.003	13/0.0039	17/0.0051	11/0.0033
Total TEQ		18.717	6.683	5.12	23.319	0.186	0.2059	0.5286	0.4047
Exceeds 2,3,7,8-TCDD CREG?		Yes	Yes	Yes	Yes	No	No	No	No

Abbreviations: CREG – Cancer Risk Environmental Guide; HpCDD/HpCDF – Hepta chlorinated dibenzo dioxin or furan, HxCDD/HxCDF – Hexa chlorinated dibenzo dioxin or furan; ND – not detected; OCDD/OCDF – Octa chlorinated dibenzo dioxin or furan; PeCDD/PeCDF - Penta chlorinated dibenzo dioxin or furan, pg/kg – picograms chemical per gram; TCDD/TCDF – tetra chlorinated dibenzo dioxin or furan, TEF –TCDD Toxicity Equivalent Factor; TEQ – TCDD Toxicity Equivalent Quotient

Appendix B. ToxFAQs for Contaminants of Concern

Accessible version of the Arsenic ToxFAQs at
https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=19&toxid=3

Accessible version of the ATSDR Polychlorinated Biphenyls ToxFAQs at
https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=140&toxid=26

Accessible version of the ATSDR Polycyclic Aromatic Hydrocarbons ToxFAQs at
https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=121&toxid=25

For easy access to the reader, images of these ToxFAQs are provided below.

Accessible version of the Arsenic ToxFAQs at
https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=19&toxid=3

Arsenic - ToxFAQs™

CAS # 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic

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Arsenic

CAS # 7440-38-2

compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How can arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce the risks of exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to determine whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic (Update). Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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Accessible version of the ATSDR Polychlorinated Biphenyls ToxFAQs at
https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=140&toxid=26

Polychlorinated Biphenyls - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over

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Polychlorinated Biphenyls

several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. PCBs have been classified as probably carcinogenic, and carcinogenic to humans (group 1) by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC), respectively.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risks of exposure to PCBs?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Accessible version of the ATSDR Polycyclic Aromatic Hydrocarbons ToxFAQs at https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=121&toxid=25

Polycyclic Aromatic Hydrocarbons (PAHs) - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl'ĭ-sī'klĭk ăr'ə-măt'ĭk hī'drə-kar'bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- Drinking contaminated water or cow's milk.
- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

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CS265956-A

Accessible version of the ATSDR Polycyclic Aromatic Hydrocarbons ToxFAQs at https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=121&toxid=25

Polycyclic Aromatic Hydrocarbons

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

September 1996

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Appendix C. Public Comments

ATSDR released the draft health consultation on July 24, 2017. The public comment period was extended to 90 days at the request of the Tribe. ATSDR met with the Tribal Council for Village of Savoonga and later with residents on the island at a public meeting. ATSDR received oral and written comments from the following entities:

- Oral comments and questions from Tribal council
- Oral comments and questions during the public meetings in Savoonga and Gambell
- Written comments from Alaska Community Action on Toxics (ACAT), on behalf of the Savoonga Tribal Council
- Written comments from Alaska Department of Environmental Conservation (ADEC)
- Written comments from Army Corps of Engineers (ACE)
- Written comments from Frank VonHippel, former researcher and professor at the University of Alaska, Anchorage

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Comments from Public Meeting in Savoonga, AK on July 25, 2017

The military said they would do long-term monitoring. What have they done? Have you used these data in the report?

ATSDR Response: Table 1-1 in the 2014 Northeast Cape HTRW Remedial Actions report lists the Long-Term Management required by site (USACE 2016.) Some of these actions include monitoring the sediment at the POL spill every five years; and monitoring groundwater at the housing and operations landfill, buried drums, fuel tanks, heat and power plant, fuel pipeline, auto maintenance, and diesel fuel pump sites every five years. This information was used in the health consultation.

Has anyone looked at the health impacts to military personnel who were stationed at Northeast Cape?

ATSDR Response: We are not aware of any studies specifically looking at the health of military personnel stationed at Northeast Cape. The way people come in contact with, or are exposed to, an environmental contaminant may be very different from one group to the next. For instance, the exposure scenario for the military serving at Northeast Cape is very different than the way in which the people of St. Lawrence Island have been exposed to military site contaminants. The military personnel were exposed for short periods—months to possibly a year or two. It is not possible to know what contaminants the military personnel may have been exposed to prior to being stationed on St. Lawrence Island. The military personnel may have experienced contaminant exposures at multiple sites throughout their service (not just at Northeast Cape.) Measuring just how much Northeast Cape contaminant exposure may have contributed to health impacts in the military personnel would not likely be possible.

The Northeast Cape site has been inactive for some time. Records of those who served at the sites are not likely to yield information on current residence. Finding the former military personnel and collecting health status information would be very difficult. Lastly, even with our

best effort the number of military personnel we are able to positively link to the site along with their health status or outcome information will likely be very low. Statistically, when we have small numbers of people we are not able to determine the chance that exposure to a contaminant will result in a negative health outcome.

The oil spill destroyed the ecosystem of the Suqi River – the fish and the animals that eat the fish and other organisms from this ecosystem are no longer there. The seal rookery, a major source of food, is no longer there. Why isn't this loss of food security issue mentioned as a health impact? This should be a major conclusion. Why won't the military acknowledge impact to the seal breeding grounds?

ATSDR Response: Added, "Additionally, Tribal members recall that the loss of fish in the Suqi River led to the demise of the seal rookery at Northeast Cape. This contributed to food insecurity at Northeast Cape, which was very detrimental to the community there," to the Fish section of the health consultation.

I remember living at Northeast Cape when I was a child. After the oil spill and loss of food I remember being hungry. We would eat scraps left over from the military from the dump. Sometimes the food was 'sour' but we ate it anyway. Would eating food scraps from a dump mixed with military debris result in long-term health effects?

ATSDR Response: The main concern with eating spoiled food would be short-term gastrointestinal illness. Contaminants may have come in contact with spoiled food that was eaten, but it is not possible to know what exposures occurred. ATSDR cautions against consuming food waste.

The military used to say not to swim in the Suqi River because of human waste was being released. People swam in it anyway. Is there a long-term disease related to this?

ATSDR Response: A number of diseases are associated with exposures from swimming in sewage-contaminated water. The main concerns would be short-term gastrointestinal illness from accidental ingestion and short-term skin irritation; however, ATSDR cautions against swimming in water bodies that may be contaminated with human waste.

Tribal council member believes that the military dumped waste on the backside of the mountain behind the military facility (pointed to an area out southwest of the main operation center in the mountains). Did the military sample or clean this area? Did you look at these data?

ATSDR Response: The 2016 Long-Term Management plan provides the following information on the sites on the backside of the mountain behind the military facility:

Site 31, the WACS station, is located southeast and uphill from the MOC in a glacial valley at the base of Kangukhsam Mountain (Figure A-2). While active, the site contained four large billboard antennas, a central main electronics building, other supporting structures, and seven ASTs. The antennas and structures were removed between 2001 and 2006. At the time of the Decision Document, PCBs remained within the former transformer pad excavation at concentrations between 1.53 and 7.09 mg/kg in approximately 110 cubic yards of soil (USACE 2009).

Soil. The selected remedy of excavation and disposal of PCB-contaminated soil was initiated at Site 31 in 2010 and continued through the 2013 field season. Excavation efforts were guided by field screening samples. Following excavation, confirmation samples indicated PCB concentrations were below the cleanup level. The excavation was backfilled with material from the onsite borrow area and contoured to blend with surrounding topography (USACE 2014).

The remedy at Site 31 is considered complete (USACE 2015b). No long-term management is required at Site 31.

Site 32 – Lower Tramway. Site 32, the Lower Tramway, is located at the northern base of Kangukhsam Mountain (Figure A-2). Site 32 consisted of a tram terminal building, substation transformer bank, two ASTs, a water well, and an anchor pit for the aerial tram line.

Soil. The buildings, ASTs, and tram structures at Site 32 were demolished and removed in 2003 and 2005. Soil samples collected in 2003 following the building demolition activities identified DRO concentrations between 1,150 and 10,400 mg/kg in the area near the former AST. No other contaminants were identified above cleanup levels (USACE 2009). In 2014, 53.13 tons of DRO-contaminated soil was removed to complete implementation of the remedy. All confirmation samples from the excavation floor and sidewalls were below site-specific cleanup levels for DRO and RRO. The USACE considers soil removal at Site 32 complete (USACE 2015a).

Long-Term Management. Periodic reviews are required until RAOs are met.

Site 33 – Upper Tram Terminal. A tramway linked the lower tram building with the radome area located on top of Kangukhsam Mountain (Figure A-2). Site 33 consisted of a tram terminal building connected to the upper camp by an enclosed track man-lift (USACE 2009). The structures and tram towers were demolished and removed during the 2003 and 2005 field seasons. During the 2001 RI, surface soil samples were collected from stained soil outside the upper tram bay. DRO concentrations were detected at a maximum of 660 mg/kg, which does not exceed the site-specific cleanup level (USACE 2009).

Site 33 met risk-based cleanup levels and was determined to be NFA in 2009 (USACE 2009).

Long-Term Management. No long-term management is required at Site 33.

Site 34 – Upper Camp. Site 34, the upper camp, is located at the top of Kangukhsam Mountain and consisted of a substation transformer pad, two ASTs, a radome building, and the upper quarters building (Figure A-2). Site structures and ASTs were demolished and removed during the 2003 field season. Historical soil sampling indicated the presence of PCBs at a maximum concentration of 1.4 mg/kg in soil adjacent to the concrete transformer pad. During the 2001 investigation, additional surface soil samples were collected from a grid around the former pad. PCBs were detected at a maximum concentration of 1.06 mg/kg (USACE 2009). Soil samples were also collected from various locations near the ASTs, an outfall pipe, the former drum field, and background locations. DRO was detected at a maximum concentration of 1,100 mg/kg (USACE 2009).

With a de minimis quantity of impacted soil and no unacceptable risk to human health or the environment, Site 34 was determined to be NFA in 2009 (USACE 2009).

No long-term management is required at Site 34.

People are fishing for more than Dolly Varden and pink salmon off Northeast Cape. They are also fishing for halibut, flounder, capelin, cigar fish, red crab, tom cod (in winter sometimes). Are there any data that can be used to describe risks from eating these fish?

ATSDR Response: ATSDR encourages eating a variety of fish from a variety of locations, not from just one location. ATSDR is not aware of the existence of samples of those fish species near the Northeast Cape site. However, if additional edible fish sample results become available, ATSDR may be available to evaluate them, upon request.

Based on more recent data, other scientists have said they would not eat the berries/greens and would not drink the Suqi River water. Would you?

ATSDR Response: ATSDR analyzed all the edible plant and surface water data currently available. Our analysis showed that the berries and greens from Northeast Cape are safe to eat. ATSDR encourages collecting berries and greens from a variety of locations. The level of chemical contaminants in the Suqi River water are low. After boiling water as a precaution to safeguard against possible biological contaminants, the water would be safe to drink.

Council member stated there were plant data that described washed and unwashed plants – washing the plants reduced the chemicals. Why didn't you use this data?

ATSDR Response: ATSDR attempted to obtain washed and unwashed plant data reported in Scrudato et al. 2012. We were told that the data were not retained when the laboratory closed, and that the available data were most likely not from Northeast Cape. Washing plants before eating is likely to remove any residual dust that may contain contamination. ATSDR recommends washing berries and vegetables before eating.

The data used in the report are old. Why didn't you use newer data? Was the site adequately characterized? Are the data good enough to be certain of health calls? Do the data sets adequately represent the site contaminants?

ATSDR Response: The berry and greens were collected in 2001, prior to remedial activities. ATSDR evaluated human exposure pathways and used the available applicable data. While the applicable data are limited and dated, ATSDR determined that they are sufficient to draw health conclusions. If new edible fish, plant, and/or marine mammal data become available, ATSDR may be available to evaluate them, upon request. ATSDR reviewed additional soil and surface water data for the final version of this health consultation (NVS IRA Council 2013.)

There were needles and medical waste dumped in the river. Are those still in the river?

> **ATSDR Response**: We have not heard about medical waste dumped in the river. Miscellaneous metal debris such as drums were removed during the cleanup activities. The 2016 Long-Term Management plan provides the following information on the river: Although Site 29 did not pose a risk to human health or the environment and met risk-based cleanup levels, the remedy selected for Site 29 included the removal of incidental debris located in the stream channel that posed an inherent hazard (USACE 2009a). The selected remedy was initiated and completed in 2010 (USACE 2011). No long-term management is required at Site 29 because the incidental debris has been removed.

ACAT stated that scientists have measured 'heavy' PCBs in blood of St. Lawrence Island people. Only light PCBs come from global transport. Heavy PCBs come from the NE Cape site therefore the PCBs in people come from the site not global transport. Has ATSDR looked at these studies? Would you comment on them? Has there been any fingerprinting done?

> **ATSDR Response**: PCBs' level of chlorination is one of many factors that affect where they are detected. ATSDR has reviewed ACAT's publication (Carpenter et al. 2005), as well as studies by Gioia et al. and Friedman et al. on the topic of PCB fingerprinting. The last sentence of Carpenter et al.'s publication states, "In summary, our results suggest that the former military site located at the NEC on St. Lawrence Island may contribute to the PCB exposure of the native residents, but that the predominant source is global transport, deposition and bioconcentration in foodstuffs."

I heard that the military performed a study looking at radiation in houses at NE Cape. Some houses had radiation detected and some didn't. All those that had 'radioactive' houses died. Is there any radiation left at the site? Did you see these data? Many people reused the materials that were at the site, could that be contributing to cancers?

> **ATSDR Response**: In 1996, the Army Corps of Engineers conducted a radiological survey at 15 sites at Northeast Cape, including the subsistence hunting and fishing camp. The survey determined that there is no evidence of elevated radiation levels at Northeast Cape. This information has been added the Chemicals of Concern section of this health consultation.

Has there been cleanup to residential standards? Can people live there without concerns for their health?

> **ATSDR Response**: Soil cleanup levels were developed based on the Human Health and Ecological Risk Assessment (MWH 2004) and are protective of future residential use. Sediment cleanup levels are protective of potential future human and ecological receptors. Groundwater cleanup levels are based on promulgated levels from 18 Alaska Administrative Code (AAC) 75, Table C. Surface water cleanup levels are also based on State of Alaska regulations 18 AAC 70.

It seems that people are getting diagnosed younger than in the past. Has anyone looked at the age at case identification over time?

> **ATSDR Response**: In response to concerns that people were dying from cancer at earlier ages, the Alaska Cancer Registry (ACR) examined the age of death from cancer over time as part of

the St. Lawrence Island cancer study analysis. From 1996 to 2014, there were four cancer deaths younger than 50 years old. Most cancer deaths in Savoonga and Gambell occurred among people between the ages of 52 and 80. This age distribution of cancer deaths has not changed over the study time period (ACR 2014).

ACR did not examine changes in age at diagnosis over time. However, in response to this new question, ACR completed some preliminary analysis of changes in diagnosis age during 1996-2016. There were 106 cancer cases reported during this time period. Most cancers were diagnosed between the ages of 37 and 82, and 9 cases were younger than 37 years old. Of these 9 cases, 2 cases were diagnosed in 2002, and 7 cases were diagnosed after 2008, which represent 14.3% of the total number of cases from 2009 to 2016. ACR compared other surrounding areas to evaluate whether this trend was unusual. ACR looked at average age of new diagnosis and the age distribution of new cancer cases for Nome Census Area excluding St. Lawrence Island, Northwest Arctic Borough to the north, and Kusilvak Census Area to the south. All three areas had newly diagnosed cases of cancer younger than 37 years old throughout 1996-2016.

There are several factors influencing why cancer cases are diagnosed at a younger age over time. These factors include improvements in transportation to regional health facilities, changes in screening rates over time, and advancements in screening technology. Since 2001, both cancer incidence and mortality rates have decreased in Alaska, which might be attributed to earlier detection, and coincides with younger ages of diagnosis. Improved screening through diagnostic technology, better access to diagnostic services, increased screening awareness, and changes in health behaviors are just some of many factors that can influence early detection rates.

Has the groundwater been characterized near the old landfill at Northeast Cape?

ATSDR Response: ATSDR did not analyze groundwater data because it is not used as a source for drinking water. Levels of contaminants were above cleanup levels. The 2016 Long-Term Management plan provides the following information on the groundwater near the old landfill at Northeast Cape:

Site 7 – Cargo Beach Road Landfill groundwater. At the time of the Decision Document (DD), residual range organics (RRO), chromium, lead, and nickel were identified as exceeding ADEC Table C cleanup levels (USACE 2009). Groundwater remediation was not included in the selected remedy because the shallow groundwater present in the tundra surrounding the site is not considered a current or reasonably expected future drinking water source (USACE 2009).

Site 9 – Housing and Operations Landfill groundwater. Diesel range organics (DRO), RRO, and lead have previously been detected in shallow groundwater above ADEC Table C cleanup levels at Site 9 (USACE 2009). Shallow groundwater at Site 9 was not considered a current or reasonably expected future drinking water source in the DD (USACE 2009).

USDA should inspect native Alaska subsistence food the same way it inspects food for public consumption.

> **ATSDR Response**: Neither Federal nor State agencies inspect subsistence food resources. Food codes do not exist which pertain to subsistence foods. Alaska Department of Conservation does track contaminant levels in fish tissue from across the state including methyl mercury, total mercury, arsenic, selenium, copper, lead, cadmium and persistent organic pollutants. For more information, contact the Fish Monitoring Program at (907) 375-8200 or their website at http://dec.alaska.gov/eh/vet/fish-monitoring-program

We used to have an ENT on the island that could evaluate nasal pharyngeal cancers but not anymore, there should be more prevention strategies for common cancers. Cases are not being identified. I identified 63 people who have cancer.

> **ATSDR Response**: When a doctor diagnoses cancer in Alaska, the cancer case is entered into the Alaska Cancer Registry and tracked over time. The Alaska Cancer Registry identified 41 people from Savoonga between 1996 and 2013 diagnosed with cancer, which is about 2 cases per year (ACR 2015). ATSDR's Regional Representative met with Alaska Community Health Aides (CHA) in March 2018 to provide training on cancer and the environment. ATSDR is developing a continuing education module which could be accessed remotely for those CHAs who were not able to attend. Additionally, the Norton Sound Health Corporation would like to partner more with the Tribe to diagnose and treat cancers at an earlier stage.

I believe that the increase in cancer is not related to smoking and that ATSDR should stop saying that it is. Cancer is because of exposures to contaminants from Northeast Cape.

> **ATSDR Response**: The Alaska Cancer Registry (ACR) investigated the types of cancers diagnosed on St. Lawrence Island between 1996 and 2013 in its cancer reports.
>
> - About 1 out of every 4 cancers were lung cancer, making it the most common type of cancer in the area (27% of all cancers). In contrast, lung cancer cases for Alaska Native people statewide account for about 16% of all cancers in 1996- 2013.
> - Colorectal cancer was the next most common type of cancer consisting of about 18% of all cases. In contrast, colorectal cancer cases for Alaska Native people statewide account for about 13% of all cases.
> - Breast and stomach cancer were the next most common cancers on St. Lawrence Island, at 9% and 8% of all cancer cases respectively. The other types of cancers each account for less than 4% of all cases.
>
> Lung, colorectal, breast, and stomach cancers are 4 of the 5 most common types of cancers for Alaska Native people statewide, and so would be expected in the St. Lawrence Island population. While the percentage of colorectal cancer cases was a little higher than statewide estimates, lung cancer was unusually higher by 11 percentage points. As shown in the ACR study, the number of observed lung cancer cases in the St. Lawrence Island population was statistically significantly higher than the number of expected cases, indicating a higher occurrence of lung cancer cases than expected on St. Lawrence Island. ACR did the same exercise for all other cancer types combined, excluding lung cancer, and found that the number of observed cancers was slightly lower than the number of expected cancers (ACR 2014).

According to the CDC and other national and international studies, tobacco use is the greatest risk factor for lung cancer. The smoking prevalence for St. Lawrence Island is more than twice the state average, with an estimated 53.4% of adults on St. Lawrence Island being current smokers. The Alaska Cancer Registry also reviewed the known tobacco use history of people diagnosed with cancer on St. Lawrence Island and found almost twice as many current smokers among people diagnosed with lung cancer compared to other types of cancer.

The higher-than-expected lung cancer cases are consistent with the high prevalence of smoking observed on St. Lawrence Island. This conclusion is an assumption based on the correlation of a well-known risk factor, but causality is not determined by the analysis, nor is it stated in the report. Correlating findings of cancer types with known amenable risk factors is commonly done in many public health efforts to better focus often limited resources and decrease the burden of preventable chronic conditions. The same study protocol conducted for St. Lawrence Island has also been used in other Alaskan communities.

Are the types of cancers changing? (more than lung or colorectal)

ATSDR Response: Besides lung and colorectal, the other two types of commonly diagnosed cancers on St. Lawrence Island were breast and stomach (all other types had only three or less occurrences). Breast and stomach were the 3rd and 5th most commonly diagnosed cancers in Alaska Native people statewide during the 18-year time period of 1996-2013. ACR examined the number of times these two cancers occurred during that time. For breast (8 occurrences), there were no unusual patterns of occurrence. For stomach (7 occurrences), four cases were diagnosed in one year almost two decades ago (1999). Besides that year, no other unusual patterns of occurrence were noted (ACR 2014). Additional analyses on other cancer types are limited due to the small number of cases.

Would ATSDR consider a more protective heath value if Alaska requested it?

ATSDR Response: ATSDR develops comparison values, such as Environmental Media Evaluation Guides (EMEG) and Cancer Risk Evaluation Guides (CREG), and health guidelines such as Minimal Risk Levels (MRL). When ATSDR values are not available for certain chemicals, ATSDR health assessors use EPA or State health values for comparison purposes. CREGs are often the most protective health values available because they assume continuous exposure over a lifetime. In some instances, a state comparison value may be used if the science can be verified and it is more protective.

Did the military use Mirex?

ATSDR Response: ATSDR is not aware of Mirex use by the military at Northeast Cape. Based on the remedial investigations, pesticides were not identified as contaminants of concern. USACE analyzed samples for pesticides (DDE/DDD/DDT) in 1994, which were not detected. We have no data indicating Mirex should be included as a contaminant of concern. The sediment core results previously presented by Scrudato et al. 2012 show Mirex present in sediment cores at low levels, which were below screening level concentrations for residential soil exposures. We do not expect these levels to harm people. The levels of Mirex did not exceed risk-based cleanup levels.

Comments from Professor Frank Von Hippel

The fish samples used for the health assessment were collected before the most active phase of remediation, and PCBs are often liberated during remediation activities, so they may not reflect current levels in fish.

> **ATSDR Response**: ATSDR reviewed the available edible fish data from Dolly Varden and pink salmon. These samples were collected in 2001, prior to remediation. ATSDR did not identify any edible fish data post-remediation for review. Additional Dolly Varden samples were collected in 2015 but have not been analyzed by a laboratory. Unfortunately, these fish samples have now exceeded EPA's recommended hold time of one year and are not acceptable for analysis. ATSDR adjusted the conclusion to reflect past exposures.

We found in the stickleback and blackfish that PCB concentrations varied a great deal by site in the watershed. I think the samples used in the report were only from the estuary and so would only reflect concentrations of fish from that site (and collected at that time, see #1 above).

> **ATSDR Response**: As stated in the text, blackfish and stickleback are not eaten; therefore, no exposure to the contaminants measured in these fish is expected. See the answer to the next comment for a discussion of fish residency.

Work was not done on these fish samples to determine if they were resident freshwater or anadromous. I would expect resident freshwater Dolly Varden in the Suqi River to have higher levels of PCBs than blackfish since they are likely at a higher trophic level, and blackfish levels are above EPA consumption guidelines.

> **ATSDR Response**: If additional fish samples are collected and analyzed in the future, they should be collected from multiple sites at Northeast Cape, analyzed for chemicals of concern, and the fish should be determined to be resident or anadromous. Unless fishers can tell the difference between resident or anadromous fish, they should be combined when calculating exposure doses.

Therefore, I do not think that you have data that would allow you to conclude that it is safe to eat Dolly Varden from the Suqi.

> **ATSDR Response**: The final version of this health consultation has been altered to clarify that the conclusion regarding fish applies to a past scenario.

To determine this, new samples would need to be obtained and measured, and each sample would need to be examined to determine if it is resident freshwater or anadromous.

> **ATSDR Response**: Agree, please see the response to comments #3 and #4 above.

It seems to be beyond the purview of your agency's mandate, but I think the nature of the data that you can consider restricts the value of the risk assessment process. Other governments, such as those in the EU, are taking a much more expansive view of risk assessment, including biological response data such as we have for the Suqi (e.g., endocrine disruption, altered gene expression – using model species such as the stickleback).

ATSDR Response: While biological models may show health effects to occur in exposed fish, ATSDR does not address ecological concerns. Human exposure to the chemical is still required in order to have an effect on a person. Although the exposure pathway for stickleback and blackfish was eliminated because people on St. Lawrence Island do not eat those species of fish, ATSDR reviewed those data, as requested in the public comments, to see if they could hypothetically cause harmful non-cancer health effects. Similar to the exposure scenario used to calculate exposure doses for fish which are regularly eaten, the hypothetical exposure scenario assumed consumption only in the summer months when tribal members use Northeast Cape as a fishing camp. The table below shows the results of this review. Adults could eat up to seven 8-ounce meals of stickleback and blackfish per week in the summer months, and children could eat three to six meals per week, depending on age, without exceeding the reference dose (RfD).

Table C-1. Fish Consumption rates for stickleback and blackfish that are not expected to result in non-cancer health effects, Northeast Cape FUDS

Back-calculated fish consumption rates for stickleback and blackfish from Northeast Cape			
Mean PCB Concentration (mg/kg)	Age Group [years]	Consumption Rate (7 days a week, 12 weeks a year, 78 years) [grams/ day]	Meals/week (8 oz meal, 4 oz for <6 years old)
Dioxin-like PCBs			
3.46e-7	2-<6	153	9.4
3.46e-7	6-<11	280	8.6
3.46e-7	11-<16	500	15.4
3.46e-7	16-<21	630	19.4
3.46e-7	Adult (>21)	704	21.7
Total PCBs			
0.030668	2-<6	50	3.1
0.030668	6-<11	91	2.8
0.030668	11-<16	161	5.0
0.030668	16-<21	203	6.3
0.030668	Adult (>21)	227	7.0

Comments from Alaska Department of Environmental Conservation (ADEC)

Page # Section	ADEC Comment	Response
V	Conclusions: Similar to ADEC's comment on the Gambell report, there appears to be a potential discrepancy re: the number of findings being referenced in the report versus the summary; noting the summary states and discusses 5 findings and the report states three conclusions.	Corrected to show four conclusions in each document.
	Conclusion 1: Related to the comment on the NEC Summary above, recommend considering elaborating on the references to '3 months' to provide better clarity and perspective; also with regard to other applicable mentions, i.e. in 'Next Steps' regarding if NEC were to become a year-round community. It is not totally clear if the report is referencing '3 months' based on implying that consumption is limited to on-site activity versus whether the same fish were consumed at the same rate for twelve months out of the year.	Done, clarified that our exposure scenario used a three-month exposure frequency
VI	Conclusion 2; Next Steps: Recommend revising the first sentence in the text box to better clarify whether the stated 'many different areas' is implied to mean all of those traditional areas, as well as FUDS site wide; and further whether any areas are recommended to be excluded from harvesting and consumption.	Done, clarified that there were no specific sites excluded.
VI Figure 2	Recommend revising the legend for 'water' to 'fresh surface water feature'.	Done
	Recommend revising 'county line' in the legend to 'St. Law. Is. Shoreline'; since the term 'county' is not applicable.	This map doesn't show that level of detail.
	Recommend revising the figure to depict the actual area/boundary that is considered the NVNC/fish camp by residents.	

Page # Section	ADEC Comment	Response
4	Remedial and Cleanup Activity: Similar to other comments above, recommend replacing references to 'contractors' throughout the document. In the last sentence of the first paragraph on this page, replace 'contactors' with 'USACE' since the Corps is the responsible party.	Done
	Please amend the discussion in this section to clarify/emphasize that the NALEMP work which was conducted by the NVS was limited and focused exclusively on the Fish Camp; and is not applicable to any of the other FUDS sites/areas of concern outside of what was considered Fish Camp AOC.	Done
8	Environmental Media: In the second full paragraph on this page, if applicable, recommend revising the reference to aromatic organic compounds (BTEX), to 'VOCs'.	Not applicable
	Recommend consider amending/revising the discussion in the last paragraph on this page to better clarify/emphasize that there is no current exposure potential based on there being no current use. However, there is contaminated groundwater at numerous sites that will require institutional controls and monitoring into the future	Done
8 Figure 3	Recommend applying comments on Figure 2 above for consistency.	Figure 3 was produced by Shannon & Wilson for the Remedial Investigation (RI).
10	Environmental Media: Recommend amending the discussion in the first paragraph on this page, and elsewhere throughout this and the other three documents where applicable, to clarify whether the statements and discussion are based on pre- or post- removal conditions (or both).	This paragraph states the data are from the RI. Spelled out "Remedial Investigation" to make it clearer.

Page # Section	ADEC Comment	Response
14 Biota	Fish: Recommend amending the statements in the info box on this page, as well as the narrative discussion in this section, to better clarify the other fish samples being referenced in re: to the statement 'has collected additional DV samples.'	Deleted text box because fish samples have exceeded the EPA-recommended hold time.
20	Conclusions; 4: Recommend amending this to also state (if applicable) i.e., 'post removal action confirmation analysis results indicated COC concentrations are below…'.	Not applicable.
27	Is there a reason why cumulative cancer risk is not presented for the combination of both exposure pathways? Further, typically exposure risk in risk assessments are based off of an upper limit of the average contaminant concentration; noting that it appears that the table only lists the average. Recommend further clarification as well as amending respective narrative discussions.	Added table with cumulative risk. Changed to 95UCL when >8 samples were available. For <8 samples, used the maximum value.

Comments from the Alaska Community Action on Toxics

Comments prepared by Alaska Community Action on Toxics (November 2017)

- Vi Waghiyi, Tribal Member, Native Village of Savoonga, and Environmental Health and Justice Program Director, Alaska Community Action on Toxics;
- Lorraine Eckstein, Ph.D. Research Anthropologist, Alaska Community Action on Toxics;
- Pamela Miller, M.En., Executive Director, Alaska Community Action on Toxics

Section 1: General Introductory Comments

ATSDR Ignores NEC Community

Change the title of this Health Consultation to: Evaluation of Environmental Exposure at the Formerly Used Defense Site (FUDS) at the Native Community of Northeast Cape, Alaska. When the U.S Department of Defense (DoD) occupied Northeast Cape (NEC) they displaced a community with tribal leaders, a council, and families who then went to live at the Village of Savoonga on St. Lawrence Island (SLI). The DoD ignored the fact that they were displacing a community of Indigenous residents and rewrote history by redefining this community as a seasonal camp. The military displaced the Native Village of Northeast Cape that included families who lived there year-round. If it had not been for the military occupation and consequent contamination, the Native Village of Northeast Cape would be present and people would still be living there year-round. The people of St. Lawrence Island do not believe that it is safe to re-establish the village because of the military contamination.

In a letter dated April 7, 1951, the Savoonga Tribal Council granted the United States Air Force a land withdrawal for military use at Northeast Cape with clear conditions, including the following provision: *"Any refuse or garbage will not be dumped in streams or near the beach within the proposed area as this will prove detrimental to the seal breeding grounds."*

The U.S Air Force and the Army Corps of Engineers have violated this agreement, causing and perpetuating extensive hazardous contamination. As the current governing entity, the Tribe reiterates authority to establish the highest standards that require restoration of the lands and waters damaged by military activities at Northeast Cape. St. Lawrence Island families want to re-establish the community at Northeast Cape but must ensure the health and safety of the people, lands, waters and traditional foods prior to relocation. The watershed of the Suqi River is still severely impaired and the contamination prevents the re-establishment and recovery of fish populations including the once plentiful salmon, tomcod, Dolly Varden. Seal haulouts at the mouth of the river have also never recovered.

The people of St. Lawrence Island have levels of PCBs in our blood serum that are 6-9 times higher the average levels in people living in the continental United States due to global transport, with higher PCB levels among the people who lived or worked at the military base at Northeast Cape. Annie Alowa, a respected elder and community health aide from Savoonga, had raised concerns about adverse health effects that she associated with the contamination from the military site at Northeast Cape, including cancers, miscarriages, low-birth weight, and other reproductive health problems. Community health researchers on the island have documented serious health harms including cancers, thyroid disease, learning and developmental problems,

diabetes, heart disease, and reproductive health impairment. The people are experiencing a cancer crisis on St. Lawrence Island.

As stated by Dr. David Carpenter, Director of the Institute for Health and the Environment at the University at Albany: "The evidence that there are health hazards from exposures to PCBs in the range of 6-9 ppb is very strong, with disease outcomes ranging from cancer to neurobehavioral effects to endocrine disruption and immune suppression." In 2013, the International Agency for Research on Cancer determined: "On the basis of sufficient evidence of carcinogenicity in humans and experimental animals, the Working Group classified PCBs as carcinogenic to humans (Group 1). PCBs are also associated with other adverse health effects including learning and development; immune, endocrine, and reproductive impairment.

To this day, the NEC families live, hunt, fish, and gather traditional foods that sustain them. Although they are kinfolk, the people of Savoonga continue to distinguish between those families who are from NEC and those who have always lived in Savoonga. It is important to note that the Yupik people of SLI are eager to return to NEC to reestablish their community; it is their right to do so. The families have witnessed greater health disparities, including cancers, birth defects, and endocrine disorders such as thyroid disease. Cancers are especially prevalent among the adults who were conceived and born in the NEC community. When respected elder and community health aide Annie Alowa first walked the NEC with ACAT's Pamela Miller in 1996, she showed her a graveyard of children who had died there, some through miscarriages and others with birth defects.

> **ATSDR response**: The title of the final health consultation should match the title of the previous version(s). There are several references in the health consultation to members of the Native Village of Savoonga's desire to re-establish the Native Village of Northeast Cape. Please see the Site Description and History and Demographics sections. Added, "…it formerly supported a community of tribal members who later relocated to Savoonga." to the Summary section in response to this comment.

ATSDR Used Health Consultations to Betray the People of St. Lawrence Island (SLI)

The leaders of the Army Corps have refused to complete their responsibilities on SLI. They have left the remaining health hazards in place and made it clear that they intend to abandon the people of SLI before all remediation efforts are completed.

The people of SLI asked for assistance from the Agency for Toxic Substances and Disease Registry (ATSDR) which worked for six years to create two Health Consultations—one for the military sites left at Gambell and the other at Northeast Cape. However, the ATSDR did not conduct these Health Consultations in good faith. ATSDR did not consult the tribes as required on a government-to-government basis, not did the agency respect and incorporate the knowledge and observations from the community. The mere fact that the ATSDR accepts the Army Corps' false conclusions, suggests that this is more of the same iniquities accredited to the ATSDR twenty-five years ago and repeated into present times. It is well known that the Centers for Disease Control and Protection (CDC) and the ATSDR produce documents that are "inconclusive by design."

Here is a quote from a document entitled *Inconclusive by Design: Waste, Fraud and Abuse in Federal Environmental Health Research* (May 1992). This investigative study by the Environmental Health Network and the National Toxics Campaign Fund states that "[a] major weakness in ATSDR's approach has been its lack of involvement with the public. During and after health assessments, contact with and outreach to local residents by ATSDR has been grossly inadequate. ATSDR has acknowledged this shortcoming as well. Asked by the Environmental Health Network, a network of hazardous waste victims and public health experts, the agency gave itself a "C" when it comes to "communication with communities."

The implications of this failure to communicate are dire, just as where a doctor fails to listen carefully to his or her patients [page 11]." https://www.ejnet.org/toxics/inconclusive.html

The ATSDR failed to communicate with us, they did not listen carefully to the people of SLI or study the most recent published, peer-reviewed journal articles by ACAT which include authors from SLI Yupik community health workers who live on SLI and are part of ACAT's research team.

Sixteen years after the phrase "inconclusive by design" was coined, the U.S. House of Representatives Committee on Science and Technology produced a forty-one-page Memorandum (2008) that concludes the following about the work of the CDC and ATSDR: "Instead of ensuring a margin of safety and recommending measures to end public exposures to toxics, both of these agencies have routinely funded and conducted studies of effects of toxic pollution on public health which are *inconclusive by design* [emphasis in original document; [page 38]." https://www.google.com/search?q=Memorandum+September+22%2C+2008+INCONCLUSIVE+BY+DESIGN&ie=utf-8&oe=utf-8 [ATSDR updated link to https://www.cdc.gov/media/pressrel/2008/pdf/atsdrstaffreportsept2008.pdf]**. Furthermore, this appraisal by Congress of the ATSDR continues to the present. The Center for Health, Environment & Justice warns communities (such as those on SLI) about the ATSDR:**

"Typically, if you raise enough public attention and pressure, the state will ask the [ATSDR] to do a health study. While you may initially be excited, be careful what you ask for. ATSDR has a poor track record at investigating health problems in communities. You are more likely to get a result that is "inconclusive by design" than you are to get an honest answer to your questions. At least that's what history tells us." http://chej.org/2015/02/16/health-studies-what-you-can-expect-and-what-you-can-do/ [ATSDR could not verify link.]

The ATSDR is also remiss in the people that they hire to conduct Health Consultations who lack necessary scientific qualifications, cultural understanding and sensitivity. The ATSDR staff spent minimal time on SLI and the Health Consultation reflects a poor understanding of the complexities of the military contamination and a lack of respect for the knowledge and culture of the people of SLI. The Health Consultation fails because of its reliance on 1) outdated and incomplete sampling data and site characterization from the Army Corp, 2) reliance on poor and outmoded toxicological models, and 3) inaccurate assumptions about hydrology and dispersion of contaminants. Note also, that the Reviewers of the Health Consultation work at the ATSDR, and although they may have advanced academic degrees, they blithely accepted the weaknesses of this document, as with the Gambell health consultation, knowing full well that it serves the DoD by offering speculation that pass as facts and inconclusiveness by design.

ATSDR response: ATSDR uses the best science available to investigate exposures. In response to the 1992 Congressional report, ATSDR expanded its community involvement program. This included additional community visits and expanded public comment periods. ATSDR visited St. Lawrence Island seven times, including visits to Savoonga twice before receiving the petition, and five times after receiving the petition. During these visits, communication with tribal leaders was conducted on a government-to-government basis, and concerns and information were gathered from the community and used in this evaluation. ATSDR also provided the Tribe with a 90-day public comment period for both the data validation draft and the public comment version. ATSDR followed approved guidance in assessing exposures and health risks.

Section 2: Foreword

Paragraph 1. The U.S. EPA (EPA) does not provide oversight or regulation of the investigation and cleanup of the military sites on SLI. **The ATSDR is inconclusive by design**.

Paragraph 2. **The ATSDR staff who prepared this health consultation do not have the necessary expertise. Furthermore, the ATSDR Health Consultation for SLI was not completed in an "expeditious" way (as claimed in this paragraph); it took six years.**

Paragraph 3; Exposure. **Information from the public, particularly the knowledge and observations of the people of St. Lawrence Island, was not taken into account.**

Paragraph 4; Health Effects. **The ATSDR does not recognize the children of SLI and other high-risk groups such as women, elderly people, and those with chronic illnesses. The NEC families did not receive special attention even though they have suffered multi-generational exposures and health disparities.**

Paragraph 5: Health Effects continued. The ATSDR lacks adequate scientific expertise.
Paragraph 6; Community. Local health knowledge and observations were not taken into account. The health knowledge presented to the ATSDR by the people of SLI was misrepresented and dismissed in this health consultation.

Paragraph 7; Conclusions. In response to ATSDR's claim that they can recommend "full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances," we note that the residents of SLI need these services for the evaluation of both the Gambell and NEC sites, but they are being withheld.

ATSDR response: The Foreword section of ATSDR's documents is not site-specific; rather it is meant to provide information on the health assessment process. The Foreword section is optional; therefore it was removed from this final version.

Section 3: Additional Introductory Comments

Captive Agencies

As we observed in our comments on the Gambell Health Consultation, the ATSDR is inconclusive by design so that when the ATSDR recommends action by the U.S EPA or other regulatory agencies, these agencies avoid acting on the recommendation because the ATSDR's findings were speculative or inconclusive. This health consultation does more harm than good because it is poorly designed and executed, relies on outdated and incomplete site characterization, old

toxicological models, and does not incorporate the knowledge and observations of the SLI Yupik people.

Renowned journalist and pundit, Molly Ivins, informs our comments. Shortly before her death from cancer in 2003, she defined a harmful governmental agency as a "captive agency," one that has been captured by the industry it is supposed to regulate. She wrote about captive agencies in her syndicated column (May 29, 2003):

"Those who work at captive agencies come to identify with their industry and believe their function is to service it, not regulate it."

Precautionary Principle

The precautionary principle and action is a strategy to cope with possible risks where scientific understanding is yet incomplete. Below is the definition suggested by the United Nations Educational Scientific Cultural Organization (UNESCO): Box 2. Precautionary Principle: When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm. Morally unacceptable harm refers to harm to humans or the environment that is threatening to human life or health, or serious and effectively irreversible, or inequitable to present or future generations, or imposed without adequate consideration of the human rights of those affected.

> **ATSDR response**: This document followed ATSDR's health assessment process to determine whether exposures at the site are or were high enough to cause harm to the community's health. ATSDR's process includes several conservative assumptions to make sure our evaluations are protective of health however; it is not based on the precautionary principle. Information about ATSDR's health assessment process can be found in the Public Health Assessment Guidance Manual, available at: https://www.atsdr.cdc.gov/pha-guidance/index.html

Section 4: Summary., INTRODUCTION Paragraph 1.

Comment: The advice in the Conclusion at the end of this Health Consultation states that the NEC fish and traditional foods are safe. This conclusion is unwarranted given that it relies on inadequate and outdated information. The contaminants at NEC continue to pose a significant source of pollution to traditional subsistence foods, water supplies, and medicinal plants. Recent studies by our community-based research team show that fish (stickleback and blackfish) continue to have elevated levels of PCBs. Also, these sentinel fish in the Suqi River show estrogenic effects, thyroid disruption, and altered gene expression linked with exposure to PCBs. Fish and humans share the same hormone systems and most of the genes underlying diseases in humans are the same genes underlying those diseases in fish. Estrogenic effects are associated with abnormal development and certain cancers. Altered gene expression results are also consistent with higher cancer risk.

The hazardous chemicals abandoned by the U.S. military present health hazards to the traditional fishing, hunting, and food gathering areas and means of survival, economic, social, spiritual, and cultural development for the Yupik people and future generations, particularly the NEC families. In this section also, the ATSDR claims to have used "environmental data" collected from the Native Village of Savoonga, Army Corps, ACAT, the Alaska Division of Public Health, and input from "Tribal officials and community members." However, input from tribal officials, community members, and ACAT was not taken into account.

Some of the following comments were made on the previous draft, however, are repeated here because they were not taken into account.

The site description/history is incorrect and incomplete. The military displaced the Native Village of Northeast Cape that included families who lived there year-round. If it had not been for the military occupation and consequent contamination, the Native Village of Northeast Cape would be present and people would still be living there year-round. The people of St. Lawrence Island do not believe that it is safe to re-establish the village because of the military contamination.

> **ATSDR response**: Added, "The site formerly supported the Native Village of Northeast Cape before tribal members relocated to Savoonga," to the Site Description and History section. The following section, Demographics, states this as well.

It is incorrect to state that "it will not be possible to definitively determine the source of the contaminants or to or to determine the global transport and deposition of other pollutants in the environment." Global contaminants can be distinguished from local sources (e.g. the military contamination) through such means as congener-specific analyses, sediment core profiles, and contaminant distributional data. For example, some of our research, published in a peer-reviewed journal, clearly distinguishes local and global sources. See: Scrudato, Ronald J. J.R. Chiarenzelli, P.K. Miller, C.R. Alexander, J. Arnason, K. Zamzow, K. Zweifel, J. Kava, V. Waghiyi, D.O. Carpenter. 2012. Contaminants at Arctic formerly used defense sites. Journal of Local and Global Health Sciences, Vol. 2012, 2. http://www.qscience.com/doi/abs/10.5339/jlghs.2012.2

> **ATSDR response**: ATSDR's goal is to determine if people could be harmed by contamination, regardless of source. The last sentence of Carpenter et al. 2005 states, "In summary, our results suggest that the former military site located at the NEC on St. Lawrence Island may contribute to the PCB exposure of the native residents, but that the predominant source is global transport, deposition and bioconcentration in foodstuffs." Therefore, there seem to be discrepancies in these two reports. For this and other reasons, ATSDR will not speculate on the origins of contamination at Northeast Cape.

The discussion misrepresents history—local residents salvaged materials that had been disposed during the military occupation and after the site had been abandoned by the military. People of St. Lawrence Island viewed this as wasteful and were trying to make use of materials yet were not warned of their inherent hazards. Much of this material was re-used as building materials for homes where the contaminants such as PCBs, lead, and asbestos are a source of continuing exposure to people of SLI.

ATSDR response: Added, "Much of the material was reused as building material for homes," to the first paragraph of the Chemicals of Concern section.

You rely on outdated information (ATSDR 2000) concerning the health effects of PCBs which nullifies the conclusions of this health consultation. There have been many relevant and critical studies on the health effects of PCBs in the peer reviewed literature since 2000 that should be taken into consideration in this health consultation. In 2013, the International Agency for Research on Cancer determined: "On the basis of sufficient evidence of carcinogenicity in humans and experimental animals, the Working Group classified PCBs as carcinogenic to humans (Group 1).

Additionally, dioxin-like PCBs were also classified in Group 1 on the basis of extensive evidence of an Ah-R-mediated mechanism of carcinogenesis that is identical to that of 2,3,7,8-tetrachlorodibenzo-para-dioxin, and sufficient evidence of carcinogenicity in experimental animals. However, the carcinogenicity of PCBs cannot be solely attributed to the carcinogenicity of the dioxin-like PCBs." This is a definitive determination of a committee of 26 experts from 12 countries who reviewed more than "70 independent epidemiological studies with informative data for carcinogenicity in human beings." The IARC assessment states, in part: "PCB congeners can be categorized by their degree of chlorination, substitution pattern, and binding affinity to receptors. 12 congeners with a strong affinity for the aryl hydrocarbon receptor (AhR) are referred to as dioxin like PCBs. PCBs are readily absorbed and distributed in the body and accumulate in adipose tissue. Biotransformation of all PCB congeners starts with cytochrome P450- dependent monooxygenation.

Low-chlorinated PCBs are readily metabolized into highly reactive electrophilic species (i.e., arene oxides, quinones) which, in addition to producing DNA adducts and reactive oxygen species, are directly genotoxic and mutagenic. By contrast, highly chlorinated PCBs are poorly metabolised but, through induction of xenobiotic-metabolising enzymes, can also generate reactive oxygen species, lipid peroxidation, oxidative and alkylating DNA adducts, and can eventually cause genotoxic effects. Individual PCBs activate numerous receptors, including AhR and the constitutive androstane and pregnane xenobiotic receptors (CAR/PXR). AhR activation is one of the key events linked to carcinogenesis mediated by dioxin-like PCBs. Sustained activation leads to deregulation of cell-cycle control and cell proliferation, inhibition of apoptosis, suppression of cell-to-cell communication and adhesion, and increased cell plasticity and invasiveness. Non- dioxin-like PCBs induce many of these effects via several AhR-independent mechanisms, including activation of the constitutive androstane and pregnane xenobiotic receptors, and perturbations in cell-to cell communication and cell adhesion.

PCBs can compromise the immune surveillance mechanism. Highly chlorinated PCBs with a strong affinity for the AhR are potent immunotoxicants; less-chlorinated PCBs, which are less immunotoxic, act via AhR-independent mechanisms, including metabolic activation. Both low-chlorinated and high-chlorinated PCBs are associated with chronic inflammatory responses. Non-dioxin like PCBs can stimulate the production of inflammatory mediators, whereas dioxin-like PCBs can inhibit such reaction. By contrast, some dioxin-like PCBs, but not non-dioxin-like PCBs, can compromise the normal function of the vascular endothelium. PCBs target the endocrine system. Several models have shown direct modulation of nuclear steroid hormone-dependent gene expression by PCBs. Furthermore, depending on their structure,

monohydroxylated PCB metabolites can act as oestrogen agonists or antagonists. These disruptions might have reproductive, toxic, and carcinogenic consequences.

> **ATSDR response**: ATSDR agrees that PCBs are carcinogenic. The Health Consultation states that the IARC classifies PCBs as carcinogens in the Chemicals of Concern section and the Soil section. For the final version of this health consultation, ATSDR reviewed soil and surface water data from the Removal Action/Site Investigation Report published by the Native Village of Savoonga in 2013. This data included congener-specific PCBs in soil. Table A-3 presents the Toxic Equivalencies (TEQ) for dioxin-like PCBs in soil. These TEQs were used to calculate cancer risk. The calculated increased lifetime cancer risk for dioxin-like PCBs in soil at the site is about 1 to 2 additional cancer cases in 1,000,000 people, which is considered a very low or no apparent increased risk, and the hazard quotient is below one for all age ranges.

The document states that many environmental studies have been conducted at NE Cape and uses the Corps contractor reports as a source of information for data. It must be acknowledged that these data are severely limited and do not accurately represent the nature and extent of contamination at NEC.

> **ATSDR response**: ATSDR found the environmental data available to be sufficient for evaluating the site. Biota data were limited—this limitation is mentioned in the Biota section, which is located on pages 16-20. Exposure dose calculations for biota data are also discussed in Appendix A.

We disagree with assumptions used to calculate exposure doses and that MRLs based on LOAELs are valid. These determinations are based on the outmoded concept of "dose makes the poison" which ignores low-dose effects and non-monotonic dose-responses that are known to occur with endocrine-disrupting chemicals. "The concept of nonmonotonicity is an essential one for the field of environmental health science because when NMDRCs occur, the effects of low doses cannot be predicted by the effects observed at high doses. In addition, the finding that chemicals have adverse effects on animals and humans in the range of environmental exposures clearly indicates that low doses cannot be ignored." Reference: Vandenberg et al. 2012. Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. Endocrine Reviews 33(3):378-455. "Assumptions used in chemical risk assessments to estimate a threshold dose (i.e. LOAEL, MRL) below which daily exposure to a chemical is estimated to be safe are false for endocrine disrupting chemicals." These assumptions also ignore the fact that there are critical windows of development when people are more vulnerable to exposures, the fact that there are cumulative and synergistic effects of chemicals, and that people are exposed to chemical mixtures.

> **ATSDR response:** Information about how ATSDR calculates exposure doses and develops MRLs can be found in the Public Health Assessment Guidance Manual, available at: https://www.atsdr.cdc.gov/pha-guidance/conducting_scientific_evaluations/screening_analysis/index.html and https://www.atsdr.cdc.gov/pha-guidance/conducting_scientific_evaluations/epcs_and_exposure_calculations/index.html

It is not correct to assume that groundwater was never used as drinking water. Groundwater and surface waters are connected — water from the Suqi River has been and is currently used as a

drinking water source. These assumptions therefore are not health protective. Several contaminants exceeded the CVs. The consultation must also include congener-specific analyses of PCBs (rather than arochlors), and additional contaminants such as organochlorine pesticides.

> **ATSDR response**: Available Suqi River surface water samples were compared to ATSDR drinking water CVs. One sample exceeded CVs. ATSDR calculated the increased lifetime cancer risk associated with drinking Suqi River water at that sample's concentration, which posed a low increased cancer risk. ATSDR did not evaluate groundwater samples, which exceeded cleanup levels, because people are not drinking the groundwater. This should be addressed if people drink groundwater in the future. For the final version of this health consultation, additional surface water data was evaluated. Only PAHs exceeded health-based comparison values for screening surface water. The total lifetime increased cancer risk from drinking water containing the maximum amount of PAHs in the Suqi River was 2 to 5 additional cancer cases in 1,000,000 people which is considered a very low or no apparent increased risk.

ATSDR recommends testing of any new or existing groundwater or surface water prior to future use as a potable water source. This is not reasonable advice given that the Suqi River is currently used as a water source and that the community does not have the means to conduct their own testing. A prudent approach would be to educate and advise people not to use the Suqi River as a drinking water source and mandate regular, independent water quality monitoring with results provided to the community.

> **ATSDR response**: See previous response. Using available Suqi River chemical samples, the surface water was not found to pose a health hazard if used as a drinking water source. However, whenever utilizing an untreated surface water source, it is a prudent health practice to boil the water to safeguard against possible biological contamination. Additionally, if Northeast Cape became a year-round community and the Suqi River was used as the drinking water source for that community, it would need to be tested regularly and meet water quality standards. ATSDR is available, upon request, to evaluate additional surface water or groundwater sampling that may become available and comment on public health implications in the future.

The cancer risk presented here is based on outdated information that understates risk concerning PCBs. As stated above: IARC, 2013 concludes: "on the basis of sufficient evidence of carcinogenicity in humans and experimental animals, the Working Group classified PCBs as carcinogenic to humans (Group 1)." It is irresponsible not to determine non-cancer risks based on the spurious argument that non-cancer health guidelines are not available for Arochlor 1260. Enough is known about endocrine effects, immune and metabolic disorders, and other diseases associated with exposures to PCBs that urgent measures should be taken clean up the site and to protect public health.

> **ATSDR response**: The Health Consultation states that the IARC classifies PCBs as carcinogens in the Chemicals of Concern section and the Soil section. Cancer risk was calculated because cancer is the most sensitive endpoint for Aroclor 1260. Because the most sensitive cancer endpoint was not found to be of concern for Aroclor 1260, non-cancer effects are also unlikely. Non-cancer risks were calculated for chemicals in which non-cancer health effects are the most sensitive endpoints.

Surface water samples taken from 2004 are not adequate to base determinations and it should not be assumed that people do not drink water from the Suqi River.

> **ATSDR response**: No use of the Suqi River for current drinking water was reported to ATSDR by community members; however, ACAT identified the Suqi River as a drinking water source. Additionally, Tribal members would like to use it for drinking water in the future. For these reasons, the available Suqi River surface water samples collected during remediation were compared to ATSDR drinking water CVs. If additional sample results become available in the future, ATSDR may evaluate them, upon request.

The January 2013 report of the NVS clearly indicates that there is a present threat to the public health of the people of St. Lawrence Island and that measures need to be taken to prevent further exposures and harm to public health.

> **ATSDR response**: Added, "The RA/SI Report recommends additional RA/SI activities for the NVNC site to further investigate, abate, and remove remaining environmental hazards," to the Remedial and Cleanup Activity section.

The conclusion that consuming wild plants from NEC is "not expected" to cause non-harmful health effects is speculative and not supported.

> **ATSDR response**: ATSDR utilized the limited, available edible plant data to calculate exposure doses and compare those doses to health guidelines. ATSDR attempted to obtain additional plant data from the Scrudato, et al. publication, however those data were no longer available. If additional edible plant data are collected, ATSDR may be available to evaluate those data, upon request.

The document misinterprets fish consumption advisories of EPA. In 2000 EPA issued a document entitled "Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories." They give tables on how many fish meals per month one can safely eat based on the chemical concentrations. For PCBs the values given in the ATSDR report are 0.0135 ppm Aroclor 1254 and 0.0043 ppm Aroclor 1260, for a total of 0.0178 ppm. The EPA guidance is that if fish have this concentration, a person can safely eat no more than 2 meals per month without increasing risk of cancer. But they have measurements of only two of the Aroclor mixtures, so that is an underestimation of the total PCB content. For benzo-a-pyrene, EPA has only one value for PAHs. The BAP concentration is 0.0048 ppm, which triggers an advisory of no more than two meals per month. But this is a gross underestimation of the total PAH content. On the basis of these values, we believe that ATSDR understates risk (Observation from Dr. David Carpenter MD).

> **ATSDR response**: Given the need to balance the benefits and risks of fish consumption, fish advisories and the method of calculation are managed by each state, usually by the health department. Alaska has not issued a PCB fish advisory. ATSDR calculated site-specific exposure doses and compared them to health guidelines. Total PCBs (detected Aroclors 1254 and 1260) and PAHs (benzo-a- pyrene equivalents) were the only contaminants that exceeded health guidelines in fish, not the only contaminants which ATSDR reviewed. ATSDR reviewed all available PCB and PAH data. ATSDR does not have congener data for PCBs in fish other than stickleback and blackfish. Aroclor data were the only PCB data that were available for edible fish.

Contamination from military activities at NEC virtually destroyed fish species in the Suqi River that were used for subsistence. Data presented here from 2001 and 2003 are incomplete and outdated. More recent data concerning elevated PCB levels in stickleback and blackfish cannot be ignored. These are sentinel fish species and important to consider when assessing hazards to human health.

ATSDR response: Although multiple sources have confirmed that stickleback and blackfish are not eaten on St. Lawrence Island, these data were obtained and reviewed in response to this comment. Hypothetical fish consumption rates were calculated. This table shows the amount of fish that different age groups could consume without exceeding a hazard quotient of 1—in other words, the amount of stickleback/blackfish that could be consumed without risk of the most sensitive non- cancer health effects such as decreased antibody response and altered social behavior. Other health effects from PCBs are expected to occur at higher doses not observed here. The maximum concentration found in stickleback or blackfish was used, which is a very conservative estimate. Similar to the exposure scenario used to calculate exposure doses for fish which are regularly eaten, the exposure scenario assumed consumption only in the summer months when tribal members use Northeast Cape as a fishing camp. Adults could eat up to seven 8-ounce meals of stickleback and blackfish per week in the summer months, and children could eat three to six meals per week, depending on age.

Table C-1. Fish Consumption rates for stickleback and blackfish for Northeast Cape that are not expected to result in non-cancer health effects

Back-calculated fish consumption rates for stickleback and blackfish from Northeast Cape			
Mean PCB Concentration	Age Group [years]	Consumption Rate (7 days a week, 12 weeks a year, 78 years) [grams/ day]	Meals/week (8 oz meal, 4 oz for <6 years old)
Dioxin-like PCBs			
3.46e-7 mg/kg	2-<6	153	9.4
3.46e-7 mg/kg	6-<11	280	8.6
3.46e-7 mg/kg	11-<16	500	15.4
3.46e-7 mg/kg	16-<21	630	19.4
3.46e-7 mg/kg	Adult (>21)	704	21.7
Total PCBs			
0.030668 mg/kg	2-<6	50	3.1
0.030668 mg/kg	6-<11	91	2.8
0.030668 mg/kg	11-<16	161	5.0
0.030668 mg/kg	16-<21	203	6.3
0.030668 mg/kg	Adult (>21)	227	7.0

It is not true that chemical data and subsistence ingestion rates are not available. See: Welfinger-Smith, Gretchen. Judith L. Minholz, Sam Byrne, Vi Waghiyi, Jesse Gologergen, Jane Kava, Morgan Apatiki, Eddie Ungott, Pamela K. Miller, John G. Arnason, David O. Carpenter. 2011. Organochlorine and Metal Contaminants in Traditional Foods from St. Lawrence Island, Alaska. Journal of Toxicology and Environmental Health, Part A.74:1195-1214. http://www.ncbi.nlm.nih.gov/pubmed/21797772 **EPA guidelines for consumption of fish are health-based guidelines. Moreover, the State of Alaska and other agencies have determined consumption rates for fish and marine mammals.**

> **ATSDR Response**: The Welfinger-Smith et al. publication is referenced in the Other Traditional Foods section of the health consultation. ATSDR did not have access to the raw data used in Ms. Welfinger-Smith's publication. Whenever possible, ATSDR uses site-specific ingestion rates.

The determination of cancer risk is simplistic and based on false assumptions. Congener specific determinations should be made for PCBs rather than determinations for arochlor 1254 and 1260. The risk assessment does not consider the full range of contaminants that people are exposed to, critical windows of development, synergistic and cumulative effects, exposures to mixtures, endocrine effects at low doses. Observation from Dr. Carpenter: The document quotes the American Cancer Society saying that only 2% of cancers are caused by environmental pollutants, whereas studies published in the New England Journal of Medicine indicate that about 85% of cancer is due to "environmental factors." The document minimizes the effects of exposure to known carcinogenic chemicals such as PCBs.

> **ATSDR response**: The discrepancy between the percentage of cancers caused by environmental factors is due to a difference in the way "environment" is defined. A broader definition of the term environment includes environmental tobacco smoke, aka secondhand smoke, and other lifestyle factors. These factors account for a large percentage of cancers. A more narrow definition of environment includes contamination of air, soil, water and food. For a more in-depth discussion, please see Laura A. McGuinn, Armen A. Ghazarian, Gary L. Ellison, Chinonye E. Harvey, Christine M. Kaefer, Britt C. Reid. Cancer and environment: Definitions and misconceptions. Environmental Research, Volume 112, 2012, available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3267861/ ATSDR reviewed newer PCB congener data for this final version of the health consultation. Please see the Soil section and Appendix A.

The consultation document notes that ADHP concluded that the levels of PCBs in blood serum were similar to those in other Alaska Native populations and that the levels would "not be expected" to cause adverse health effects. This statement flies in the face of enormous evidence. The evidence that there are health hazards from exposures to PCBs in the range of 6-9 ppb is very strong, with disease outcomes ranging from cancer to neurobehavioral effects to endocrine disruption and immune suppression. There is no question but that certain Alaska Native populations have serum PCB levels above the national average. The study that Middaugh and ADHP purport to dispute was published in the peer-reviewed literature: Carpenter, David O. Anthony P. DeCaprio, David O. Hehir, Farooq Akhtar, Glenn Johnson, Ronald J. Scrudato, Lucy Apatiki, Jane Kava, Jesse Gologergen, Pamela K. Miller, Lorraine Eckstein. 2005. Polychlorinated Biphenyls in Serum of the Siberian Yupik People from St. Lawrence Island,

Alaska. International Journal of Circumpolar Health 64:4 2005. http://www.ncbi.nlm.nih.gov/pubmed/16277117 **The lead author, Dr. David Carpenter, is an internationally renowned expert on the health effects of PCBs and was an invited specialist consulted on the IARC expert panel on the carcinogenicity of PCBs.**

> **ATSDR response**. Residents of St. Lawrence Island have PCB blood serum levels similar to those of other native Alaskans. Alaska natives have higher levels of PCBs in blood serum than other Americans. According to ADPH 2003, "While clear toxic effects have been demonstrated at high PCB doses, scientific controversy remains regarding possible subtle effects at low doses. However, the overall weight of evidence supports the conclusion that no adverse health effects would be expected at the PCB concentrations measured in this study."

It is not accurate to say that children "could" be at greater risk. It is well established that they are at greater risk.

> **ATSDR response**: The Child Health Considerations section states that, "Children are at greater risk…"

We find the conclusions, recommendations, and action plan insufficient and not protective of human health. The assumptions that were made to draw these conclusions are inaccurate and simplistic. We are highly disappointed with this consultation because we think that it is fundamentally flawed, relies on incorrect assumptions and outdated references, and does not properly take into consideration the valid and long-standing observations (beginning with community health aide and elder Annie Alowa) and knowledge of the people of St. Lawrence Island concerning the health problems associated with the military site at NEC. The document does not reference the full range of publications concerning St. Lawrence Island and NEC. Please see full list below.

- **Carpenter, David O. Anthony P. DeCaprio, David O. Hehir, Farooq Akhtar, Glenn Johnson, Ronald J. Scrudato, Lucy Apatiki, Jane Kava, Jesse Gologergen, Pamela K. Miller, Lorraine Eckstein. 2005. Polychlorinated Biphenyls in Serum of the Siberian Yupik People from St. Lawrence Island, Alaska. International Journal of Circumpolar Health 64:4 2005.** http://www.ncbi.nlm.nih.gov/pubmed/16277117
- **Welfinger-Smith, Gretchen. Judith L. Minholz, Sam Byrne, Vi Waghiyi, Jesse Gologergen, Jane Kava, Morgan Apatiki, Eddie Ungott, Pamela K. Miller, John G. Arnason, David O. Carpenter. 2011. Organochlorine and Metal Contaminants in Traditional Foods from St. Lawrence Island, Alaska. Journal of Toxicology and Environmental Health, Part A.74:1195-1214.** http://www.ncbi.nlm.nih.gov/pubmed/21797772
- **Hoover, Elizabeth. Katsi Cook, Ron Plain, Kathy Sanchez, Vi Waghiyi, Pamela Miller, Renee Dufault, Caitlin Sislin, David O. Carpenter. Indigenous Peoples of North America: Environmental Exposures and Reproductive Justice. 2012. Environmental Health Perspectives. National Institute of Environmental Health Sciences. National Institute of Health, U.S. Department of Health and Human Services:** https://ehp.niehs.nih.gov/doi/10.1289/ehp.1205422
- **Scrudato, Ronald J. J.R. Chiarenzelli, P.K. Miller, C.R. Alexander, J. Arnason, K. Zamzow, K. Zweifel, J. Kava, V. Waghiyi, D.O. Carpenter. 2012. Contaminants at Arctic formerly used defense sites. Journal of Local and Global Health Sciences, Vol. 2012, 2.** http://www.qscience.com/doi/abs/10.5339/jlghs.2012.2

- **Miller, Pamela K. Viola Waghiyi, Gretchen Welfinger-Smith, Samuel Carter Byrne, Jane Kava, Jesse Gologergen, Lorraine Eckstein, Ronald Scrudato, Jeff Chiarenzelli, David O. Carpenter, Samarys Seguinot-Medina. 2013. Community-based participatory research projects and policy engagement to Protect Environmental Health on St. Lawrence Island, Alaska. International Journal of Circumpolar Health; Circumpolar Health Supplement 72: 21656**
- **Byrne, Samuel. Pamela Miller, Viola Waghiyi, C. Loren Buck, Frank A. von Hippel, David O. Carpenter. 2015. Persistent Organochlorine Pesticide Exposure Related to a Formerly Used Defense Site on St. Lawrence Island, Alaska: Data from Sentinel Fish and Human Sera, Journal of Toxicology and Environmental Health, Part A: Current Issues, 78:15, 976-992.**
- **Samuel Byrne, Samarys Seguinot-Medina, Pamela Miller, Vi Waghiyi, Frank A. von Hippel, C. Loren Buck, David O. Carpenter. 2017. Exposure to polybrominated diphenyl ethers and perfluoroalkyl substances in a remote population of Alaska Natives. Env. Poll. 231:387-395.**

> **ATSDR response**. The Documents Reviewed and Cited section included all the above except the 2017 publication, which was published after ATSDR published the public comment version of the health consultation. Byrne et al. 2017 has since been reviewed and added to the Documents Reviewed and Cited section.

CONCLUSIONS: "ATSDR reached three important conclusions in this health consultation." Comment: Four conclusions are offered.

> **ATSDR Response**. Made the correction in the Summary to state that ATSDR reached four conclusions.

Conclusion 1. "Eating fish from Northeast Cape in the summer (3 months) is not expected to harm people's health." **Comment: "is not expected to harm people's health" is speculative about the safety of the fish at NEC and should not be included—this is an example of inconclusive by design. Furthermore, ACAT's CBPR research team have sampled sentinel fish (stickleback and blackfish) in water bodies at NEC and found elevated levels of PCBs and adverse endocrine and developmental effects.**

> **ATSDR response.** ATSDR used the available edible fish data to calculate exposure doses and compared those doses to health guidelines. While we can never be absolutely certain if exposures will cause health effects, exposure doses did not exceed established health guidelines. Stickleback and blackfish are not eaten on St. Lawrence Island. Per ACAT's request, ATSDR calculated a hypothetical fish consumption rate. Table C-1 shows the amount of fish that different age groups could consume without exceeding a hazard quotient of 1—in other words, the amount of stickleback/blackfish that could be consumed without risk of non-cancer health effects.
>
> The maximum concentration found in stickleback or blackfish was used, which is a very conservative estimate. Similar to the exposure scenario used to calculate exposure doses for fish which are regularly eaten, the exposure scenario assumed consumption only in the summer months when tribal members use Northeast Cape as a fishing camp. Adults could eat up to seven 8-ounce meals of stickleback and blackfish per week in the summer months, and children could eat three to six meals per week, depending on age.

Table C-1. Amount of fish that different age groups could consume without risk of non-cancer health effects.

Back-calculated fish consumption rates for stickleback and blackfish from Northeast Cape			
Mean PCB Concentration [mg/kg]	Age Group [years]	Consumption Rate (7 days a week, 12 weeks a year, 78 years) [grams/ day]	Meals/week (8 oz meal, 4 oz for <6 years old)
Dioxin-like PCBs (			
3.46e-7	2-<6	153	9.4
3.46e-7	6-<11	280	8.6
3.46e-7	11-<16	500	15.4
3.46e-7	16-<21	630	19.4
3.46e-7	Adult (>21)	704	21.7
Total PCBs			
0.030668	2-<6	50	3.1
0.030668	6-<11	91	2.8
0.030668	11-<16	161	5.0
0.030668	16-<21	203	6.3
0.030668	Adult (>21)	227	7.0

Conclusion 1. Basis for Conclusion, Sentence 1. "Contaminants are not present in fish at sufficiently elevated levels to be harmful."

Comment: Current toxicological models demonstrates that the old axiom—"the dose makes the poison"—is not valid. We disagree with assumptions used to calculate exposure doses and that MRLs based on LOAELs are valid. These determinations are based on the outmoded concept of "dose makes the poison" which ignores low-dose effects and non-monotonic dose-responses that are known to occur with endocrine-disrupting chemicals. "The concept of nonmonotonicity is an essential one for the field of environmental health science because when NMDRCs occur, the effects of low doses cannot be predicted by the effects observed at high doses.

In addition, the finding that chemicals have adverse effects on animals and humans in the range of environmental exposures clearly indicates that low doses cannot be ignored." Reference: Vandenberg et al. 2012. Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. Endocrine Reviews 33(3):378-455. "Assumptions used in chemical risk assessments to estimate a threshold dose (i.e. LOAEL, MRL) below which daily exposure to a chemical is estimated to be safe are false for endocrine disrupting chemicals." These assumptions also ignore the fact that there are critical windows of development when people are more vulnerable to exposures, the fact that there are cumulative and synergistic effects of chemicals, and that people are exposed to chemical mixtures. We know that even miniscule doses can harm the health of the developing child and that harm may be manifested across generations due to the transmission of contaminants from mother to child as well as epigenetic effects.

ATSDR Response. Evidence available from epidemiological studies suggests that exposure to high concentrations of chlorinated dibenzo-p-dioxins (CDDs) may induce long-term alterations in glucose metabolism and subtle alterations in thyroid function (ATSDR 1998). Although there is evidence for endocrine effects in humans exposed to dioxin-like PCBs, these are not the most sensitive endpoints. Immunological and developmental effects are the most sensitive endpoints; therefore, they were used to derive the MRL (ATSDR 1998, 2012b). The MRL was used as the health guideline in this health consultation and is believed to be protective of immunological and developmental endpoints, as well as less sensitive endpoints such as endocrine effects.

Conclusion 1, Sentence 2. "Contaminants were measured in egg, head and fillet samples of blackfish, Dolly Varden char and pink salmon. **ATSDR did not consider blackfish samples in this document because these are not eaten by Tribal members."**

Comment: Blackfish and stickleback are indicator fish and sentinel species. Samples were taken to measure the safety of the waters, and the samples show elevated levels of PCBs and adverse developmental and endocrine effects. The ATSDR should not suggest that these other fish are safe to eat if the sentinel fish indicates that the waters are not safe.

Contamination from military activities at NEC virtually destroyed fish species in the Suqi River that were used for subsistence. Data presented in the health consultation from 2001 and 2003 are incomplete and outdated, and based on only a very few fish samples. More recent data concerning elevated PCB levels in stickleback and blackfish cannot be ignored. These are sentinel fish species and important to consider when assessing hazards to human health.

ATSDR response. ATSDR evaluated all available edible fish species. While stickleback and blackfish may be of interest from an ecological standpoint, the human health exposure pathway was eliminated because they are not fish that humans eat. If additional edible fish data become available, ATSDR would be interested in reviewing those data. Please see the hypothetical exposure scenario and table above.

Conclusion 1, Next Step. Sentence 1 & 2. "ATSDR recommends Tribal members continue to eat fish from the traditional seasonal fishing grounds at Northeast Cape. Subsistence fish have many healthy, as well as cultural, benefits."

Comment: This recommendation is irresponsible and dangerous to the health of the people of St. Lawrence Island. We highly disagree with the recommendation because it is based on the inadequate site characterization of the Corps and extremely minimal fish samples taken in the early 2000s.

ATSDR response. Added, "in the summer," to clarify the exposure frequency assumption of three months that ATSDR used in their calculations.

Conclusion 1, Next Steps. Sentence 3. "If the Northeast Cape becomes a year-round community in the future, ATSDR recommends collecting additional edible fish samples."

Comment: First, there is already an NEC year-round community who has been displaced and will return as soon as the military toxics are removed from the area and when it is a safe and healthy place to live. A regular and comprehensive monitoring plan must be independently conducted using a community-based participatory research model that includes the people of SLI in the design, implementation, and interpretation of results. This should include integrated analysis of surface and groundwater (use of SPMDs), sediments, plants/berries, sentinel and edible species of fish, and marine mammals.

> **ATSDR response.** If additional data become available, ATSDR may work with the community to analyze them.

Conclusion 2. "Based on available (limited) data, eating greens and berries from Northeast Cape year-round is not expected to harm people's health."

Comment: The ATSDR should not recommend this, because their data are extremely limited and incomplete. This is irresponsible! The SLI people already refrain from gathering from NEC because of the known hazards, however signage in the Yupik language is warranted to prevent consumption of water, greens and berries, and fish.

Conclusion 2. Basis for Conclusion.

Comment: Remove Conclusion 2 entirely, inasmuch as this entire paragraph is based on insufficient data that are not able to represent the actual risks.

Conclusion 2. Next Steps.

Comments are identical to "Conclusion 1. Next Steps."

> **ATSDR Response.** ATSDR reviewed all available edible plant data. ATSDR attempted to obtain additional plant data from the Scrudato et al. publication, however those data were no longer available. While these data are somewhat limited, they provide enough information to inform health conclusions. If additional edible plant data are collected, ATSDR may be available to evaluate those data, upon request.

Conclusion 3. "Accidentally ingesting soil for half of the year and drinking Suqitughneq (Suqi) River surface water year-round are not expected to harm people's health."

Comment: This is highly speculative, and it should be rewritten to remove the sarcasm.

Conclusion 3. Basis for Conclusion. "Contaminants are not present in soil or Suqi River surface water at sufficiently elevated levels to be harmful."

Comment: Site characterization of the nature and extent of contamination is woefully inadequate and incomplete. This conclusion is not warranted.

Conclusion 3. Next Steps. "If the Northeast Cape becomes a year-round community in the future, ATSDR recommends collecting and analyzing additional Suqi River surface water samples for all water quality parameters before the river is used as a drinking water source."

Comment: This is an insulting and circular argument. The NEC community will not return there to live year-round until the military toxics are properly remediated. The nature and extent of contamination at NEC must be fully characterized in order to inform responsible clean up decisions that are protective of the health of the residents of NEC.

> **ATSDR Response**. Although the Suqi River water is safe to drink from a chemical perspective, it would be a prudent public health practice to boil the water before use to safeguard against any possible biological contamination. Additionally, if Northeast Cape becomes a year-round community, a drinking water sampling protocol would need to be established if the river was used as an ongoing source of drinking water.

Conclusion 4: "There is not enough contact with site contaminants to suggest that exposures are contributing to cancer and health defects rates."

Comment about Cancer: ACAT has twenty-years of experience with leaders from the Army Corps who tell barefaced lies about the toxicity and exposure pathways at the toxic sites on SLI. The site is improperly characterized with incomplete and inadequate information about the nature and extent of contamination. Furthermore, the ATSDR follows suit by showing disrespect for the community by discrediting or ignoring the knowledge of the SLI leadership about exposure pathways and cases of cancer. The incidents of cancer are so high in SLI among those exposed to toxics left behind by the military, that one of the leaders exclaimed, "It is not a matter of whether we will develop cancer; it is a matter of when!"

Many SLI residents see military toxics as a form of genocide because the toxics that cause cancer can be passed down to future generations. Their health has already been harmed. The people of SLI challenge the cancer rates offered by the Alaska cancer registry. They are conducting their own community cancer registry.

The ACAT research team determined that NEC families have blood serum levels of PCBs that are higher than the other two groups on SLI (those Yupik who live in Gambell and those who live in Savoonga but are not from the NEC community.)

Before the military occupation on SLI, there were no cases of cancer. ACAT's Research Anthropologist, reviewed the archived data at the University of Alaska Fairbanks, which includes information about the health of the people on SLI recorded by teachers and missionaries dating back to 1904. Among those archives, were notes from a husband-and-wife team Dr. Dorthea Cross Leighton and her husband (anthropologist and physician) who studied the health of the people in Gambell in the summer of 1943. Almost all of the people allowed medical examinations and clinical health interviews. Although many cases of tuberculosis and accidents were recorded, not one case of cancer was identified. (Yes, physicians did know how to identify cancer in the 1940s, and yes, the Drs. Leighton would have been able to diagnosis cancers—see this document:)

"Before 1948, in the 1940s, oncology—the science of dealing with the physical, chemical and biologic properties and features of neoplasms, including causation, pathogenesis, and treatment—was an evolving field in medicine. Tumors were classified and diagnosed according to the latest editions of 2 textbooks in tumor pathology." [Steven I Hajdu, MD. (2007). The First Editor of Cancer and his contribution to oncology. 60th Anniversary Edition of Cancer; Supplement to Cancer. American Cancer Society in Wiley InterScience. December 27, 2007, page 1718.

Downloaded pdf]: https://www.google.com/search?q=oncology+in+the+1940s&ie=utf-8&oe=utf-8
[ATSDR updated link: https://acsjournals.onlinelibrary.wiley.com/doi/epdf/10.1002/cncr.23707]

A decade later after the Leightons, another anthropologist (Charles Campbell Hughes) went to live in Gambell and reported about cultural change. Among his ethnography, field notes, and numerous journal articles, Dr. Hughes had, indeed, recorded lists of health conditions reported for the people of SLI since the Leightons were there. In 1953 only one "neoplasm" had ever been reported in the previous decade. [Hughes, Charles Campbell (1960). An Eskimo Village in the Modern World. NY: Cornell University Press.] So, over a course of 74 years from when the Leightons were at Gambell, the expected cases of cancer rose from 0 to whatever number the ATSDR deemed in July 2017 as "what we would expect to see in these communities."

In 1998, a health aide and Elder from Savoonga, Annie Alowa, reported to the Colonel Jahn who was in charge of the Alaska Army Corps of Engineers. She had not seen any cases of cancer before the military came, and after they abandoned the base, the Savoonga families who had lived and worked at Northeast Cape, started dying of cancer. She named families who had cancer with at least one death each. Fourteen had died. The Colonel dismissed her knowledge rudely at that time, and the legacy of disrespect continued as exemplified by the ATSDR in Bullet 1.

At that time, ACAT produced a twelve-minute video of the final words of Annie Alowa before she died of cancer. At the end of this powerful video, viewers were urged to contact Colonel Jahn to request that SLI be moved up on the list for cleanup of the abandoned military sites. Jahn called Annie's widower to offer condolences, and later in a letter written to various Alaska agencies, Jahn mocked the widower for identifying Annie's sickness as "a virus that gave her cancer."

It should be noted here that a spurious argument has been made that Annie Alowa did not have the expertise to identify cancer. However, one must keep in mind that in addition to identifying cancer that was appearing among those families displaced to Savoonga by the military base at Northeast Cape, she was also identifying increased miscarriages, still births, and birth defects among those families who were associated with the abandoned base.

> **ATSDR Response.** In regard to the ACAT research results mentioned above, the publication referenced states, "The mean serum PCB levels in those persons whose families have camps at the NEC tended to be higher than those of the other Yupiks, although the overall difference did not quite reach the level of statistical significance." (Carpenter et al. 2005). Statistically significant means a result is unlikely due to chance. This is important because if these findings are not significant, we cannot say with assurance that the differences in PCB levels in serum arise from time spent at Northeast Cape.

Comment about Birth Defects: Below are quotes from Bulletin No. 16, July 14. 2008 produced by the Division of Public Health, State of Alaska Epidemiology, entitled: High Prevalence of Major Congenital Anomalies in Alaska 1996-2002.

"We found the birth prevalence of [birth defects] in Alaska to be twice as high as the 3% reported for the United States as a whole…Our data indicate that Alaska Native infants have twice the risk of [birth defects] as white infants, with 10% of the birth cohort affected versus 4% of whites. Controlling for identifiable risk factors did not explain the racial disparity."

"During multivariate analysis, controlling for gender and maternal age, prenatal alcohol and cigarette use, and prenatal care initiation, the Alaska Native race continued to be associated with the risk of [a birth defect]."

Conclusion 4. Basis for Conclusion: "Cancer and birth defects are similar in rates in other Native Alaskan communities in the southwest region of Alaska."

Comment: The authors of the ATSDR insist on comparing the rate of birth defects with other Alaska Natives so that it smooths out the fact that the people of SLI do suffer from higher rates of birth defects than white infants in Alaska and all infants in the Lower-48 states.

Conclusion 4. Next Steps. "Tribal members should continue to eat fish and marine mammals from traditional seasonal fishing grounds at Northeast Cape and other fishing and hunting areas because of the health and cultural benefits."

Comment: This is an entirely irresponsible and unwarranted recommendation based on our knowledge of the contamination at NEC. The people of SLI know that it is not safe to gather greens, berries, fish and hunt at NEC.

> **ATSDR response**: The rates of birth defects on St. Lawrence Island are similar to those of other Alaska Natives, which does not support the theory that contamination from St. Lawrence Island is causing birth defects.

Section 5: Purpose and Health Issues

The ATSDR received a request in 2011 from the President of the Native Village of Savoonga to conduct a health assessment of the FUDS at Gambell and NEC. The ATSDR agreed to conduct two Health Consultations to determine whether exposures to contaminants from the FUDS may be harmful to SLI residents. These public comments are in response to the Health Consultations presented six years later in 2017. It should be noted that the ATSDR ignored the request by the SLI Tribal Council to include Vi Waghiyi in their process. She is a tribal member and serves as ambassador for the people of SLI to governmental agencies such as the ATSDR.

> **ATSDR Response**: ATSDR received a letter from the tribe in 2017 requesting ATSDR include ACAT, including Ms. Vi Waghiyi, as part of the review process on behalf of the tribe. ATSDR conducted several conference calls with Ms. Waghiyi and met with her and other tribal members on several occasions. In response to the knowledge and health concerns expressed by community members of Gambell and Savoonga, ATSDR convened the St. Lawrence Island Healthcare and Public Health Providers Working Group (2013-2014). The Working Group's primary goal was to coordinate the public health and healthcare response to community concerns regarding the impact of contaminants on health. The co-facilitators for the group were Joe Sarcone, ATSDR Regional Representative, Alaska Office and Vi Waghiyi, tribal member Native Village of Savoonga and Environmental Health & Justice Program Director, Alaska Community Action on Toxics (ACAT).

Paragraph 1. Site Description and History. NEC is located on SLI. From 1954-1972 it was a site of "of a military surveillance and White Alice communication stations." NEC FUDS is 4,800 acres or 7.5 square miles."

Comment 1: In this site history, the ATSDR claims that the residing NEC community was simply traditional summertime fishing, hunting, and gathering camp." However, the ATSDR got it wrong. When the DoD occupied NEC they pushed out a community with tribal leaders, a council, and families who then went to live at Savoonga. The DoD ignored the fact that they were displacing a community of Indigenous residents and rewrote history by redefining this community as a seasonal camp. The ATSDR accepted the DoD's rewritten history rather than respecting the knowledge and history of the people of SLI.

Comment 2. NEC was also a drinking water source for the NEC Yupik community and also presently used when people are at NEC as a rest stop to wait out storms.

> **ATSDR response.** Added, "The site formerly supported the Native Village of Northeast Cape before tribal members relocated to Savoonga," to clarify. The Surface Water section addresses drinking water use at Northeast Cape.

Paragraph 2. Demographics. No comment necessary.

Paragraph 3. Remedial and Cleanup Activity. Sentence 1: "In recent years there have been many removal actions and remedial activities at NEC (See Table 1);"

The ATSDR describes the cleanup activity in 1-1/2 pages that includes Table 1 and three detailed paragraphs. Without including the SLI tribes, in 2006, the DoD signed a "Project Closure Report" and "No DoD Action indicated" for contaminated and hazardous toxic and radioactive waste at the NEC FUDS. In 2009, the Army Corps released a "Decision Document" that presented the selected remedies for 34 sites at NEC without including the tribe in the record of decision.

Comment: All of the remedial and cleanup activities are not protective of human health and military toxics at NEC. To this day there are ongoing sources of public health exposures. Table 1 fails to present adequate characterization and remediation at NEC. In 2009, "the contractor constructed a landfill cap; removed POL-containing drums; and performed a chemical oxidation study." However, this chemical oxidation pilot study was conducted improperly—it was highly criticized by the Technical Advisor to the Restoration Advisory Board, Dr. Ronald Scrudato.

In 2010, the contractor excavated POL-, PCB-, and arsenic-contaminated soil; capped a landfill, collected soil, groundwater, and surface water samples, hauled debris off-island for disposal; and monitored a site for natural attenuation" However, these military toxics have not attenuated since the site was abandoned.

In both 2009 and 2010, the contactors capped landfills, in spite of the fact that tribe wants all the military toxics removed—not left for attenuation and not buried in landfills and capped.

> **ATSDR Response.** ATSDR encourages the awareness of all hazards associated with safe storage, removal, and transport of hazardous substances.

Section 7: Community Health Knowledge

Title: Change to "Community Health Knowledge." This section needs to be rewritten to represent the people of SLI as knowledgeable about their health.

Sentence 1: Change the first sentence to: "Members of the NEC community moved to Savoonga when they were displaced by the military. The NEC families continue to use NEC as a seasonal fishing and hunting camp."

Change the remaining paragraph to: "Since 2000, the residents of SLI have been empowered by a series of federally funded community-based participatory research (CBPR) activities at NEC and Gambell. Established in 2011, the SLI Working Group is a community advisory body that guides all aspects of our CBPR. Community leaders, parents, elders, youth, and community health professionals from Gambell, the NEC community, and Savoonga participate with the ACAT research team which includes four Yupik community health researchers who live on SLI, and twelve faculty researchers from seven universities. Residents of SLI are authors on almost all of the fifteen, peer- reviewed publications that have emerged from our participatory research. The people of SLI would like the researchers of the ATSDR to know that it is time, now, for them to perpetuate the precautionary principle rather than promote speculation and inconclusiveness by design."

In the last words of Annie Alowa, "We are not dumb Eskimos; No, I am not."

> **ATSDR response.** ATSDR follows headings as suggested by the Public Health Assessment Guidance Manual, which does not follow the precautionary principle. The public health assessment process uses conservative assumptions to evaluate whether exposures are or were high enough to cause harmful health effects in communities.
>
> ATSDR acknowledges the community's knowledge regarding their own health effects. ATSDR added, "People are concerned about cancer, heart disease, stroke, thyroid disease, immune system disorders, and negative birth outcomes such as miscarriages, stillbirth, low birth weight, and birth defects. Tribal members are also concerned about radiation at Northeast Cape." to the Community Health Concerns section as a result of discussions with ACAT regarding the community's knowledge of health patterns on St. Lawrence Island.

Section 8. Discussion

In this section the ATSDR explains about exposure pathways, worrisome chemicals, and environmental media. The explanations about exposure pathways are so simplistic they are inconclusive by design. The discussion about possibly harmful chemicals is also inconclusive by design because they are unnecessarily complex. The detailed discussion about environmental media rests on Comparison Values (CVs) and Minimal Risk Levels (MRLs) and allows the ATSDR to conclude:

"There is minimal direct contact with sediment in the Suqi River; therefore, ATSDR did not evaluate the sediment pathway further. The shallow, tundra groundwater was never used as drinking water by the Tribal members, nor is it expected to be a potential future drinking water source [reference to Army Corps]. Therefore, groundwater is not evaluated in this health consultation because there is no exposure to this medium."

All three methods (overly simplistic and inadequate analyses) serve captive agencies or the military well, because the ATSDR Health Consultations allow them to justify disposing worrisome contaminants in landfills or by "natural attenuation" and allow the loss of the NEC wetlands and the sweet Suqi River that used to teem with life. The environmental media discussion in this Health Consultation reminded me of Mark Twain and his quote ascribed to Disraeli. Illustration by Peter Newell from COSMOPOLITAN, August 1898

Figures often beguile me, particularly when I have the arranging of them myself; in which case the remark attributed to Disraeli would often apply with justice and force: "There are three kinds of lies: lies, damned lies and statistics." - Mark Twain's Own Autobiography: The Chapters from the North American Review. There is more of the same in the remaining discussions about Soil, Surface Water. Biota—plants and animals in the environment, non-cancer health effects, Cancer risk, and Biomonitoring—testing humans for contaminants. The ATSDR is hopeless.

The remaining pages of the Health Consultation for NEC rehash the subjects discussed above and in the Health Consultation for Gambell, and continue to rely on incomplete and outdated information, false assumptions, and fail to respect and incorporate knowledge and observations of the people of SLI and community-based research

> **ATSDR response.** This report addressed the current knowledge on the human health risks associated with exposure to substances reported at Northeast Cape. We acknowledge that the assessment is based on substances measured at areas most likely to have been impacted by DoD activities. The assessment also used data collected by the community—through interviews and through the written public comment process. These comments included community-reported behaviors, consumption rates, and species of subsistence foods found on the island. This information helped steer the assessment when data was available.