THREATS TO DRINKING WATER AND PUBLIC HEALTH IN ALASKA

The Scope of the PFAS Problem, Consequences of Regulatory Inaction, and Recommendations

September 2019

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Alaska Community Action on Toxics

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EXECUTIVE SUMMARY

A virtually unregulated class of toxic chemicals is being discovered in drinking water across the nation and throughout Alaska. The widespread presence of per- and polyfluoroalkyl substances (PFAS) in the environment raises significant public health concerns that call for immediate and definitive regulatory action to prevent further exposures.

PFAS were developed beginning in the 1940s and today the class of chemicals includes nearly 5,000 compounds. PFAS were developed for their useful commercial and industrial properties: they resist heat, oil and water. These same attributes make PFAS extremely resistant to environmental degradation, earning them the name "forever chemicals." PFAS bioaccumulate and are toxic. PFAS are used in many consumer products, including: nonstick cookware, food packaging, waterproof clothing and gear, stain-resistant furniture and carpeting, and personal care products. PFAS are also found in a type of firefighting agent known as aqueous film forming foam (AFFF) used at airports, military installations, oil and gas facilities, fire training centers and other locations to extinguish petroleum and other flammable liquid (known as Class B) fires.

Alaska is in the early stages of investigating known and suspected sources of PFAS contamination to evaluate the potential for impacts to drinking water. To date, PFAS have been discovered at over 100 individual sites (mostly "AFFF source areas") in nearly 30 locations since the U.S. Department of Defense and State of Alaska first began investigating PFAS contamination. Ten Alaska communities have PFAS in their drinking water at levels deemed unsafe by the U.S. Environmental Protection Agency (EPA) and it is likely that the number of communities with contaminated water will grow as more sampling is conducted throughout the state.

The purpose of this report is to aid Alaskans as well as state and federal policymakers in making informed decisions to protect current and future generations from continued exposure to the PFAS class of chemicals. The information presented here was obtained through a review of the peer-reviewed scientific literature, hundreds of documents obtained through public records requests, and interviews with scientists and agency personnel.

KEY FINDINGS INCLUDE:

- PFAS contamination in Alaska has been confirmed at nearly every site that has been investigated in which aqueous film forming foam (AFFF) has been or is currently being used; the full extent of contamination from identified sites is unknown and new sites are likely to be identified in the future.
- Scientific evidence continues to mount linking PFAS exposure to adverse health outcomes, including liver and kidney damage, reproductive and developmental harm, immune system impairment, and certain cancers. The scientific literature also indicates that the safety level of PFAS for humans may be as low as one tenth to one part per trillion (ppt), up to 700 times lower than the EPA's health advisory level of 70 ppt.
- An increasing number of states have responded to the latest scientific understanding concerning the adverse health effects of PFAS exposure by establishing health protective regulations more stringent than EPA's health advisory levels for PFAS in drinking water sources. Meanwhile, the State of Alaska has rolled-back protections, choosing to test for and regulate only two PFAS compounds (PFOS and PFOA). Furthermore, despite their ability to receive data analyses of 18 different PFAS compounds in drinking water from contracted laboratories, the State of Alaska is requesting and reporting results for PFOS and PFOA only, as of April 2019.
- The approval in 2019 of a permit for Organic Incineration Technologies (OIT) in Fairbanks to incinerate soil contaminated with PFAS raises serious public health questions.
- To date, there has been no investigation of wastewater or biosolids derived from sewage in Alaska to determine the extent to which these sources may be spreading PFAS in the environment, despite the fact that PFAS are known to be in wastewater discharged into Alaska's rivers and Cook Inlet. Leaching of PFAS from materials deposited to landfills may also be a source of surface and/or groundwater contamination and has not been investigated.
- Limited testing of fish tissue has confirmed that some fish in Alaska have levels of PFAS that exceed consumption advisory levels established by other states. Many Alaskans rely on anadromous and resident fish species for subsistence. Recreational fishing lakes are on or near several military installations where PFAS have been detected, suggesting that as a precautionary measure, the State of Alaska should prioritize testing of fish for PFAS.

- PFAS releases originating from eight locations in the greater Fairbanks area threaten the safety of the City of Fairbanks' public drinking water source as well as private drinking water wells in Fairbanks, North Pole and Moose Creek. The full extent of PFAS contamination in the Tanana Valley watershed is unknown.
- A review of available data indicates that the Fairbanks public water system operated by Golden Heart Utilities contains PFAS at levels of concern for public health. Connecting private well owners to a contaminated public water supply is not a viable solution to protect public health.
- Where PFHxS data have been reported, a review of results of sampling in Alaska indicate that PFHxS has been detected in groundwater at the second highest concentrations (after PFOS) in many locations. Current federal health advisory and state action levels do not evaluate for this compound. PFHxS has a substantially longer half-life than PFOS and PFOA in human blood serum, is known to migrate further and faster than the two compounds that EPA and the Alaska Department of Environmental Conservation (DEC) evaluate (PFOS and PFOA), and is more difficult to remove from drinking water. The State of Alaska's failure to take action on PFHxS and other PFAS is another indication of governmental negligence in protecting public health.
- The U.S. Air Force replacement of older aqueous film forming foam (AFFF) with formulations such as Phos-Chek 3% AFFF is not a viable solution for protecting public health or the environment, as this newer formula also contains harmful PFAS compounds. Furthermore, older formulations of AFFF that contain long-chain PFAS still remain in some hangar fire suppression systems and may be released in the future.
- The Department of Defense has used the lack of designation of any PFAS as "hazardous substances" under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as a loophole to delay site characterization, sampling and remediation.
- Findings of this report indicate that offsite migration of PFAS originating from Joint Base Elmendorf-Richardson (JBER) has the potential to impact anadromous and resident fish in Ship Creek and marine life (including the endangered beluga whale) in Knik Arm of Cook Inlet. However, the Air Force has no current plans to investigate offsite PFAS migration from JBER.
- The continued use of PFAS-contaminated private wells for non-potable uses (such as watering the garden and car washing, for example) will disperse PFAS into the environment, yet decommissioning of these wells to prevent the further spread of contamination is not planned for several years.
- The U.S. Army is unnecessarily delaying action to identify and assess PFAS sources at Fort Wainwright and Fort Greely and to evaluate the potential for off-site migration of PFAS to impact drinking water sources near these two Army bases.
- The U.S. Air Force failed to provide an alternative drinking water source to Eareckson Air Station, located on Shemya Island in the western Aleutian Islands, when PFAS was discovered to exceed DEC's August 2018 Action Levels; and has not tested King Salmon Air Station on-base drinking water supply despite the fact that King Salmon has among the highest concentrations of PFAS in groundwater of any site investigated to date in Alaska.
- The State of Alaska has identified 33 airports where AFFF is known or suspected to have been released into the environment. Of these, only 13 have been investigated to date. PFAS contamination originating from airports and impacting drinking water safety has been confirmed in Fairbanks, Utqiagvik, Gustavus, Dillingham, King Salmon and Yakutat. Three airports were determined not to be impacting drinking water sources (Valdez, Cordova, Kenai), two have been eliminated for investigation (Bethel, Cold Bay), preliminary sampling at Anchorage International Airport indicates the need for further testing, and results are pending for Juneau International Airport.
- The true cost of PFAS contamination is not simply represented in the hundreds of millions of dollars already spent on site characterization and sampling, the direct financial liability, and the likely billions that will be spent on remediation (if it is even possible) but in the immeasurable harm to public health and the environment.

PART ONE: THE STORY OF PFAS

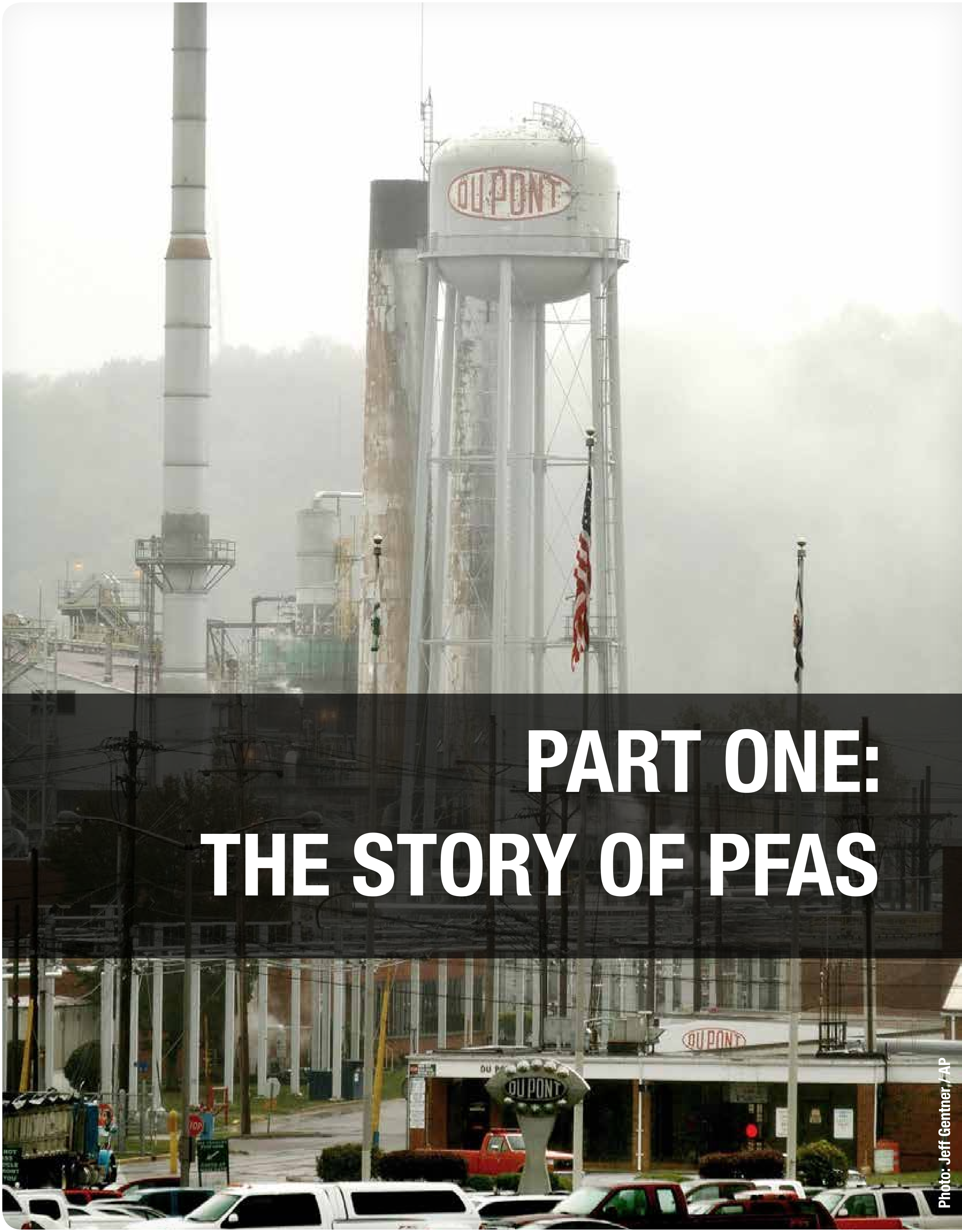


Photo: Jeff Gentner/AP

I. INTRODUCTION

Growing evidence of the widespread presence of per- and polyfluoroalkyl substances (PFAS) in the environment and in people's bodies around the world has raised significant concerns over this virtually unregulated class of toxic chemicals. PFAS are being discovered in drinking water across the United States, with an estimated 110 million Americans drinking PFAS contaminated water that exceeds levels known to cause harm to human health (Andrews, 2018). At the same time, scientific evidence continues to mount linking PFAS exposure to adverse health effects, including liver and kidney damage, reproductive and developmental harm, immune system impairment, and certain cancers. Dr. Linda Birnbaum, the Director of the National Institute of Environmental Health Sciences and the National Toxicology Program, stated that based on new data, the safety level of PFAS for humans may be as low as 0.1-1.0 parts per trillion (ppt), up to 700 times lower than the safety level of 70 ppt set by the United States Environmental Protection Agency (EPA) (Lerner, 2019b). A top official in the U.S. Centers for Disease Control and Prevention (CDC) described the contamination of drinking water by PFAS as "one of the most seminal public health challenges for the next decades" (Knaus, 2017).

The national PFAS drinking water crisis has increased the public's thirst for information and spurred a call for action to establish enforceable drinking water standards and other policies to protect public health. In Alaska, dozens of PFAS investigations are underway and contamination of drinking water sources at or above health advisory levels has so far been discovered in Utqiagvik (Barrow), at Eielson Air Force Base and the neighboring community of Moose Creek, in the City of Fairbanks, North Pole, Eareckson Air Station, Gustavus, King Salmon, Dillingham, and Yakutat. PFAS contamination originating from widely used firefighting foams, known as AFFF (aqueous film-forming foam) have been found not only in Alaska's groundwater, but also in soil, sediment, surface water and fish.

In the absence of federal action, many states are taking their own measures to protect residents by establishing health protective, enforceable drinking water standards and cleanup levels for PFAS contaminated groundwater and soils. And some states and municipalities are taking legal action against the chemical manufacturers of PFAS, including the City of Fairbanks (Case 4:19-cv-00013-JWS, 2019).

The purpose of this report is to aid Alaskans in making informed decisions to protect current and future generations from continued exposure to the PFAS class of chemicals. The report provides background on PFAS history and use, exposure pathways and health effects; discusses the current regulatory status of PFAS; provides a summary and analysis of many of the current PFAS contamination investigations in Alaska, and; makes PFAS policy and research recommendations to protect human health and the environment. The information presented in this report was obtained through a review of the peer-reviewed scientific literature, hundreds of documents obtained through public records requests, and interviews with scientists and agency personnel. In fulfilling Alaska Community Action on Toxics (ACAT) requests, the Alaska Department of Environmental Conservation (DEC) posted laboratory analytical reports and other documents to its online contaminated sites database. DEC also made publicly available PFAS drinking water sampling data for 19 locations as of May 31, 2019: **http://dec.alaska.gov/spar/csp/pfas/responses/**. Eielson Air Force Base had not responded to Freedom of Information Act (FOIA) requests in time for this report.

II. A BRIEF HISTORY AND OVERVIEW OF PFAS

The PFAS class of chemicals has been in commercial use since the 1940s and now includes nearly 5,000 human made compounds (Organisation for Economic Co-operation and Development, 2018). PFAS were developed for their commercially useful properties: they resist heat, oil and water (Interstate Technology Regulatory Council (ITRC), 2017a). Yet the same chemical properties that make PFAS valuable to industry make these compounds resistant to typical environmental degradation processes (ITRC, 2017a). PFAS are toxic, bioaccumulative and persistent in the environment, qualifying certain PFAS as persistent organic pollutants (POPS) and earning them the name "forever chemicals" (Allen, 2018). Much of the PFAS contamination detected in the U.S. drinking water supply today can be traced to releases into the environment that began decades ago (Brady, 2018).

Until recently, the EPA and United States Department of Defense (DoD) used the abbreviation PFCs when referring to perfluorinated compounds. However, PFAS is the term now accepted to describe PFOS, PFOA and other chemicals in this group (ITRC, 2017b). The term PFAS is used throughout this report. The term PFCs is only used for citing references where appropriate.

PFAS are characterized by their carbon-fluorine bonds, one of the strongest known (Lim, 2019). PFAS may be further described by their chain length as either long-chain or short-chain depending on the number of carbons (ITRC, 2017b). There are two sub-categories of PFAS: perfluoroalkyl carboxylic acids (PFCAs) and perfluoroalkane sulfonates (PFSAs). Long-chain PFAS are PFCAs with eight or more carbons (PFOA is an example) and PFSAs with six or more carbons (including PFHxS and PFOS). Short-chain PFAS refers to PFCAs with seven or fewer carbons and PFSAs with five or fewer carbons (ITRC, 2017b).

As the science becomes more conclusive on the adverse health effects linked to exposure to long-chain PFAS, chemical manufacturers are rushing to develop new, shorter chain PFAS and bring them to market. There is concern among scientists that short-chain fluorinated chemicals used to replace their long-chain cousins will prove to be "regrettable substitutions" (Green Science Policy Institute, 2018). Short-chain PFAS can be as persistent as long-chain PFAS and may pose similar health risks. Shorter-chain PFAS are also more difficult to remove from drinking water (Appleman et al., 2014; EPA, 2018d). The *Madrid Statement*, documenting the scientific consensus regarding the persistence and potential for harm of PFAS calls upon the international community to limit the production and use of all PFAS and develop safer non-fluorinated alternatives (Blum et al., 2015).

Only a handful of the thousands of PFAS that chemical manufacturers have developed have been studied for their toxicity and health effects. The two most widely used (until recently) and therefore most well-studied are the long-chain perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA).

The discovery of these highly persistent and toxic PFAS compounds in public and private drinking water supplies at harmful levels presents an urgent public health concern. While the EPA established a lifetime health advisory level (LHA) of 70 parts per trillion (ppt) for the sum of PFOS and PFOA (EPA, 2016a), scientific evidence demonstrates that this level is not protective of health (Agency for Toxic Substances and Disease Registry, 2018). It is also not an enforceable regulatory standard.

The PFAS drinking water crisis unfolding across the nation, and in Alaska, is best understood in the context of larger problems including policymaker deference to chemical industry interests, challenges in epidemiological and toxicological research, and the ubiquitous nature of PFAS in the environment (and consequently, in our food, air, and water). Too often, policymakers base their determinations on industry-funded science rather than research by independent scientists publishing in the peer-reviewed literature, resulting in inaction or weak standards that are not robust enough to protect public health, especially the most vulnerable among us—our children. Rather than require chemical manufacturers to prove with unbiased, peer-reviewed studies that a substance is safe before it goes to market, the predominant approach to U.S. chemicals policy places the burden of proof on the people who are harmed.

According to EPA's *Chemical Substance Inventory*, of the 86,208 chemicals that have been in use at some time since the inventory was first compiled in 1979, there are 40,655 chemicals currently in active commerce (EPA, 2019d). When it comes to uncertainty regarding the health risks of exposure to chemicals, including PFAS, the most health protective approach is a precautionary one. The precautionary principle, developed as a guideline in environmental decision making, states in part, that: "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" (World Commission on the Ethics of Scientific Knowledge and Technology, 2005).

Nothing short of applying a precautionary approach to regulating the PFAS class of compounds will prevent further harm to people and the environment.

PFAS-containing aqueous film forming foam (AFFF) is widely used to extinguish flammable liquid fires. *Photo: U.S. Air National Guard photo by Airman 1st Class Amber Powell/Released*

A. PFAS ARE USED IN A WIDE VARIETY OF CONSUMER PRODUCTS, INDUSTRIAL APPLICATIONS, AND IN FIREFIGHTING FOAMS

People are exposed to PFAS from contact with PFAS-containing consumer products and food packaging, and from ingestion of water and/or food that is contaminated by PFAS. The major sources of PFAS releases into the environment are:

- fire training/ fire response sites (municipal, airports, oil and gas facilities, rail yards, and military installations) (ITRC, 2018);
- industrial sites (where PFAS are manufactured or where factories produce PFAS-containing products) (ITRC, 2018) as well as thermal remediation facilities where PFAS contaminated material, including soils are incinerated (Arkenbout, 2018; Lerner, 2019a);
- landfills (where PFAS-contaminated industrial waste and PFAS-containing products have been disposed) (ITRC, 2018); and
- wastewater treatment plants/ biosolids (ITRC, 2018).

Consumer products

PFAS are widely used in products for their heat-, oil-, grease-, stain-, or water-resistant properties. Products that contain PFAS include non-stick cookware (Teflon®, for example), stain resistant treatments for furniture and carpets (Scotchgard®, STAINMASTER®), waterproof outdoor gear (i.e. GORE-TEX®) and clothing with a "durable water repellent" coating, mattresses, grease resistant food packaging (e.g., fast food wrappers, microwave popcorn bags, parchment paper, non-stick aluminum foil) (Safer Chemicals Healthy Families, 2018), dental floss (Silent Spring Institute, 2019) and other personal care products (e.g., cosmetics, sunscreen, shampoo, shaving cream (Environmental Working Group, 2018b).

Industrial applications

The chemical and thermal stability of PFAS also make them well-suited for use in the chemical processing, building/construction, aerospace, electronics, semiconductor, automotive, and firefighting industries (EPA, 2019b).

Aqueous film forming foam (AFFF)

A significant source of PFAS contamination in drinking water is aqueous film-forming foam (AFFF) fire suppressants used to extinguish class B (flammable liquid) fires. AFFF was developed by the U.S. Navy and 3M Company in the early 1960s (Lerner, 2018) and in 1969, the Navy issued military specification MIL-F-24385 (MILSPEC) requiring AFFF concentrate to contain fluorocarbon surfactants (United States Navy, 1969). Since the early 1970s, PFAS-containing AFFF that meets MILSPEC has been used throughout the world at military bases, airports, fire-training facilities, chemical facilities, and oil refineries.

B. AQUEOUS FILM FORMING FOAM (AFFF) IN ALASKA

Alaska's strategic military importance resulted in the establishment of numerous military installations dating back to the World War II and Cold War eras. AFFF was likely used at any of these sites that remained active after the early 1970s.

PFOS and PFOA are included on DoD's list of emerging contaminants (or ECs) and as such are subject to DoD's guidance for addressing ECs (Department of Defense, 2009). The DoD underwent a process to identify installations with known or suspected sources of AFFF releases into the environment. The department has found that 401 active and former installations across the United States warranted further investigation (DoD, 2018b).

Eleven former and active military installations in Alaska are currently under investigation for PFAS contamination by the Air Force, Army, and Navy. PFAS contamination of soil and/or groundwater above health advisory and/or cleanup levels has been detected at all eleven military sites in Alaska that are under investigation. Eielson Air Force Base was found to have a contaminated on-base drinking water supply and it was later discovered that PFAS have also migrated off base to contaminate drinking water wells in nearby Moose Creek (see Greater Fairbanks Area, page 30).

Due to rugged geography and the consequent lack of road infrastructure, Alaskans depend heavily on air travel. Airports are often situated directly adjacent to communities that rely on public and/or private wells for their drinking water. If these wells are located downgradient from an airport where AFFF has been used, it is highly likely that PFAS are present in the groundwater.

In order to maintain Federal Aviation Administration (FAA) certification, airports must routinely test AFFF systems on ARFF vehicles (Aircraft Rescue and Firefighting) under Title 14 CFR Part 139 (Federal Aviation Administration (FAA), 2012). The FAA issued a guidance document in January 2019 recommending that airport operators *consider* (emphasis added) using newly accepted alternative systems for regulatory compliance testing of AFFF systems on ARFF vehicles (FAA, 2019) but because vehicle modifications are required to use any of the FAA-accepted systems, it is likely that without public pressure to do so, Alaska airports will continue using AFFF for testing systems. The alternative systems may be used for testing only, not for emergency response (FAA, 2019). In 2018, Congress directed the FAA through section 332 of the *FAA Reauthorization Act* (PL: 115-252) to permit airports to use PFAS-free firefighting foams in recognition of the availability and efficacy of safe alternatives to AFFF foams. A March 12, 2019 letter to FAA from non-governmental environmental and health organizations, including ACAT, addressed concerns that FAA has been slow to respond to this directive despite the availability of PFAS-free foams and requested a clear timeline of action (Wells, 2019).

In January 2019, the Alaska Department of Transportation & Public Facilities (DOT&PF) in collaboration with DEC Contaminated Sites Program identified 33 airports where AFFF is known or suspected to have been released into the environment. PFAS contamination of drinking water originating from AFFF use at Fairbanks International Airport and the airport that serves Utqiagvik (Barrow) had already been discovered and has more recently been confirmed in Gustavus, Dillingham, King Salmon and Yakutat. Most, but not all, of the airports to be evaluated for PFAS contamination are state-owned (See Table 3: Airports Identified by State of Alaska for PFAS Evaluation, page 29).

AFFF releases are widely dispersed across the state and groundwater contamination has been documented in every region – North, Southwest, Interior, Southcentral and Southeast Alaska. (See Testing for PFAS in Alaska, page 24).

C. PEOPLE ARE EXPOSED TO PFAS PRIMARILY THROUGH INGESTION OF CONTAMINATED FOOD, WATER, AND DUST

For the general population (non-occupational), the primary route of exposure for PFAS is ingestion of food, water, or dust containing PFAS (Centers for Disease Control and Prevention (CDC), 2018). The effects of dermal contact with PFAS and inhalation of contaminated air are not well-studied. Certain PFAS bioaccumulate in fish, wildlife, and people. Developing babies are primarily exposed through transmission by umbilical cord blood, and infants may be exposed through breast milk.

Food

Diet is recognized as the most common route of exposure for the general population. You may be exposed to PFAS if you:

1. Eat food that has been cooked in non-stick cookware.
2. Consume food that comes in grease-resistant packaging (fast food wrappers, for example) (Schaider et al., 2017).
3. Consume food that has been processed with industrial equipment that has PFAS in its gaskets, sealants or filters or that has been in contact with PFAS containing tubing or hoses such as may be used in soda and ice cream dispensers (Dyer, 2019).
4. Eat produce or other crops that were irrigated with PFAS-contaminated water (Food and Drug Administration (FDA), 2019) or grown in soils fertilized with biosolids (treated sludge from wastewater treatment plants) that contain PFAS (Marusic, 2019).
5. Eat livestock that was raised on PFAS-contaminated feed and/or grazed on fields where PFAS-contaminated biosolids were applied.
6. Consume fish (Hurdle, 2018), wild game, wild plants or mushrooms that may contain PFAS either through bioaccumulation in the food web or water/nutrient uptake.

According to the EPA, exposure from food represents a consistent exposure to PFAS (EPA, 2016d) and little is known about the long-term effects of these chronic exposures.

Water

Current and/or historic PFAS releases into the environment (groundwater, surface water, soil, air) contaminate drinking water sources, presenting a significant public health hazard. Because PFAS are highly mobile and do not break down in the environment, groundwater contamination plumes may extend well beyond the industrial facility, fire-training area, airport, emergency response site, wastewater treatment plant or landfill where the release of PFAS initially occurred or is occurring.

Photo: ***ACAT Archives***

Dust

People may be exposed to PFAS through the incidental ingestion of dust in homes, offices and vehicles (Fraser et al., 2013); because of their hand-to-mouth behavior, children are at higher risk of ingesting contaminated household dust (Wu et al., 2015).

D. THE MANUFACTURERS KNEW ALL ALONG THAT PFAS ARE HARMFUL CHEMICALS

In a recent review paper by Grandjean (2018), the author states that "identification and characterization of environmental hazards that impact human health must rely on the best possible science to inform and inspire appropriate public health intervention." The paper describes how early exposure and toxicity studies conducted by industry and dating back to the 1960s were not made public until after the year 2000. Grandjean concludes that:

> *Early research on environmental PFAS exposures and their health implications became available at a substantial delay and was not taken into account in initial regulatory decisions on exposure abatement. Only in the last 10 years or so has environmental health research focused on the PFAS and revealed important human health risks, e.g. to the immune system. Although guideline values for PFAS in drinking water have decreased over time, they remain too high to protect against such toxicity. (Grandjean, 2018, p. 6)*

He urges a precautionary approach prior to the use of replacement chemicals: "Given the serious delays in the discovery of PFAS toxicity, their persistence in the environment, and their public health impact, PFAS substitutes and other persistent industrial chemicals should be subjected to prior research scrutiny before widespread usage" (Grandjean, 2018, p. 6).

In August 2019, the Environmental Working Group released a chronology revealing secret internal industry memos and studies from 3M and Dupont:

> *As far back as 1950, studies conducted by 3M showed that the family of toxic fluorinated chemicals now known as PFAS could build up in our blood. By the 1960s, animal studies conducted by 3M and DuPont revealed that PFAS chemicals could pose health risks. But the companies kept the studies secret from their employees and the public for decades. (Environmental Working Group, 2019)*

The chronology of industry deception and associated documents can be found here: **https://www.ewg.org/pfastimeline/**.

III. PFAS EXPOSURE LINKED TO A RANGE OF HEALTH OUTCOMES

As stated in the overview of this report, per- and poly-fluoroalkyl substances (PFAS) are synthetic chemicals that are used broadly in many industrial and consumer products. They are water- and oil-repellant, thermally stable and resistant to degradation. These properties make PFAS useful for many applications but also make them highly resistant to environmental degradation. They have been found to be highly mobile in the environment and bioaccumulate (build up in tissue) in humans and animals. For this reason, PFAS persist in the environment and can be found in nearly all people. A substantial body of scientific evidence exists evaluating the health effects of numerous PFAS. The most commonly studied are PFOA, PFOS, PFNA and PFHxS. These studies have examined both human populations and animal models. PFAS have been associated with a wide range of detrimental health effects including liver damage, endocrine disruption, immunotoxicity, cancer, and developmental harm. This section summarizes some of the relevant research about each of these health effects. The first two subcategories of this section briefly summarize the findings of human and animal studies investigating the health effects of PFAS exposure. The remaining subcategories briefly detail the specific health effects and the implications of these associations.

Additionally, it is important to note PFOS and PFOA, the two most studied of the PFAS chemicals, persist in the environment, although they have been voluntarily phased out by industry in the U.S. However, replacement compounds are being produced, used and dispersed widely throughout the world. The health effects of these replacement PFAS are not well characterized, but preliminary evidence indicates similar detrimental effects to PFOS and PFOA (Bruton and Blum, 2017; Cordner et al., 2019; Ritscher et al., 2018). Limited data should not be used as an excuse to justify delaying action to mitigate the risks associated with PFAS (Science and Environmental Health Network, 1998).

A. ANIMAL STUDIES

Animal studies are important for understanding how chemical exposures may affect humans. It is unethical and illegal to assign potentially harmful exposures to humans in randomized control trials, which are the gold standard for determining causation in research. Animal studies provide the opportunity to measure how physiological systems similar to humans are affected by various exposures. Animal studies of PFAS have demonstrated a wide range of adverse health effects (Grandjean, 2018; ATSDR, 2018, Sunderland et al., 2019; Johansson et al., 2008; Olsen et al., 2009). Health effects observed in animals include altered hormone levels (TSH, T4 and testosterone), enlargement and alteration of liver function, and developmental problems (ATSDR, 2018). In a 2019 review paper of PFAS literature, Sunderland et al. reported, "PFOS, PFOA, and PFHxS exposures during the peak time of rapid brain growth in mice resulted in an inability to habituate in the unfamiliar environment"; meaning brain development was disrupted by exposure to these compounds (Sunderland, 2019). In rodents, prenatal exposure to PFOS and PFOA is associated with developmental and reproductive effects, reduced birthweight, structural defects, delays in postnatal growth and development, pregnancy loss, decreased gestational duration, and increased neonatal mortality (ATSDR, 2018). Rats that were fed PFOA developed various malignant tumors (IARC, 2017).

B. HUMAN STUDIES

C8 Health Project

The C8 Health Project was an extensive epidemiological study involving approximately 69,000 individuals living near a factory that released PFOA into the air and into the Ohio River between the 1950s and 2002. The project was completed in 2013 and assessed health outcomes and disease associations following PFOA contamination of drinking water in the Mid-Ohio Valley. The project assessed the links between PFOA exposure and disease and summarized the findings of over 35 studies. Probable links were found between PFOA exposure and six diseases: high cholesterol, thyroid disease, pregnancy-induced hypertension, ulcerative colitis, and kidney and testicular cancer (Steenland et al., 2013, Fletcher et al., 2013; Fitz-Simon et al., 2013; Lopez-Espinosa et al., 2012; Barry et al., 2013; Darrow et al., 2013). "Probable Links" is a legal term defined in the Settlement Agreement that means, "…given the available scientific evidence, it is more likely than not that among class members, a connection exists between PFOA exposure and a particular human disease" (C8 Science Panel, n.d.).

C. HEALTH OUTCOMES: A REVIEW OF THE SCIENTIFIC LITERATURE

An extensive body of human epidemiologic evidence exists on PFAS exposure and health outcomes. Several comprehensive literature reviews have been completed in the past few years (ATSDR, 2018; Ballesteros et al., 2017; Post et al., 2012; C8 Science Panel, n.d.; Jian et al.,

TABLE 1. SUMMARY OF A SELECTION OF PFAS HEALTH EFFECTS FOUND IN ATSDR'S *DRAFT TOXICITY ASSESSMENT PROFILE FOR PERFLUOROALKYLS*—ADAPTED FROM THE NATURAL RESOURCE DEFENSE COUNCIL SCIENTIFIC POLICY ASSESSMENT FOR ADDRESSING PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN DRINKING WATER (READE ET AL., 2019)

Associated Health Effect	Perfluoroalkyl Substances (PFAS)*									
	PFOS	PFOA	PFHxS	PFNA	PFDeA	PFDoA	PFUA	PFHxA	PFBA	PFBS
Immune Effects	X	X	X	X	X	X	X			
Developmental and Reproductive	X	X			X	X	X	X	X	
Lipids	X	X		X	X					
Liver	X	X	X		X				X	X
Endocrine	X	X			X				X	
Body Weight	X	X		X	X	X	X			
Blood	X	X	X				X	X	X	X

**this is not an exhaustive list of PFAS*

2017; Winkens, et al., 2017; Chang, et al., 2016, Sunderland, 2019). The Agency for Toxic Substances and Disease Registry (ATSDR) completed one of the most recent and comprehensive literature reviews on PFAS and published its results in its 2018 *Draft Toxicological Profile for Perfluoroalkyls*. Some of those health effects are summarized in Table 1, page 13. Our review of the literature confirmed associations between PFAS exposure and the health outcomes listed below, which are covered in greater detail in the following sections:

- High Cholesterol (Fletcher et al., 2013; Fitz-Simon et al., 2013; Jain & Ducatman, 2018; Nelson et al., 2010)
- Immunotoxicity (Grandjean et al., 2012; DeWitt et al., 2009; Stein et al., 2016a; Granum et al., 2013; Stein et al., 2016b; Looker et al., 2014; Dong et al., 2013)
- Mammary Gland Development and Breastfeeding Outcomes (Macon et al., 2011; Tucker et al., 2015; White et al., 2011)
- Cancer (Barry et al., 2013)
- Endocrine Effects and Thyroid Disease (Lopez-Espinoza et al., 2012; Kim et al., 2016; Shah-Kulkarni et al., 2016)
- Liver Damage (Bassler et al., 2019; Darrow et al., 2016; Das et al., 2017; Gallo et al., 2012)
- Ulcerative colitis (Steenland et al., 2013, 2018)
- Pregnancy-induced Hypertension and Preeclampsia (Darrow et. al., 2013; Stein et al., 2009; Savitz et al., 2012a, 2012b)
- Additional Concerns (Bach et al., 2016; Darrow et al., 2013)

High Cholesterol

Exposure to PFOA and PFOS is consistently associated with hypercholesterolemia in epidemiological studies. Hypercholesterolemia (high levels of cholesterol in the blood) is associated with an increased risk of heart disease, especially coronary artery disease and atherosclerosis. A 2019 review article by Sunderland et al. found that "the majority of studies examined found associations between elevated serum PFASs and detrimental lipid profiles such as elevated total cholesterol and low-density lipoprotein cholesterol (LDL-C) or reduced high-density-lipoprotein cholesterol (HDL-C)" (Sunderland et al., 2019). ATSDR found evidence to suggest a link between PFOA, PFOS, PFNA, and PFDeA serum concentrations and serum lipid levels, specifically total cholesterol and LDL cholesterol (ATSDR, 2018). A longitudinal cohort study from the C8 Health Project found a positive association between PFOA and PFOS serum levels and LDL cholesterol levels (Steenland et al., 2009) which was consistent with other studies examining associations between lipid metabolism and PFAS serum levels, including Fletcher et al., 2013; Fitz-Simon et al., 2013; Jain et al., 2018; and Nelson et al., 2010, among others.

High cholesterol can lead to coronary artery disease which can cause blockages of the vasculature that supplies blood to the heart. This can cause heart failure, angina (chest pain), heart attacks and abnormal heart rhythms. High cholesterol can also cause atherosclerosis, which is a narrowing of blood vessels that can lead to heart attack, stroke and other complications (American Heart Association, 2019).

Immunotoxicity

Studies have found positive associations between elevated PFAS blood levels and immune effects. These effects are found at extremely low PFAS blood concentrations and are especially pronounced in children (Grandjean et al., 2012). Other studies have found similar associations between vaccine immune response and PFAS exposure (Grandjean et al., 2012; Grandjean et al., 2017a, 2017b; Granum et al., 2013; Looker et al., 2014; Stein et al., 2016a; Stein et al., 2016b). The National Toxicology Program concluded that PFOA and PFOS are *presumed to be immune hazards to humans* (National Toxicology Program, 2016). A 2018 review paper showed four out of five studies examining the link between PFAS exposure and suppressed immune response (as measured by antibody titers) found significant associations between PFAS levels in blood and decreased antibody concentrations (Sunderland et al., 2019). The same review revealed five out of seven studies examining associations between PFAS exposure and immune markers found significant evidence of immune suppression (Sunderland et al., 2019). These effects have been shown for multiple vaccines, including tetanus/diphtheria, MMR (measles, mumps, rubella), and influenza (Sunderland et al., 2019).

The implications of this are noteworthy; decreased immune response to vaccines that protect against potentially fatal diseases not only increases risk for individuals exposed to PFAS but also for society. Vaccination programs rely on "herd immunity," or the ability of immune individuals to break the chain of infection in a population. PFAS exposure may reduce herd immunity by preventing antibody production and allowing vaccinated people to get sick and transmit disease. The consequences of not reaching that threshold can be seen today in communities experiencing measles outbreaks due to insufficient vaccination rates (Department of Health and Mental Hygiene of the City of New York, 2019).

Mammary Gland Development and Breastfeeding Outcomes

Alteration to mammary gland development has been linked to PFAS exposure at extraordinarily low concentrations in mice (Macon et al., 2011; Tucker et al., 2015; White, et al., 2011). These studies found that prenatal exposure of mice to PFOA resulted in reduced ductal elongation and branching, decreased density of terminal end buds (TEBs) and timing of terminal end buds, and decreased epithelial growth of mammary tissue. Alterations to TEBs could result in increased potential for cellular transformations that could make the gland more susceptible to developing diseases such as breast cancer later in life (Fenton, 2006; Macon & Fenton, 2013). Of note, these effects were found at extremely low doses of PFOA serum concentrations; so low that a no-observable adverse effect level (NOAEL) could not be determined. This means that there is no PFOA exposure level at which mammary gland development is not altered.

In a 2017 cohort study, Timmermann et al. found an association between PFAS exposure and decreased breastfeeding duration in two birth cohorts in the Faroe Islands. This study showed a doubling of maternal serum PFAS (PFOS most pronounced) exposure was associated with a reduction in duration of exclusive and total breastfeeding. These associations were found in both multiparous (having given birth more than once) and primiparous (first time giving birth) mothers. Two other studies found associations between PFAS exposure and breastfeeding duration (Fei et al., 2010; Romano et al., 2016). One of these studies found that PFOA concentrations were inversely related to breast feeding duration, indicating that the higher the PFOA blood concentration, the shorter the breastfeeding duration lasted (Romano et al., 2016). The other study found that PFOS and PFOA exposure was associated with reduced lactation, although causation was not clear as this effect was not seen in primiparous women (Fei et al., 2010).

Cancer

Several studies have investigated PFAS carcinogenicity, with the focus of these studies on PFOA and PFOS. Experts overseeing the C8 Health Project determined that there was a probable link between exposure to PFOA and increased risk of testicular and kidney cancer (Barry et al., 2013; Steenland & Woskie, 2012; Vieira et al., 2013). Other studies of the general population have been inconsistent regarding PFAS exposure and associations with prostate, bladder, pancreatic and liver cancer, suggesting further research is needed to fully understand the cancer risk associated with PFAS exposure (Sunderland et al., 2019). A study of an Inuit population in Greenland found a significant positive association between breast cancer risk and exposure to various PFAS (Wielsøe et al., 2017).

The International Agency for Research on Cancer (IARC) has classified PFOA as *possibly carcinogenic to humans (Group 2b)*, with the finding of a positive association for cancers of the testis and kidney (IARC, 2017). The EPA Science Advisory Board judged PFOA as 'likely to be carcinogenic' (EPA, 2006). The EPA Office of Water concluded that "there is Suggestive Evidence of Carcinogenic Potential of PFOA in humans" (EPA, 2016c).

Endocrine Effects and Thyroid Disease

Thyroid hormones play key roles in metabolism, development and growth. Disruption of the function of these hormones can lead to an array of health problems, including hyperthyroidism (excessive thyroid hormone secretions), hypothyroidism (too little diseases can cause a wide range of symptoms, from mild discomfort to debilitating fatigue, weakness, depression, memory impairment and other problems (Mayo Clinic, 2019). Disruption of thyroid function during development can lead to severe cognitive delays, dwarfism, delayed puberty and other growth problems (Mayo Clinic, 2019).

Several studies have found associations between PFAS exposure and thyroid disruption and disease (Byrne et al., 2018; Knox et al., 2011; Melzer et al., 2010; Winquist & Steenland, 2014). As part of the C8 Science Panel, Knox et al. (2011) found PFOA and PFOS were positively associated with total free thyroxine (T4) concentrations in a heavily exposed population in the mid-Ohio River Valley (2011). Additionally, the C8 Science Panel found a probable link between PFOA exposure and thyroid disease in 32,254 adults and children (C8 Science Panel, 2012), as did a 2010 cross-sectional study of 3,974 adults in the National Health and Nutrition Examination Survey (NHANES) population (Melzer et al., 2010). Another study found several PFASs, including PFOA and PFNA were positively associated with thyroid stimulating hormone (TSH) serum concentrations in a remote population of Alaska Native people (Byrne et al., 2018). This same study found free triiodothyronine (T3) was significantly associated with PFOS and PFNA exposure and total T3 was significantly associated with PFNA. Notably, the magnitude of effect of PFAS on thyroid outcomes was different depending on the sex of the study subjects.

Liver Damage

The liver is an essential organ, responsible for many important processes in the body, including detoxifying blood, digesting food, storing vitamins and minerals, producing certain hormones, immune function, and protein synthesis. PFAS exposure alters liver function in both animal and human subjects. A 2019 cohort study found that PFOA, PFOS, PFHxS, and PFNA exposure was associated with an increase in biomarkers indicative of liver cell apoptosis (cell death) and a decrease in immune factors in blood (Bassler et al., 2019). Among NHANES participants recruited from 1999-2000 and 2003-2004, higher serum concentrations of PFOA were positively associated with liver enzymes, especially in obese individuals (Lin et al., 2010). One animal study found that PFAS exposure was associated with increased liver weight and steatosis (fatty liver disease) in mice (Das, 2017). Several other animal studies found similar results (Bijland et al., 2011; Kim et al., 2011; Tan et al., 2013; Wan et al., 2012). ATSDR's review found increases in serum enzymes and decreases in serum bilirubin suggestive of liver damage associated with PFOA, PFOS and PFHxS exposure (ATSDR, 2018).

Ulcerative Colitis

Ulcerative colitis is a chronic inflammatory disease that affects the intestines. The exact cause is unknown but there is consensus that there is an autoimmune component of the disease. It causes ulcers in the innermost lining of the large intestine and rectum which may lead to health problems including diarrhea (sometimes bloody), abdominal pain, rectal pain and bleeding, weight loss, fever, fatigue, and difficulty defecating. The disease has no cure, affects people to varying degrees and may come and go over the course of a person's lifetime. It can be debilitating and can lead to life-threatening complications (Mayo Clinic, 2019).

The C8 Science Panel found a probable link between PFOA exposure and ulcerative colitis. This positive trend was pronounced, with a strong dose-response gradient (Steenland et al., 2013). A case-control study found higher serum concentrations of PFOA in ulcerative colitis cases compared to Crohn's disease patients (Steenland et al., 2018). This study also found that other PFAS serum concentrations were lower in controls (disease-free individuals) than in cases (diseased individuals).

Pregnancy-Induced Hypertension and Preeclampsia

Pregnancy-induced hypertension (PIH) is a type of high blood pressure that develops during pregnancy and can lead to a serious hypertensive condition called preeclampsia. Preeclampsia is characterized by high blood pressure and signs of organ damage, most commonly to the kidneys and liver. Symptoms may include headaches, protein in urine, vision changes, abdominal pain, nausea and vomiting, thrombocytopenia (decreased platelets), impaired liver function and shortness of breath. Preeclampsia can be fatal to both the mother and the fetus if not addressed promptly (Mayo Clinic, 2019).

Several studies have found associations between PFOA exposure and PIH and/or preeclampsia (ATSDR, 2018). These associations were observed in several different analyses from the C8 Health Project as well as other studies including Darrow et al., 2013; Huang et al., 2019; Savitz et al., 2012a, 2012b; Stein et al., 2009; and Wikstrom et al., 2019.

D. ADDITIONAL CONCERNS

Replacement PFAS

While US companies have voluntarily phased out use of PFOA and PFOS, they have developed and are using replacement PFAS (including "short-chained" PFAS). "Short-chain" is a term used to describe the chemical structure of these compounds. On a molecular level, the PFAS that were developed first such as PFOA and PFOS, have many carbon atoms bound together consecutively, with fluorine atoms bound to each carbon. These multiple bound carbons are referred to as "chains." Certain replacement PFAS have fewer carbon atoms in the carbon chain of the molecule and are therefore referred to as "short-chain" or "short-chained" compounds whereas the older PFAS are referred to as "long-chain" or "long-chained" compounds. These short-chain chemicals have been found widely in surface water, drinking water, and air in many parts of the United States and Europe.

Preliminary data suggest that GenX, a successor to PFOA, formerly used in production of Teflon®, may also be detrimental to human health. Animal studies have shown health effects in the kidney, blood, immune system, developing fetus, and especially the liver after exposure through ingestion. An EPA draft toxicity assessment of GenX determined, "there is Suggestive Evidence of Carcinogenic Potential of oral exposure to GenX chemicals in humans, based on the female hepatocellular adenomas and hepatocellular carcinomas and male combine pancreatic acinar adenomas and carcinomas in rats" (EPA, 2018a). Animal studies have shown that perfluorobutanesulfonic acid (PFBS), a replacement for PFOS, is associated with thyroid, kidney, reproductive and fetal health effects. The thyroid and kidney are especially sensitive to PFBS in these models (EPA, 2018a). The Chemours chemical plant has been discharging GenX and other short-chain PFAS chemicals into Cape Fear River for over a decade and was recently sued for numerous Clean Water Act violations (North Carolina Department of Environmental Quality v. Chemours Company FC LLC, 2018).

These short-chain PFAS have similar chemical characteristics to PFOA and PFOS. They are highly persistent and mobile, and many are bioaccumulative and likely toxic. The short-chain molecules are water soluble, making them highly mobile through the environment. These chemicals have been found in many places but are presumed by some to be less toxic than their predecessors, despite a wide knowledge gap in the science (EPA, 2018a). Currently there are few to no regulations on the production and use of these replacements.

Fetal and Child Health

Children are of special concern when addressing potentially harmful environmental exposures. Infants and children are especially susceptible to toxic exposures because they are undergoing rapid development and growth and consume more water per unit body weight than adults, which often results in higher exposures. Due to their hand-to-mouth behavior, children are also more

Photo: Alejandro Pena

likely to be exposed to specific sources of PFAS such as soil and house dust. A 2017 systematic review of the literature on exposure to PFAS and health outcomes in children found associations between PFAS exposure and dyslipidemia, immune response, asthma, renal function and age at menarche (Rappazzo et al., 2017). Several studies have also linked PFAS exposure in children to thyroid dysfunction, including Lopez-Espinoza et al., 2012 (PFOA and PFOS); Kim et al., 2016 (PFOA, PFNA, PFDA, PFUnDA); and Shah-Kulkarni et al., 2016 (PFNA, PFPeA, PFHxS). Thyroid problems during development can lead to severe cognitive developmental delays and delayed puberty onset.

Notably, many studies have found that PFAS are in cord blood and breast milk, indicating the transfer of PFAS from mother to neonate and newborn (Beesoon et al., 2011; Liu et al., 2011; Lee et al., 2013; Midasch et al., 2007; Cariou et al., 2015; Mogensen et al., 2015). Exposed fetuses are born with body-burdens of PFAS that may persist for years after birth (Winkens et al., 2017).

Synergistic Effects

Most research on PFAS has examined associations between one or two PFAS and health outcomes in isolation. In real-world settings, people are exposed to multiple PFAS simultaneously, creating scenarios that likely have synergistic or additive effects on the health of exposed individuals.

Photo: Steve Hillebrand, USFWS

"Synergistic effects" refers to how multiple compounds may interact to create an effect that is more pronounced than what would occur if those compounds acted alone. Interaction between these compounds in the body and environment and the subsequent health effects have not been studied extensively and represents an important gap in the research.

Drinking Water Standards

While the EPA has established the health advisory drinking water level for PFOA and PFOS at 70 parts per trillion (ppt), some research indicates that level should be significantly lower (Grandjean, 2015). As noted in the Introduction, Linda Birnbaum, the director of the National Institute for Environmental Health Sciences (NIEHS) released a statement to *The Intercept* that the safety threshold for PFOA in drinking water could be as low as 0.1 ppt (Lerner, 2019b). Other studies suggest that the drinking water standard for PFOA and PFOS should be as low as 1.0 ppt (Grandjean, 2015). These recommendations were made based on conclusions from immunotoxicity and mammary gland development studies.

E. CONCLUSION

A strong body of evidence exists about the detrimental health effects of PFAS exposure. While some of these associations are better understood than others, the evidence supports the conclusion that PFAS are harmful to human health. These include liver, cardiovascular, hormone, immune, reproductive and developmental effects, among others. These health problems are broad and have serious consequences for individuals and communities suffering from them. Limited evidence and lack of causal relationships are often cited as reasons not to regulate or take action on mitigating the risks associated with PFAS exposure. Historically, early research on environmental PFAS exposures and their health effects became available at a significant delay and was not considered when regulatory decisions on exposure abatement were being made (Grandjean, 2018). PFAS manufacturing corporations completed studies that showed deleterious health effects as early as 1976 but did not make the results public or publish them in a scientific journal (Grandjean 2018). The Precautionary Principle should be implemented when addressing the regulation, manufacture and use of PFAS. As stated in the Wingspread Statement on the Precautionary Principle, "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" (Tickner & Raffensperger, 1998).

IV. GOVERNMENT FAILS TO REGULATE PFAS CHEMICALS

A. FEDERAL STANDARDS

No PFAS are regulated under EPA's federal *Safe Drinking Water Act* (EPA, 2016e). Nor are any PFAS listed as "hazardous substances," under EPA's *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), also known as Superfund (EPA, 2016d). Arguably, swift, precautionary action by the EPA is imperative to address the unacceptable risk that PFAS pose to public health (see Recommendations, page 62). The lack of definitive action by EPA and consistent, enforceable federal regulations is hindering PFAS investigation and remediation efforts in states, including the State of Alaska, that have decided to wait for further direction from EPA.

The EPA published its *PFAS Action Plan* in February 2019, outlining short-term solutions and long-term strategies the agency is taking related to drinking water, clean-up, monitoring, research, enforcement and risk communication (EPA, 2019c). In the plan, the EPA commits to "initiating steps to evaluate the need for a maximum contaminant level (MCL)" (EPA, 2019c, p. 2) for PFOA and PFOS sometime in 2019, the first in a long series of necessary steps to regulate these two contaminants under the *Safe Drinking Water Act* through the establishment of MCLs (EPA, 2015b). In addition, it is insufficient to establish regulations for two of the thousands of PFAS chemicals. PFAS must be regulated through a class approach (See Recommendations, page 62).

The federal response to the PFAS public health crisis has been inadequate and inconsistent. Regulatory measures have not kept pace with the science. The media is often the first to alert the public to a contamination problem, as was the case with the Food and Drug Administration (FDA) when news of their own study finding PFAS in the U.S. food supply was leaked to the media in June 2019 before they had announced their study results (Associated Press, 2019; Neltner & Maffini, 2019). The FDA scrambled to post something on its website, promising more public information and results to come (Food and Drug Administration (FDA), 2019).

While the EPA goes through the slow process of determining if any PFAS should be regulated under the *Safe Drinking Water Act* or as "hazardous substances" under CERCLA, the Agency has established drinking water advisory levels to provide guidance in managing risk and conducting groundwater monitoring and clean-up of just two of an estimated 5,000 PFAS. However, the current lack of enforceable drinking water standards and laws governing the production and use of PFAS means that people continue to be exposed daily from a multitude of sources.

EPA Health Advisory Levels for PFOS and PFOA in Drinking Water

The EPA established provisional health advisory levels (HAs) for PFOS and PFOA in drinking water in 2009, recommending that people not drink water with concentrations at or above 200 ppt for PFOS and 400 ppt for PFOA (EPA, 2009). Increasing scientific evidence of serious health risks linked to exposure to PFOS and PFOA led to the EPA's establishment of a lifetime health advisory (LHA) level for drinking water of 70 ppt for the summed concentrations of PFOS and PFOA in 2016 (EPA, 2016a). The Agency for Toxic Substances and Disease Registry (ATSDR) suggests that even these levels could be up to six times too high to protect public health (ATSDR, 2018).

EPA's health-based advisory levels for PFOS and PFOA have been the *de facto* standard adopted by many federal and state agencies, local officials and drinking water system operators across the country to assist them in evaluating risks and taking action to protect residents. The provisional health advisory was used by the U.S. Department of Defense as a basis for assessing risk at numerous military installations in Alaska where sampling for PFAS first occurred in 2012 – 2015, before EPA published its lower lifetime health advisory (LHA) levels.

In calculating risk, the EPA LHA levels incorporate a relative source contribution (RSC) to account for the fact that exposure to PFAS from consuming contaminated water is one of several sources to which people may be exposed. The RSC for EPA's LHA levels assumes that, in the absence of complete data, 20% of the exposure is from consuming contaminated drinking water, and 80% is from exposure to other sources including food, household dust, and contact with household products (EPA, 2016b).

Unregulated Contaminant Monitoring Rule (UCMR)

The Unregulated Contaminant Monitoring Rule (UCMR) is a tool for identifying and collecting data for emerging contaminants not currently regulated under the *Safe Drinking Water Act* to support the regulatory determination process (EPA, 2015a). The EPA included six PFAS – perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), perfluoroheptanoic acid (PFHpA) and perfluorobutanesulfonic acid (PFBS) in its third round of the Unregulated Contaminated Monitoring Rule (UCMR 3) (EPA, 2012; 2015c).

The UCMR 3 mandated that between the years 2013-2015 all of the nation's public drinking water supplies serving 10,000 or more people as well as a representative sampling of 800 smaller public water systems be tested for the above mentioned six PFAS compounds (EPA, 2012, 2015c). Results from the monitoring effort showed that the drinking water of six million U.S. residents contained levels of PFOS and PFOA exceeding EPA's lifetime health advisory of 70 ppt for PFOS and PFOA (Hu et al., 2016) Drinking water contamination with\npoly- and perfluoroalkyl substances\n(PFASs. EPA treated results below the UCMR minimum reporting levels of 20 ppt for PFOA and 40 ppt for PFOS as "zero" (EPA, 2018c). The Environmental Working Group, a non-profit, non-partisan organization dedicated to protecting human health and the environment, dug deeper into the data and its analysis suggests that up to 110 million Americans could be drinking PFAS-contaminated water at levels of concern for public health (Andrews, 2018). While the EPA publicly identified the utilities with results exceeding its health advisory levels, the Environmental Working Group wanted to know the full results. Environmental Working Group researchers found that data showing lower detections than the LHA were withheld from the public by EPA and in some cases not even recorded by the laboratories (Andrews, 2018). One lab, Eurofins Eaton Analytical, analyzed one third of the nationwide samples and found that 28 percent of the water utilities it tested contained PFAS chemicals at or above 5 ppt (Andrews, 2018). A limitation of the UCMR is that it includes only a modest sampling of public water systems serving fewer than 10,000 people, of which there are several in Alaska. In addition, UCMR3, while monitoring for six PFAS, used only the levels of PFOS and PFOA as a basis for determining whether or not drinking water was safe.

Because the EPA did not require monitoring for any PFAS in UCMR 4 (monitoring cycle 2018-2020) (EPA, 2015d), no new nationwide PFAS drinking water occurrence data will be available until after the next round of monitoring (UCMR 5) which will take place 2023-2025. In its *PFAS Action Plan*, the EPA announced its intent to include more PFAS under UCMR 5 than were monitored for under UCMR 3 and to utilize newer analytical methods at lower minimum reporting levels (EPA, 2019b). EPA is in the process of developing a proposal for the rule with the final rule to be published in December 2021 (EPA, 2019e). The agency held a public meeting in July 2019 to discuss potential approaches to UCMR 5 (EPA, 2019e). Seven specific PFAS analytes have been nominated on the Contaminant Candidate List 5 for consideration in UCMR 5 (Price, 2019).

Federal agencies are undergoing a number of regulatory processes and research initiatives to respond to growing public health and environmental concerns associated with PFAS contamination. New bills are also being introduced in Congress.

Unwilling to wait for the EPA's policy to catch up to the latest science, several states, including California, Connecticut, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania and Vermont have adopted or are in the process of establishing more stringent and enforceable PFAS standards than EPA's (Association of State Drinking Water Administrators, n.d.; Safer States, n.d.). In July 2019, New Hampshire passed the strictest PFAS standards in the nation, requiring local water systems, landfills and wastewater plants to routinely test and treat for four PFAS and establishing limits of 12 parts per trillion for PFOA, 15 ppt for PFOS, 18 ppt for PFHxS and 11 ppt for PFNA (Ropeik, 2019). The State of Alaska is currently basing its action levels on the EPA's LHA, but for a brief seven months from August 2018 – April 2019, Alaska had stricter standards to determine clean-up levels for drinking water safety that included the consideration of concentrations of not only PFOS and PFOA, but four additional PFAS that are widely found in the environment (DEC, 2018e).

B. STATE OF ALASKA ACTION LEVELS AND GUIDANCE

The State of Alaska first promulgated regulatory cleanup levels for PFOS and PFOA in groundwater in 2016, using the same toxicity information EPA used to derive its LHA for PFOS and PFOA, but without the relative source contribution factor. It also added a provision in regulation to allow application of a lifetime health advisory level, such as the LHA for PFOS and PFOA. Under this regulatory authority, if groundwater or surface water used for consumption, are found to contain PFOS and PFOA at levels at or exceeding the LHA, the "responsible party" (e.g. the DoD, State of Alaska, municipality, or private entity) is required to provide an alternative drinking water under Alaska Administrative Code 18 AAC 75.345 (DEC Division of Spill Prevention and Response (SPAR), n.d.-c).

In August 2018, based on the evolving science on PFAS, the DEC under then-Governor Bill Walker's Administration, issued a technical memorandum with action levels and guidance on sampling for a total of six PFAS in soil, groundwater, and drinking water: Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), pefluoroheptanoic acid (PFHpA) and the shorter chain, perfluorobutanesulfonic acid (PFBS) (DEC, 2018e). The DEC set action levels for PFAS compounds in groundwater and surface water used as drinking water at 70 ppt for the sum of five PFAS compounds (PFOS + PFOA + PFNA + PFHxS + PFHpA), with a separate action level of 2,000 ppt for PFBS. The technical memo also provided guidance on soil migration to groundwater clean-up levels, as PFAS are highly mobile and transfer from soil to groundwater.

According to DEC's August 2018 Action Levels:

> *Based on review of available information, DEC considers the six PFAS compounds addressed in this memorandum to be hazardous substances under state law. Several of these compounds have been found in groundwater and surface water used as drinking water. The department finds that action levels are necessary to consistently determine where drinking water treatment or alternative drinking water sources are necessary to ensure adequate protection of human health (DEC, 2018e).*

On October 1, 2018, DEC issued draft regulations for public comment that set cleanup levels for the six PFAS. Amendments to 18 AAC 75 proposed establishing the action levels for the sum of the five PFAS as groundwater cleanup levels; set a revised cleanup level of 4,000 ppt for PFBS, and set new and updated soil cleanup levels for all six compounds (PFBS, PFNA, PFHxS, PFHpA, PFOS and PFOA). The public comment period was closed on November 13, 2018. Thirty-seven comments were received from private citizens, municipalities, state agencies, and industry groups. Alaska Community Action on Toxics provided comments in 2018 which stated in part:

> *Although we appreciate the efforts of the Alaska Department of Environmental Conservation (DEC) to establish new cleanup levels for this subset of PFAS, these proposed measures do not protect Alaskans from exposure to unsafe levels of PFAS, particularly sensitive subpopulations such as pregnant and nursing women and their developing babies, infants, children, elders, and people with chronic diseases. Studies show that infants, for example, are exposed to much higher levels of PFAS than adults using the same drinking water source (Post et al., 2017). DEC must take additional affirmative measures to protect the health of Alaskans, including establishing much stronger health protective cleanup levels for the entire PFAS class and also an enforceable, health protective drinking water standard for the PFAS class of chemicals. (ACAT, 2018)*

After newly-elected Alaska governor Mike Dunleavy took office, his administration acted swiftly to weaken the PFAS standards/regulations put in place by the previous administration. On February 28, 2019, the administration directed DOT&PF, the agency charged with addressing PFAS contamination at state-managed airports, to investigate PFOS and PFOA only at newly identified sites (DOT&PF & DEC, 2019). In April 2019, the Dunleavy Administration announced its decision to rescind the August 2018 Action Levels for six PFAS and apply the EPA's 70ppt LHA to the sum of PFOS and PFOA only where groundwater used for drinking is found to be contaminated and to stop testing for PFNA, PFHxS, PFHpA and PFBS. The new guidance states, "any new testing for PFAS will be for PFOS and PFOA only" (DEC, 2019r).

In choosing to limit future testing of PFAS compounds to only PFOS and PFOA, the Dunleavy Administration acted against the recommendations of career and environmental public health professionals in both the Alaska Department of Environmental Conservation and Alaska Department of Health and Social Services (DHSS) and ignored the evidence presented in more than 90 studies that identify adverse health effects for PFHxS and PFNA (Schlichting, 2019).

DEC Commissioner Jason Brune and DOT&PF Commissioner John MacKinnon defended the Administration's decision to roll back PFAS standards citing public comments opposing the August 2018 draft regulations (Brune & MacKinnon, 2019). However, nearly half of the comments received were from individuals—many of whom live in PFAS impacted communities—who sought stricter standards or supported the proposed changes. Environmental health advocates, including managers within the DHSS also supported the standards. Opposition to the more stringent standards included potentially "Responsible Parties" (including the Department of Defense) that could face more costly PFAS investigation and remediation under the proposed standards. Industry trade groups including the American Petroleum Institute and American Chemistry Council, a lobby group for the chemical industry, urged the State to hold off until EPA takes action at the federal level.

The State is now only requiring Responsible Parties to report results for PFOS and PFOA. The State has directed its own contractors conducting work at PFAS contaminated sites to request analytical results for only PFOS and PFOA from analytical laboratories, even though EPA has analytical methods that measure for 14 PFAS, or 18 PFAS, and new methods will detect even more PFAS compounds (See Method 537, page 26).

Although only two PFAS are now being reported in analytical results, the Dunleavy Administration has committed to providing alternative drinking water or treatment to all impacted communities or well owners where results prior to April 9, 2019 documented levels above DEC's 2018 Action levels (the "sum of five"). Communities or well owners identified after that date will not have the benefit of the "grandfather" clause, and contamination from any other compounds besides PFOS and PFOA will not be reported or regulated (Brune, 2019b).

Sally Schlichting, Manager for the DEC Contaminated Sites Program's unit for science-based regulatory standards policy, wrote a memorandum on April 28, 2019 that stated her objections to the Administration's decision to put the regulations on hold:

> *The best way to protect our citizens of the state of Alaska is not by rolling back standards. Such action goes against our responsibility as environmental and health professionals to ensure the drinking water of Alaskans is safe. As a science-based agency, we must use a science-based approach to set standards, investigate all potential contaminated areas and receptors, require complete reporting of all analytes, and do all that we can to protect Alaskans and the environment from additional exposures to PFAS. That's our job. To do otherwise is negligence.*

DEC Commissioner Jason Brune dismissed Ms. Schlichting's warning saying that, "this individual is entitled to her opinion. However, she does not speak for DEC nor for the Administration" (Brune, 2019a). He went on to say that "the science on PFAS is evolving and the EPA has recently published a plan that will lead to consistent guidelines and certainty for states that are dealing with this emerging issue" (Brune, 2019a). It is yet to be seen whether the State of Alaska will continue to defer to the EPA, as this is not a position typically embraced by the State, historically a staunch defender of States' rights. In the meantime, Alaskans who may be drinking unsafe, PFAS-contaminated water, are receiving a lesser standard of protection while other states are taking proactive measures to protect the health of their residents.

In reviewing the docket for EPA's "Draft Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS" there were no comments submitted by the State of Alaska, although ACAT joined with many other public interest groups in submitting comments (EPA, n.d.-a). The comment period closed June 10, 2019.

The change in regulations is causing considerable confusion within and among agencies working to address PFAS contamination in Alaska, impeding efforts that were already underway to address the problem and delaying future action. In addition, it is more difficult for the public and the media to receive answers to questions as all PFAS related correspondence must be cleared at the Commissioner and Chief of Staff level within the Administration. Many questions remain unanswered, including: will the State continue investigating contamination at other state-managed airports? Will the State begin reporting results for all 18 PFAS listed in EPA's analytical method 537.1 for drinking water as mandated by the Alaska Legislature's intent language attached to $9.4 million in funding appropriated to the State to respond to PFAS? Will the State expand sampling of fish, livestock, and agricultural produce where contaminated surface or groundwater has been documented? Will the State set a fish consumption advisory level for PFAS? Will the State take enforcement action against responsible parties who are failing to investigate known AFFF releases? What action will the State take, if any, in the absence of sufficient federal actions?

In November 2018, DEC published its *PFAS Action Plan*, affirming the agency's commitment "to provide for a coordinated approach among the various programs addressing the challenges with regulating this class of emerging contaminants" (DEC, 2018a, p. 2). The *Action Plan* outlines specific actions currently being taken or planned by DEC programs, including: identifying sites where PFAS discharge, release, or disposal has occurred; evaluating and responding to drinking water impacts; evaluating wastewater discharges and treated biosolids as sources of PFAS contamination; evaluating lakes, streams and rivers for PFAS; evaluating solid waste landfills as sources of PFAS contamination, and protecting air quality. The State's *PFAS Action Plan* is described as "a living document," but there has been very little progress in addressing PFAS public health risks and environmental concerns under the Dunleavy Administration. Other than an update in December 2018 to include a set of actions by DOT&PF, no other updates have been made.

MEMORANDUM

State of Alaska

Department of Environmental Conservation
Division of Spill Prevention and Response- Contamianted Sites

TO: John Halverson, Program Manager

DATE: April 28, 2019

THRU:

FILE NO:

PHONE NO: 465-5076

FROM: Sally Schlichting, Manager

SUBJECT: Administration decisions on PFAS

As the manager for the Contaminated Sites Program's unit for science-based regulatory standards policy, I am stating my objection to the administration's recent decision to put regulations on hold, to roll back protective levels for six per- and polyfluoroalkyl substances (PFAS) in drinking water, and to limit future testing of these compounds in soil, drinking water, surface water, fish tissue and other media. These actions have been taken against the recommendations of career environmental and public health professionals in both DEC and the DPHSS.

The recommendations of staff in our two agencies to regulate these chemicals are based on the body of scientific research available about PFAS, which continues to point to a wide array of health impacts including intergenerational toxicity, reproductive toxicity, immunotoxicity, and certain cancers. DPHSS staff have tallied nearly 90 studies that identify health effects for PFHxS and PFNA, two compounds that the administration is now choosing not to regulate. The ATSDR, in their draft 2018 toxicological profile on 14 PFAS, recommended a minimum risk level of 7 ppt for PFOS alone, an order of magnitude lower than EPA' s Lifetime Health Advisory of 70 ppt. Multiple other states with robust toxicology programs are setting levels for one or more PFAS that are significantly more stringent than the EPA LHA.

Furthermore, consistent with our regulatory and statutory authority, we have identified the six UCMR3 PFAS to meet the definition of hazardous substances. This allows us to set criteria for these compounds based on available information and to require that responsible parties provide alternative water where criteria are exceeded, but also even when there is insufficient information to set a cleanup level. Based on these state authorities and the weight of scientific evidence, it is negligent on the part of the administration to pull back in setting protective levels for at least six PFAS in the drinking water of Alaskans, and furthermore, to restrict reporting of PFAS sampling to only two compounds – PFOS and PFOA.

The best way to protect our citizens of the state of Alaska is not by rolling back standards. Such action goes against our responsibility as environmental and health professionals to ensure the drinking water of Alaskans is safe. As a science-based agency, we must use a science-based approach to set standards, investigate all potential contaminated areas and receptors, require complete reporting of all analytes, and do all that we can to protect Alaskans and the environment from additional exposures to PFAS. That's our job. To do otherwise is negligence.

May 8, 2019

Jason Brune, commissioner, Alaska Department of Environmental Conservation:

"This individual is entitled to her opinion. However, she does not speak for DEC nor for the Administration. Multiple State of Alaska agencies were involved in the April decision regarding where to set the State's interim action levels, and we ultimately decided to defer to the EPA's Lifetime Healthy Advisory Level for drinking water. The science on PFAS is evolving and the EPA has recently published a plan that will lead to consistent guidelines and certainty for states that are dealing with this emerging issue. While most states have not adopted regulations specific to PFAS cleanup levels, Alaska's 2016 regulations remain on the books and set cleanup limits for groundwater and soil to protect human health. We will be closely monitoring the EPA's progress on this issue and the emerging science, and if necessary we will adjust our course."

PART TWO: TESTING FOR PFAS IN ALASKA

To date, there are 27 locations in Alaska currently recognized as contaminated with PFAS. The DEC Contaminated Sites Program has identified 100 individual PFAS-contaminated sites within these locations (DEC, 2019a). There is every reason to believe that the number of contaminated sites will grow as more areas are identified where AFFF has been released into the environment.

Following a discussion of the PFAS Investigation Process is a summary about selected PFAS contaminated sites identified to date in Alaska, including available information on the status of investigation and information gaps. Sites in the Fairbanks area are discussed first as this is where PFAS contamination of drinking water supplies is the most widespread; other sites are presented alphabetically by community or name of military installation.

The analytical data for PFAS in groundwater used for this report were presented in laboratory reports in micrograms per liter (μg/L), nanograms per liter (ng/L), or parts per trillion (ppt). In this report, all data have been converted to ppt for comparison to EPA health advisory and DEC action levels. While soil migration to groundwater is a significant concern, this report focuses primarily on groundwater data.

A Note on Groundwater Hydrology

A number of factors influence the distribution and movement of groundwater (Davie & Quinn, 2019). Characterizing site hydrology is important when investigating PFAS groundwater contamination originating from a source where PFAS have been released into the environment. Aquifers occur at different depths and may be confined or unconfined. Seasonal fluctuations of rivers may affect depth to groundwater and the direction of groundwater flow as has been noted in PFAS site investigation reports for Galena (adjacent to the Yukon River), King Salmon (Naknek River), and in the Tanana Valley of Fairbanks (influenced by both the Tanana and Chena Rivers). The presence of permafrost also influences groundwater hydrology. Many Alaska communities are situated on glacial and glaciofluvial deposits—a mix of layered clay, silt, sand, and gravel—left behind during glacial retreat. Variations in the permeability and geometry of these subsurface sedimentary deposits may help to explain why PFAS concentrations may be detected at significantly different levels in drinking water wells located within only a few hundred yards of one another. Repeated sampling for PFAS during different seasons can help to determine whether PFAS concentrations are overall stable, decreasing or increasing; however Alaska's cold climate and short field season limits field activities and sampling. It is beyond the scope of this report to discuss the groundwater hydrology of individual sites; further discussion can be found in site investigation reports and other referenced documents throughout this report.

I. THE PFAS INVESTIGATION PROCESS

A. DEPARTMENT OF DEFENSE (DOD) INVESTIGATIONS

The site-specific information presented in this report is largely based on U.S. Air Force, Army, and Navy documents prepared as part of a comprehensive DoD effort to identify, assess, and investigate known and suspected AFFF releases to determine if PFAS contaminants are impacting drinking water supplies on and/or off site. DoD is following the CERCLA site assessment process to identify PFAS releases (Sullivan, 2018).

The six PFAS included in DEC's August 2018 Action Levels meet the definition of "hazardous substance" under State law AS 46.03.826(5). No PFAS are classified as hazardous substances under federal law; under CERCLA, PFOS and PFOA are considered pollutants or contaminants. The lack of designation by EPA of any PFAS as hazardous substances delays site investigation and remedial action. EPA regional screening levels and State of Alaska cleanup levels are used to determine whether to continue to a remedial investigation.

The earliest PFOS/PFOA data collected at Alaska military installations occurred from 2012-2014 at select sites including Eielson AFB, Fort Wainwright, King Salmon Air Station, and Galena Forward Operating Location. It was during a screening level site investigation that it was discovered that Eielson's groundwater had PFOS/PFOA at levels exceeding EPA's provisional health advisory in place at the time (See Eielson AFB/Moose Creek, page 31).

The U.S. Air Force, Army and Navy are in the early stage of the CERCLA process of investigating PFAS contamination in Alaska: site assessment. Unless it is discovered during site assessment that a PFOS or PFOA release may present "an imminent and substantial danger to public health or welfare" (i.e. contamination of drinking water

EPA'S METHOD 537

The world of PFAS analysis is evolving in response to the increasing need to detect a growing number of individual PFAS compounds in water, sediments and soil. In 2009, EPA published the first analytical method to test specifically for PFAS in drinking water – Method 537 rev 1.1, or simply "Method 537" (EPA, 2019a). Laboratories can detect up to 14 PFAS in finished (i.e. treated) drinking water using this method. Method 537 was used to evaluate for six PFAS during UCMR3 from 2013-2015 and is the method used by public water utilities in Alaska. While not officially validated by the EPA for analyzing PFAS in drinking water sources such as untreated groundwater or surface water, Method 537 is the de facto method used (B. Englund, personal communication, March 26, 2019). Method 537 does not detect many of the short-chain PFAS (EPA, 2018c) that are being used as replacements for PFOS and PFOA in AFFF and other products today. An update to Method 537 (Method 537.1) published in November 2018 can detect 18 PFAS compounds in potable drinking water (EPA, 2019f), including the GenX chemical hexafluoropropylene oxide dimer acid (HFPO-DA) (EPA, 2018b), used as a replacement for PFOA (Dupont's Teflon®) in non-stick cookware (Environmental Working Group, 2018a).

To meet an ever-increasing demand for analyzing PFAS in non-drinking water and solids and/or additional PFAS compounds and their analytes, laboratories have developed modifications to EPA's Method 537. The State of Alaska approves modified methods that meet U.S. Department of Defense specifications for quality assurance published in 2017 (QSM 5.1 Table B-15) (B. Englund, personal communication, March 26, 2019). These approved methods have been used to analyze groundwater, surface water, soil, and sediment associated with AFFF releases at military installations in Alaska as well as at other PFAS contaminated sites for which DEC provides regulatory oversight.

EPA is in the process of developing approved methods for non-drinking water (groundwater, surface water, wastewater) and solids (soil, sediment, biosolids) and for an anticipated 11 short-chain PFAS not included in Method 537. The agency anticipates it will have a draft method for non-potable water in fall 2019 (EPA, 2019b).

It is important to note that the agency (i.e. State, DoD) ordering the PFAS analysis may choose to limit reporting results to fewer PFAS than were analyzed by the laboratory as DEC chose to do beginning in April 2019, limiting reporting to PFOS and PFOA only. However, the more we know about PFAS health risks, the more the evidence suggests that an approach assessing the sum of all PFAS compounds detected is the most health protective. Reporting as much data as the analytical method is designed for will enable data to be re-evaluated as the science of PFAS evolves over time.

NON-DETECTS (ND) IN LABORATORY REPORTS

On laboratory reports, a PFAS compound may show a result of "ND," or non-detect. This does not always mean that the PFAS compound is not present, though it may. A result of ND could also indicate that if present, the compound is below the minimum detection level (MDL) of the analytical method or below the minimum reporting level (MRL) of the client. Where possible, this report aims to elucidate sample results in which drinking water could have higher concentrations of PFAS than a result of "ND" might suggest.

supplies), it can be expected that the process of collecting data to inform remedial actions will take a long time, especially as both the State and DoD appear to be waiting for EPA to make regulatory determinations.

The following site assessment actions have taken place or are in process for the sites identified by DoD:

- **Preliminary Assessment (PA) –** Typically the first step in the CERCLA process, the purpose is to determine whether or not there is a potential threat to human health warranting further investigation (US Dept of Energy, 1993). This determination is made through the collection of historical, geological, ecological and other information. The PAs for PFAS contamination have included interviews with current and past personnel who may know about the history of AFFF use and storage, site reconnaissance, and research to identify potential AFFF sources (places where AFFF was stored, used in training activities/ emergency response, or accidentally released). The PA provides initial analysis of existing information, makes a formal recommendation for further action/ no action and sets priorities for the site inspection/sampling locations. Generally, there is no field sampling associated with a PA. In 2015, PAs were finalized for Eielson AFB, Joint Base Elmendorf-Richardson (JBER), former Kulis Air National Guard Base, and Clear Air Station; PAs were completed for Galena FOL in 2016, King Salmon Air Station in 2018, and for the Naval Arctic Research Laboratory and Eareckson Air Station in 2019. PAs have not yet been completed for Fort Wainwright or Fort Greely. Not surprisingly, given DoD's historic use of AFFF since the 1970s, all sites in Alaska for which

PAs have been completed have been recommended for further PFAS investigation.

- **Site Inspection (SI) –** The second step of site assessment focuses on data collection and analysis to help characterize releases (Department of Energy, 1993). Based on the sampling results, SI reports may include recommendations for repeat sampling or that sampling be initiated for new areas to fill data gaps. The SI reports for Alaska military installations have varied in terms of number of PFAS analytes reported and details presented (i.e. maps, modeling). It appears that Base Realignment and Closure (BRAC) sites are moving along more quickly than active military installations and that the Air Force is further along in the CERCLA process than the Navy or Army. SI reports were completed for Eielson AFB, Clear Air Station, JBER, Galena FOL, and Kulis in 2018. Alaska's short field season may delay further action.

TABLE 2. HIGHEST DETECTED PFOS AND PFOA LEVELS IN GROUNDWATER AT DEPARTMENT OF DEFENSE SITES UNDER INVESTIGATION FOR PFAS CONTAMINATION IN ALASKA

Military installation	Highest detected concentration in groundwater		Year*	Number of PFAS sampled for to date**	Investigation of off-site migration to date?
	PFOS (ppt)	PFOA (ppt)			
Adak1	3,630	716	2018	14	N
Clear Air Station2	160	2,200	2016	12	N
Eareckson Air Station3	250,000	2,800	2016	2	N
Eielson Air Force Base 4	2,000,000	250,000	2014	14	Y
Fort Greely5	90	18	2016	2	N
Fort Wainwright6	3,300	440	2013	2	N
Former Galena Forward Operating Location (FOL)7	239,000	49,900	2014	12	N
King Salmon Air Station8	150,000	81,000	2013	16	N
Former Kulis Air National Guard Base (ANGB)9	7,600	8,400	2016	14	Planned
Joint Base Elmendorf-Richardson (JBER)10	24,000	5,100	2016	14	N
Naval Arctic Research Laboratory (NARL)11	N/A: No sampling has occurred on site to date	N/A: No sampling has occurred on site to date			Y (Imikpuk Lake)

Note: PFAS testing has only occurred as part of other groundwater monitoring or sampling events at Fort Greely and Fort Wainwright. No base-wide identification or sampling of known or suspected AFFF release areas has occurred to date; therefore these data on highest concentrations cannot be considered representative of PFAS concentrations at these military installations.

**This is the year that the sample with the highest concentration was taken; PFAS sampling may have taken place in other years.*

*** Data for PFAS compounds other than PFOS, PFOA, and PFBS may not be included in site investigation reports (it may not even be mentioned that more PFAS were tested for); however analytical results for additional PFAS may be available in associated laboratory reports.*

1 Naval Facilities Engineering Command Southwest (NAVFAC), 2019a, Figure 7.

2Air Force Civil Engineering Center (AFCEC), 2018e, Table 3-4.

3 AFCEC, 2018a, Table 5-2a.

4 AFCEC, 2015e, p. 10.

5 Bering-KAYA Support Services, 2017, p. 9-8.

6 Fairbanks Environmental Services, 2017. Figure 4-3.

7 AFCEC, 2016, p. 3-1.

8 AFCEC, 2014, Appendix A; Table 1.

9. AFCEC, 2018b, Exhibit 5-10.

10 AFCEC, 2018f, p. 4-2.

11 NAVFAC, 2019b, p. 2-4.

If at any point in the process PFOS and/or PFOA are found to exceed screening levels, the Responsible Party must provide alternative drinking water until a long-term solution can be developed.

Following the publication of EPA's lifetime health advisory in May 2016, DoD issued a memorandum to the Army, Navy and Air Force directing each of the departments to test treated drinking water for PFOS and PFOA at all installations where DoD supplies drinking water and to follow EPA recommended actions if the drinking water was found to exceed EPA's health based standards (DoD, 2016). In cases where a private contractor provides water, the memo states: "Where DoD is not the water purveyor, *installations are encouraged* [Emphasis added] to contact their water purveyor to determine their response to the new HA for PFOS and PFOA"(2016). In a March 2018 briefing to the House Armed Services Committee, DoD reported that 90 military installations were known to be contaminated with PFOS/PFOA at levels exceeding EPA's LHA (Sullivan, 2018). The DoD report revealed that there are a total of 401 installations that have known or suspected releases of PFOS/PFOA. The report also indicated that while testing of drinking water supplies had been completed for all Air Force and Navy installations, not all Army installations with non-DoD water purveyors had had their drinking water tested. Doyon Utilities, LLC (Doyon Utilities) is a private utility contracted to provide water to Fort Greely, Fort Wainwright, and JBER. Fort Greely and Fort Wainwright obtain their water from on-base groundwater wells; JBER obtains most of its water from an off-base source upgradient from AFFF source areas.

DoD reported in an annual report to Congress that as of December 31, 2016, the Department had spent $202 million on sampling, analysis, and response actions to address PFOS and PFOA (DoD, 2018a). According to DoD Spokeswoman Heather Babb, as of July 2019, the Department of Defense had spent a total of $550 million (CNBC, 2019).

B. STATE OF ALASKA INVESTIGATIONS

The DEC, in collaboration with DOT&PF, identified 33 airports where AFFF has been used and where PFAS could be present in groundwater (See Table 3: Airports Identified by State of Alaska for PFAS Evaluation, page 29). The sites with highest priority for evaluation are those where public and/or private drinking water supplies have the potential to be impacted by PFAS contamination. To date, the State of Alaska has contracted with environmental consultants Shannon & Wilson, Inc. (S&W) for most well search and sampling efforts. Results from initial sampling are used to determine whether or not further sampling is necessary. If any single groundwater sample result from initial sampling shows concentrations of PFAS in groundwater at or exceeding action levels, the well search area and sampling efforts continue to expand in an iterative process until no new exceedances are found. As of August 2019, only a handful of the 33 communities whose drinking water may be impacted by AFFF originating from airports have had their water tested.

Refer to *DEC's Action Plan for PFAS* to learn more about how the Division of Spill Prevention and Response's (SPAR) Contaminated Sites Program and the Division of Environmental Health's Drinking Water Program are working to identify private and public drinking water

Signs posted at the Holy Rosary Church well in Dillingham after the State of Alaska discovered that PFAS originating from the airport has contaminated groundwater. The well serves as a public drinking water supply for nearly 300 people. *Photo: Avery Lill/KDLG* wells that may be impacted by PFAS contamination from airports and other locations where AFFF has been released as well as to ensure that delivered water or water treatment is provided by the Responsible Party (i.e., city, DOT&PF, DoD) (DEC, 2018a).

The DEC Action Plan is available at: https://dec.alaska.gov/spar/csp/pfas/action-plan/.

TABLE 3. AIRPORTS IDENTIFIED BY STATE OF ALASKA FOR PFAS EVALUATION*

Part 139 Certified state-owned Airports	PFAS contamination of drinking water sources?
Adak	Unknown (not yet sampled)
Anchorage International Airport	Unknown (first sampled June 2019)
Bethel	No further investigation**
Cold Bay	No further investigation**
Cordova	NO (first sampled Dec. 2018)
Deadhorse	Unknown (not yet sampled)
Dillingham	YES (first sampled Dec. 2018)
Fairbanks International Airport (FAI)	YES (first sampled Aug. 2017)
Gustavus	YES (first sampled July 2018)
Homer	Unknown (not yet sampled)
King Salmon	YES (first sampled Dec. 2018)
Kotzebue	Unknown (not yet sampled)
Nome	Unknown (not yet sampled)
Petersburg	Unknown (not yet sampled)
Sand Point	Unknown (not yet sampled)
Sitka	Unknown (not yet sampled)
Unalaska	Unknown (not yet sampled)
Utqiagvik (Barrow)	YES (first sampled Aug. 2017)***
Wrangell	Unknown (not yet sampled)
Valdez	NO (sampled Dec. 2018)
Yakutat	YES (first sampled Feb. 2019)
Part 139 Certified Airports (muni-owned and/or operated)	**PFAS contamination of drinking water sources?**
Kenai	NO (sampled Dec. 2018)
Ketchikan	Unknown (not yet sampled)
Juneau	Unknown (first sampled Aug. 2019)
Past Part 139 Certified Airports and former DoD sites	
Aniak	Unknown (not yet sampled)
Galena (DoD)	Unknown (not yet sampled)
Iliamna	Unknown (not yet sampled)
Kodiak (USCG)	Unknown (not yet sampled)
McGrath	Unknown (not yet sampled)
Northway (DoD)	Unknown (not yet sampled)
Port Heiden	Unknown (not yet sampled)
Red Dog (owned by NANA Regional Corp)	Unknown (not yet sampled)
St Paul	Unknown (not yet sampled)

NOTE: Those airports with confirmed PFAS contamination impacting drinking water sources are in bold.

** This list of airports and sampling status was compiled based on information provided between February and June 2019 by managers within DEC's Contaminated Sites Program and DOT&PF.*

***No sampling will occur; DEC has determined that drinking water impacts are not expected*

****Surface waters of adjacent Isatkoak Reservoir were sampled; no sampling on airport property or at any other offsite locations has occurred.*

II. GREATER FAIRBANKS AREA

Of PFAS-contaminated areas currently under investigation in Alaska, the Fairbanks North Star Borough (including the communities of Moose Creek and North Pole) has the largest extent of PFAS contamination impacting the drinking water of the greatest number of Alaskans. Eight PFAS sites and their associated plumes are currently under investigation in the Fairbanks area and other sources may be identified in the future. The full extent of PFAS contamination of Tanana Valley groundwater remains unknown.

PFAS contaminated groundwater at levels acknowledged by EPA and/or DEC to pose a risk to human health have been traced to Eielson Air Force Base (AFB), the Fairbanks International Airport (State-owned), the Fairbanks Regional Fire Training Center (owned by the City of Fairbanks), and North Pole Refinery (currently owned by Flint Hills, Inc., a subsidiary of Koch Industries). Additional locations in the Fairbanks area with confirmed contamination include Fort Wainwright, Alyeska Pipeline Services' Nordale Storage Yard and two commercial properties where AFFF was used in emergency response to extinguish fires – Napa Auto Parts and Bloom Enterprises.

One of the most troubling aspects of the PFAS problem in Tanana Valley groundwater is that testing results show that PFAS have contaminated the public water supply, and although the levels are still below action levels, the contamination poses a threat to public health. Conventional water treatment is not effective at removing the PFAS that has been detected in Fairbanks' water.

In addition to groundwater contamination affecting drinking water, PFAS from current and/or historic use of AFFF has been detected at levels of concern in fish from Kimberly Lake near the former North Pole Refinery (Alaska Department of Health and Social Services (DHSS), 2019) and Polaris Lake on Eielson AFB (Friedman, 2019b), prompting the Alaska Department of Fish & Game to issue an emergency order on April 3, 2019 closing both lakes to sport fishing (ADF&G, 2019). PFAS have also been discovered in compost, biosolids made from treated sewage sludge and sold by Golden Heart Utilities (GHU) for use on home gardens and lawns, resulting in the immediate suspension of all compost sales at the end of May 2019 (McGroarty, 2019). Issues of concern for the utility workers and larger Fairbanks community include the safety of storing PFAS-contaminated compost at the GHU facility and potential health hazards for workers, possible contamination of ground- and surface waters from compost stored on-site as well as from compost distributed in the community, safety of produce grown in PFAS-contaminated compost, and the ultimate fate of the contaminated compost.

Legal Action

On April 26, 2019, the City of Fairbanks filed suit against 3M Company and Tyco Fire Products, the manufacturers of the AFFF formulations that were used by the city-owned Fairbanks Regional Fire Training Center for nearly 20 years. The suit seeks at least $4.3 million to recuperate costs of site cleanup and providing clean drinking water. The complaint alleges that "3M and Tyco knew or should have known that PFAS are mobile and persistent when released into the environment and constitute significant risks to groundwater, drinking water supplies and human health" (Case 4:19-cv-00013-JWS, 2019, p. 2, Paragraph 3).

The lawsuit also alleges that 3M "engaged in a campaign to distort scientific research concerning PFAS and to suppress research into the potential harms associated with PFAS" (Case 4:19-cv-00013-JWS, 2019, p. 8, paragraph 43) and failed in their duty to warn the users of AFFF by not providing "adequate warnings of the scope of the risk or hazards." The Fairbanks case has been consolidated with more than 100 cases across the country involving PFOS and PFOA in a federal Multidistrict Litigation ("MDL") due to the national scope of the water contamination (Chemical Watch, 2019). The pretrial proceedings will take place in the South Carolina District Court and any trial of the City of Fairbanks' case would be held in Alaska (City of Fairbanks, 2019).

While the City of Fairbanks, State of Alaska and Department of Defense have already spent millions of dollars to respond to the immediate need to provide safe drinking water, the cost of ongoing site investigations, long term monitoring, long-term solutions to provide clean drinking water, remediation, and prevention of future PFAS contamination will continue to mount in the years, and more likely, decades to come.

The true cost of PFAS contamination, however, is not in dollars spent, but in people harmed. It is unknown what the health impacts may be to residents who without knowing it were drinking highly contaminated water, possibly for decades before the contamination was discovered. And there are many in the Fairbanks area who have no choice but to prolong their exposure to PFAS at levels deemed unsafe in some other states, because the concentrations do not meet thresholds that would trigger a "Responsible Party" to be required to provide a safe alternative.

The locations where PFAS contamination has been confirmed in the greater Fairbanks area are presented in order of the date of discovery.

A. EIELSON AIR FORCE BASE/ MOOSE CREEK

Eielson Air Force Base is located in the Tanana River Valley on a relatively flat floodplain terrace approximately two miles from the active river channel. The on-base water supply, discovered to be contaminated in spring 2015, serves 5,500 people who live on base as well as roughly 3,000 others who work on base but reside off-base. The Air Force has so far identified 15 AFFF release areas for PFAS investigation including former and current fire training areas (FTAs), hangars, fire stations, emergency response locations, nozzle spray test areas, buildings with AFFF systems, biosolids land spreading areas, and Garrison Slough – the main drainage system for the base (Air Force Civil Engineering Center (AFCEC), 2015c).

PFAS contamination of groundwater at Eielson AFB was discovered during a screening-level investigation of four AFFF areas at Eielson AFB in July 2014 as part of a larger nationwide assessment of AFFF areas at Air Force facilities. The highest detection was in shallow groundwater from a monitoring well near the KC-135 fire site where the combined concentration of PFOS and PFOA was 2,000,000 ppt (AFCEC, 2015e; Union of Concerned Scientists, 2018). A preliminary assessment and further site investigations have resulted in an expanding list of PFAS contamination source areas on Eielson AFB. Some sites were already recognized under CERCLA; other sites are new.

Of 25 on-base monitoring wells sampled during a site investigation in 2016, 18 tested above EPA's LHA. An expanded site investigation at Eielson AFB and Moose Creek calls for the installation of 24 new monitoring wells (DEC, 2019s).

Drinking Water Impacts – Public Water System

DEC's Contaminated Sites Program had requested in a letter to Eielson AFB dated November 13, 2012 that the Air Force conduct sampling and analysis for PFOS and PFOA at areas where extensive fire training was performed (DEC, 2012). In the letter, DEC states that, "it should be emphasized that perfluorinated compounds are known to migrate long distances in the saturated zone," and cites concern that base drinking water wells could be impacted. DEC further asserts that, "sampling and analysis is required to assure protectiveness of the base residents."

After two years, the Air Force still had not addressed concerns that the water supply at Eielson AFB could be unsafe to drink. In a January 2015 letter to Eielson AFB Major Scott Boyd, EPA Region 10 requested that the Air Force initiate sampling of drinking water supply wells for

Crash crewmen spray a foam/water agent on the remnants of an Alaska Air National Guard KC-135E Stratotanker aircraft that exploded and burned on September 20, 1989 at Eielson Air Force Base while taxiing to a parking area. *Photo: The U.S. National Archives*

PFOS and PFOA, citing previous discussions and requests by EPA and DEC as well as the DoD's own Instruction 4715.18 (DOD, 2009) for the identification, assessment, and risk management of emerging contaminants (EPA Region 10, 2015). Testing results confirmed that three of the six on-base drinking water supply wells were contaminated with PFOS and PFOA above the EPA provisional health advisory levels in place at the time.

The drinking water is now being treated with a GAC filter after a lesser-quality GAC filter installed in spring 2016 failed to remove PFOS and PFOA to below EPA health advisory levels. Off-site sampling revealed that AFFF releases on Eielson AFB have contaminated every drinking water well in the adjacent community of Moose Creek.

In March 2015, Eielson AFB began testing its treated drinking water for PFOS and PFOA during routine water quality monitoring. When results from the first quarter of 2015 detected PFOS concentrations of .35 ppb (350 ppt) and PFOA at 0.1 ppb (100 ppt) in Eielson AFB's drinking water (United States Air Force (USAF), 2016), the Air Force stopped using the three supply wells with levels of PFOS exceeding health advisory levels and switched to its other three supply wells. Results from the next three quarterly monitoring events showed that levels of PFOS in the treated drinking water were lower than in the first quarter, ranging from 62 ppt to 150 ppt and that PFOA was also detected at lower concentrations—9.8 to 41 ppt (USAF, 2016).

In April 2016, Eielson AFB upgraded its water treatment plant with two granular activated carbon (GAC) units. A month later, EPA established its lifetime health advisory (LHA) level of 70 ppt for the sum of PFOS and PFOA. Results of quarterly sampling in July 2016 were compared to the LHA and Eielson AFB's drinking water was again found to be unsafe. When sampling data showed that the GAC filtration system failed to remove PFOS and PFOA to safe levels, the Air Force switched wells while upgrading the GAC system to a bituminous re-agglomerated activated carbon system (WaterWorld, 2019).

Moose Creek Drinking Water Impacts – Private Wells

When it was confirmed in early 2015 that Eielson AFB's drinking water supply was highly contaminated with PFOS and PFOA, the Air Force expanded its investigation, first to on-base monitoring wells near the northern boundary adjacent to Moose Creek, and then to areas offsite, including the community of Moose Creek. Results from expanded rounds of sampling of private water supply wells in Moose Creek showed that 169 of 174 private wells tested had levels of PFOS + PFOA above EPA's LHA with the combined concentrations detected from 83 ppt – 2,222 ppt (Sullivan, 2018). Upon discovery of PFOS and PFOA in the groundwater, the United States Air Force (USAF) provided bottled water to Moose Creek's 750 residents under an emergency action order and later installed temporary water supply systems (either a point of entry GAC filter system or a water storage system tank) to 164 Moose Creek properties under a Time Critical Removal

Action (TCRA) (USAF, 2015b). These temporary systems will be removed when the permanent solution for providing safe drinking water (piped water from the City of North Pole Water Treatment Plant) is implemented. The piped water expansion plan was finalized in June 2019 after a public comment period and with agreement by the EPA and DEC. Service line connections are anticipated to be completed by Fall 2022 (AFCEC, 2019). To prevent future use of the contaminated groundwater in the Moose Creek area, the USAF will petition the Alaska Department of Natural Resources to designate the groundwater in the Moose Creek area as a Critical Water Management Area (CWMA), which will "deem the groundwater as unusable for all uses," and "prohibit the installation of new water wells."(AFCEC, 2019)

The ongoing use and discharge of PFAS contaminated groundwater from the PFAS plume originating from Eielson AFB is an ongoing concern for DEC as documented in a September 27, 2018 letter to the Air Force obtained by ACAT through a public records request (DEC, 2018b). "DEC is concerned that water wells within the contaminant plume continue to be used in a manner where untreated water is discharged either to septic systems or to the ground surface through use of outdoor spigots." The letter goes on to state, "With PFAS's status as emerging contaminants, combined with the potential for change or migration in the plume(s), it is important to account for uncertainty and protect public health and the environment by preventing further spread of the contaminants. Moreover, the release of pollution of hazardous substances without DEC approval is prohibited by state law" (DEC, 2018b). The Air Force responded in a memorandum dated October 25, 2018, stating that its response to eliminate PFOS and PFOA drinking water exposure, "is not intended or designed to prevent groundwater discharge to soil or surface water," and that, "a response action designed solely to eliminate continued non-potable uses of water, and avoid discharges of water impacted by pollutants or contaminants at private wells would be contrary to Department of Defense and USAF policies" (AFCEC, 2018d). The Air Force plans to decommission private wells by fall 2021 when Moose Creek is connected to North Pole's public water supply, but not before then.

At the time of this report, the U.S. Air Force had not responded to a request made on May 4, 2019 under the *Freedom of Information Act* for labels of Class B firefighting foam(s) currently being used at Eielson, but it can be assumed that Eielson AFB is using Phos-Chek 3% as this is the product that replaced PFOS-containing foams when the Air Force completed its transition in June 2018 (AFCEC Public Affairs, 2018). Up until 2003, Eielson AFB had used 3M's AFFF and was using Ansul AFFF at the time of the preliminary assessment (AFCEC, 2015c).

CDC/ATSDR Eielson Exposure Study

In a limited investigation to assess exposures to PFAS, the Centers for Disease Control and Prevention (CDC) and Agency for Toxics Substances Disease Registry (ATSDR) are conducting an exposure study of Moose Creek residents impacted by the large plume of PFAS contamination from Eielson AFB (CDC, 2019; Friedman, 2019a). Moose Creek is one of eight military-impacted sites nationwide selected for the CDC/ATSDR study, which will assess levels of PFAS in the bodies of study participants and serve as a foundation for future PFAS exposure health studies (the exposure study does not look at health impacts). The CDC/ATSDR will randomly select people from Moose Creek, who, if they choose to participate, will have their blood and urine sampled, likely in 2019 - 2020. CDC/ATSDR estimates that the community has been exposed for 34 years.

B. FORT WAINWRIGHT

Fort Wainwright Army Garrison is the fourth largest Army Training area in the United States. Its Main Post is located partially within the Fairbanks city limits. The Chena River flows through eastern and northern portions of Fort Wainwright. The post serves approximately 15,000 people, including military personnel and their family members, Army retirees and civilians, with roughly half of the population living on base. The Golden Heart Utilities public supply wells for Fairbanks' public water system are located approximately one mile downgradient of Fort Wainwright's western boundary (United States Army Garrison Fort Wainwright, 2011, Figure 3-1.)

The first testing for PFAS at Fort Wainwright occurred in 2013 and was limited to two former fire training areas. The purpose of the sampling—which also analyzed for other contaminants including GROs, DROs, VOCs, EDB and organochlorine pesticides—was to identify and evaluate potential contamination that could impact future construction projects in the fire pits training area (Fairbanks Environmental Services, 2017). Based on results showing PFOS and/or PFOA at levels exceeding groundwater and/or soil migration to groundwater action levels, the Army conducted a second round of groundwater sampling in spring 2015. PFOS and PFOA were detected in groundwater during the 2013 and 2015 sampling events in over half of the 13 monitoring wells sampled. PFOS was detected in groundwater at concentrations ranging from 20 ppt – 3,300 ppt and PFOA at 10 ppt – 440 ppt, exceeding EPA's provisional health advisory limits and DEC's cleanup levels (Fairbanks Environmental Services, 2017, Figures 4-3 and 4-4).

The U.S. Army appears to be lagging behind the Navy and Air Force in the CERCLA process to evaluate installations for PFAS contamination. The Army will not release its preliminary assessment for Fort Wainwright to DEC or the EPA and will not be conducting sampling of potential AFFF release areas until summer 2020 (E. Blake, personal communication, 8/27/19).

In addition to the known AFFF use at fire training pits, other potential sources of PFAS contamination include hangar fires and plane crashes that DEC and EPA acknowledge are known to have occurred at Fort Wainwright. There are likely other sources of PFAS contamination from training exercises, emergency response, and accidental releases at Fort Wainwright. Until potential source areas are identified and sampling occurs, potential risks cannot be assessed, and no remedial actions can be taken. What we do know is that the entire Fairbanks area relies on groundwater for its drinking water supply and it is likely that contamination originating from Fort Wainwright is contributing to groundwater contamination beyond the base boundaries.

Despite detections of PFOS and PFOA in groundwater on the installation in 2013, Doyon Utilities, LLC, the private utility that owns and operates Fort Wainwright's water system did not test the Main post water supply for PFAS until October 2017. The only data on PFAS sampling at Fort Wainwright available at this time are results from quarterly sampling for PFOS and PFOA of the eight active public supply wells on the main post and the results from the sampling that occurred in 2013 and 2015 at the former fire training pit area. There are no sampling data for Fort Wainwright for any PFAS compounds other than PFOS and PFOA.

Drinking Water Impacts

Fort Wainwright obtains its drinking water from on-base groundwater wells that supply the public water system (PWS ID: AK2310918), owned and operated by Doyon Utilities, LLC. The main post is served by two primary source wells at a depth of approximately 80 feet: Well A (North Well) and Well B (South Well) located in the water treatment plant (Bldg 3559). There are also backup water supply wells for the water plant and fire protection wells (Doyon Utilities, n.d.-b). Fort Wainwright facilities that are not connected to the main post water system are serviced by individual wells. This would include wells for the recreational facilities (i.e. golf course), dedicated building wells, and other facilities.

In October 2017, Doyon Utilities tested its primary drinking water source wells, back up wells, and emergency fire protection wells for PFOS and PFOA and explained in a "PFAS Notice" in its 2018 *Consumer Confidence Report* that of the eight wells tested only one—an emergency fire protection well—had detectable levels of PFOS and PFOA at a combined concentration of 12.6 ppt (Doyon Utilities, 2019b). Doyon Utilities initiated quarterly monitoring for PFOS and PFOA for the eight main post wells in 2018. A review of Chemical Sample Reports for 2018 and the first quarter of 2019 posted to DEC's contaminated sites database shows that PFOS has been detected at concentrations ranging from 2.1 – 2.6 ppt in the primary source Well A and PFOA has not been detected above the minimum reporting level (MRL) of 2.0 ppt in this well. Well B, the other primary well for Fort Wainwright, did not show detections of PFOS or PFOA above the MRL in 2018, but did show a result of 2.3 ppt for PFOS in February 2019. Results from samples of groundwater from Fire Protection Well 1032 have consistently shown detections above the MRL of 2 ppt. Quarterly sampling in 2018 and the first quarter of 2019 for Well 1032 which is 58 feet deep showed combined concentrations of PFOS and PFOA ranging from 14.1 – 24.7 ppt. PFOA was detected at approximately one half the concentration as PFOS in each sample. This well is located north of the Ladd Army Airfield close to the Chena River and is less than two miles upgradient from Golden Heart Utilities supply wells for Fairbanks' public water system (United States Army Garrison Fort Wainwright , 2011, Figure 3-1). PFOA was consistently detected in samples from the Central Heat and Power Plant (CHPP) Well 5 in 2018. Concentrations ranged from 6.6 – 14 ppt. PFOS was not detected above the MRL in this well.

Doyon Utilities employs conventional water treatment with green sand filtration for the main post water supply. Fort Wainwright's wastewater is not treated on site but is directed underground and then to lift stations operated by Golden Heart Utilities. The Golden Heart Utilities Wastewater Treatment Plant serves as a regional wastewater treatment facility for the greater Fairbanks area (Utility Services of Alaska, n.d.).

C. FAIRBANKS REGIONAL FIRE TRAINING CENTER (RFTC) BURN PIT

The Fairbanks Regional Fire Training Center is located within Fairbanks city limits on 30th Avenue near a residential area and the popular South Davis Park sports fields. The facility was built in 1987 and its 40-foot diameter burn pit was used for firefighting exercises until 2004. For nearly 20 years, the burn pit was routinely used by firefighters for practice in suppressing liquid fuel fires. The pit would be filled with water and floated with jet fuel, diesel, and/or gasoline. Once ignited, trainees would practice discharging AFFF to extinguish the fuel fire.

In August 2015, in preparation for decommissioning the burn pit, DEC sampled standing water in the pit for PFAS and found levels of PFOS and PFOA exceeding DEC's action levels at the time (200 ppt for PFOS and 400 ppt for PFOA). Although the burn pit was lined, it is suspected that AFFF leaked through the liner and was over-sprayed beyond the edges of the pit (City of Fairbanks, n.d.). Upon receiving the sampling results, DEC recommended the City begin a well search immediately to delineate the contaminant plume (DEC, n.d.-b).

Drinking Water Impacts – Private Wells

The City of Fairbanks alerted property owners with private drinking water wells within an initial well search area northwest (downgradient) of the Regional Fire Training Facility and sampling began for PFOS and PFOA in February 2016 with several rounds of additional testing. While the full extent of the PFAS plume is still unknown, DEC has sampled all of the wells identified in the well search (R. Burgess, personal communication, June 17, 2019).

To date, over 160 wells have been sampled in the RFTC plume. Forty-eight eligible properties have been connected to the public utility. Under *Ordinance 6060*, passed by the Fairbanks City Council in September 2017, property owners receive a stipend of $2,500 to assist with payment of water bills which represent a new expense for those who have historically relied on private wells for their drinking water (City of Fairbanks, 2017). *Ordinance 6060* also established that properties with combined PFOS and PFOA concentrations of 59.5 ppt (85% of the EPA's lifetime health advisory) are eligible for municipal water service connections (City of Fairbanks, 2017), a lower threshold than EPA's lifetime health advisory of 70 ppt.

Analyzing all of the data for private wells impacted by the PFAS plume from RFTC, or any of the sites discussed in this report is beyond the scope of this report. However, as an example of how people may continue to be exposed to PFAS at levels that independent scientists and some states have agreed are unsafe, we provide the following analysis of 12 private wells with PFAS concentrations that fall below EPA's LHA action level of 70 ppt for PFOS and/or PFOA. The combined concentration of PFOS and PFOA was, on average, between 20 ppt – 30 ppt for these 12 wells tested on a quarterly basis over the course of 4-8 quarters, ranging from August 2016 – July 2018, depending on the well, as not all were tested each quarter (S&W, 2018c; S&W, 2018e).

The PFAS levels in these 12 wells fall below the criteria established by the City of Fairbanks for connecting private wells to the public water supply, but are nearly twice the level deemed safe by several other states, including New Jersey and New Hampshire.

Data from 2016 sampling of wells in the Fairbanks Regional Fire Training Center plume summarized by Shannon & Wilson show that analytical results for at least 6 PFAS and up to 19 PFAS compounds were reported. PFOS was generally detected at the highest concentrations, followed by PFHxS, and then PFOA. In one neighborhood, PFNA was the compound detected at the highest concentrations at 200 ppt – 510 ppt in three of six wells (S&W, 2016).

Drinking Water Impacts – Public Water System

Fairbanks homes and businesses that are connected to the public water system are served by two privately held, publicly governed utilities – Golden Heart Utilities and College Utilities which serve different areas of the city, but obtain their drinking water from the same source. The public water system is supplied by three groundwater supply wells (70 – 90 feet deep) that tap into the aquifer beneath the Tanana Valley (College Utilities Corporation, 2018). Due to possible contaminated areas (known as PCA's), assessed by DEC, the aquifer that Fairbanks residents rely on for their groundwater received a "high to very high vulnerability ranking" based contaminants known to be present (2018). The raw water is treated in a lime softening conventional treatment plant. According to the EPA, due to the chemical properties of PFAS and the fact that they dissolve in water, "traditional drinking water treatment technologies are not able to remove them"(EPA, 2018d).

In 2017, Golden Heart Utilities—which also provides the water that College Utilities Corporation pipes to its customers—monitored Fairbanks' treated public water for six PFAS compounds: PFOS, PFOA, PFHxA, PFHxS, PFNA and PFBS. Of the six, four were detected. As reported in their 2018 *Annual Consumer Confidence Water Quality Report*, College Utilities Corporation found PFAS at the following levels in treated water supplied by the Golden Heart Utilities water treatment plant:

PFOS:	2.4 ppt – 2.9 ppt
PFOA:	2.9 ppt – 3.5 ppt
PFHxA:	2.8 ppt – 3.2 ppt
PFHxS:	5.1 ppt – 5.9 ppt

When summed, concentrations of the four PFAS compounds known to be present in Fairbanks' municipal drinking water in 2017 would be 13.2 ppt – 15.5 ppt (Golden Heart Utilities, 2018). This does not include PFNA and PFBS which were below reporting limits of 2 ppt. Considering only PFOS and PFOA levels, the average concentrations detected in the public water were 5.3 ppt – 6.4 ppt for the sum of both.

D. FAIRBANKS INTERNATIONAL AIRPORT (FAI)

Several PFAS source areas have been identified at FAI since initial sampling of groundwater for PFOS and PFOA in May 2017 near the fire training area burn pit confirmed the presence of PFOS and/or PFOA at levels exceeding groundwater cleanup levels of 200 ppt and 400 ppt, respectively. Additional sampling in September 2017 from monitoring wells on airport property showed a maximum concentration of 18,000 ppt PFOS and a maximum concentration of 850 ppt for PFOA (S&W, 2018b).

Drinking Water Impacts – Private Wells

Beginning in November 2017, a private well search and sampling effort began to determine the extent to which PFAS contamination from AFFF use at the airport had migrated offsite and could be impacting private drinking water wells. The effort to further characterize and delineate the FAI PFAS contamination plume affecting groundwater and soil is ongoing (DEC, 2019m).

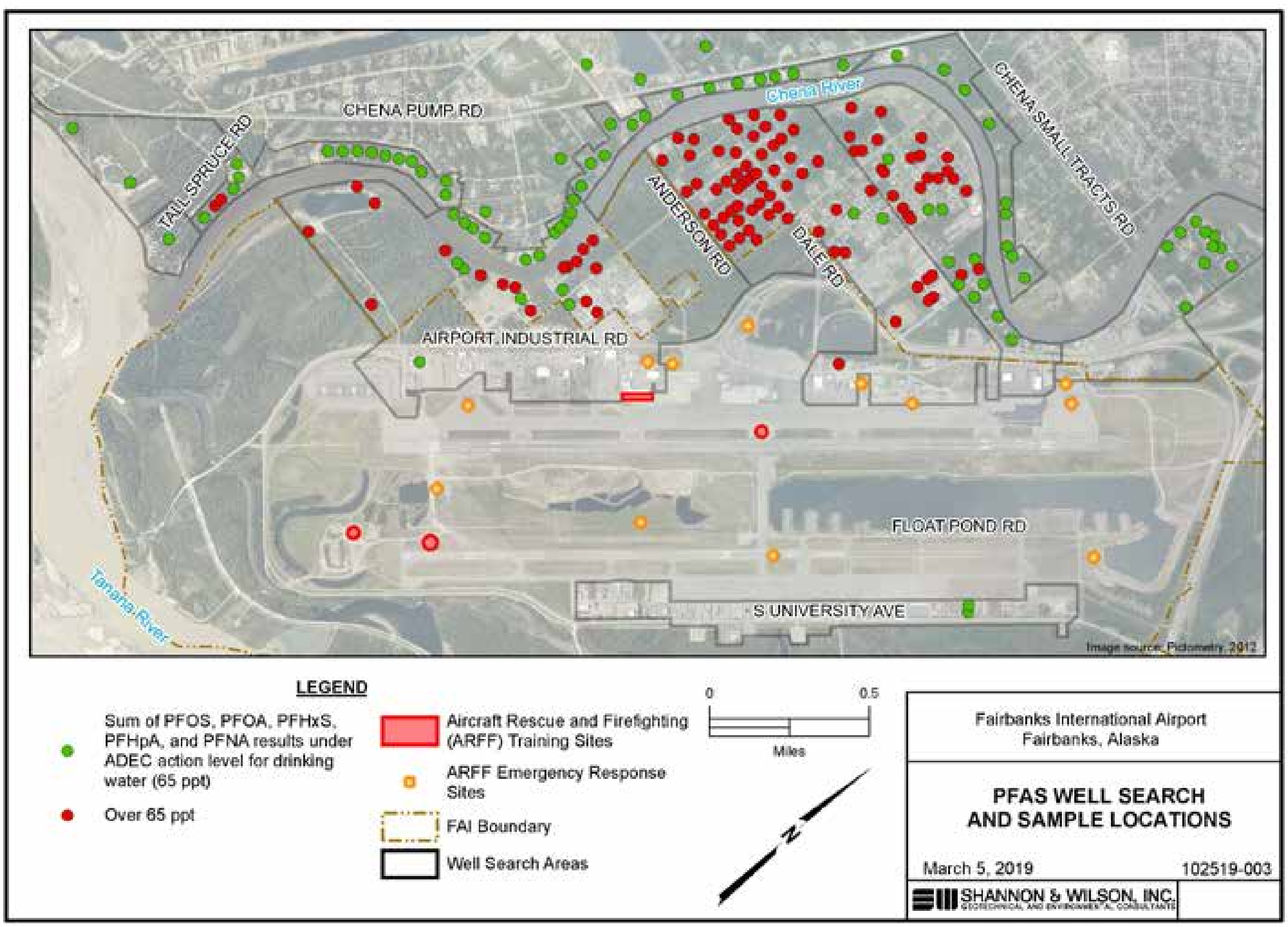
Groundwater samples taken to date have primarily been collected from wells connected to indoor plumbing that are used for cooking or other domestic purposes (category 1 and 2 wells, respectively). The well search and sampling effort extended in the direction of groundwater flow (to the west of Fairbanks International Airport) in several rounds of sampling between November 2017 and March 2018. As of November 30, 2018, 193 wells had been sampled with 102 wells having detections above the DEC action level (Department of Transportation & Public Facilities (DOT&PF), n.d.). In October 2018, the well search was expanded to sample across the Chena River from the airport and sampling results showed that the plume is not extending beyond the Chena river to the northwest (DEC, 2019m). DEC is fairly confident that the extent of private drinking water well impacts from the airport plume has been defined (R. Burgess, personal communication, June 13, 2019).

As of December 2018, FAI had connected 61 properties to College Utilities and 29 of the original 107 properties that requested bottled water were still receiving it (DOT&PF, n.d.; S&W, 2019h, Table 1).

Drinking Water Impacts – Public Water System

Fairbanks residents connected to the public water supply receive their water from the same source which is then distributed by one of two privately-held, publicly governed utilities, Golden Heart Utilities or College Utilities Corporation. See Fairbanks Regional Fire Training Center (page 34) for a discussion of results of PFAS monitoring of the public water system.

DOT&PF maintains a Fairbanks Airport ARFF Training Areas Contamination webpage with updates and documents related to the PFAS contamination plume originating from the airport: **http://www.dot.state.ak.us/airportwater/fairbanks/**.



E. NORTH POLE TERMINAL

The former North Pole Oil Refinery, now the "North Pole Terminal," operated from 1977 until 2014 under three different owners. The current property owner is Flint Hills Resources, a subsidiary of Koch Industries. During the refinery's 37 years of operation, there were nearly 400 documented petroleum spills (Buxton, 2014). Groundwater downgradient of the former refinery was discovered to be contaminated with the industrial solvent sulfolane in 2009. Most properties with private wells have been fitted with point of entry (POE) filters (DEC, 2019b).

Sampling for PFOS and PFOA was included in routine semiannual groundwater monitoring on North Pole Terminal property in 2017. Levels of PFOS and PFOA in groundwater in three of the nine onsite monitoring wells tested above cleanup levels. The highest concentration of combined PFOS and PFOA was 2,470 ppt in one well (Arcadis U.S., Inc., 2018, Table 3-6). Given the known migration of the contaminant sulfolane to drinking water wells in the direction of groundwater flow to the north and northwest of the former refinery, DEC initiated offsite groundwater sampling for PFAS in 2018 (DEC, 2019e).

Drinking Water Impacts – Private Wells

Shannon & Wilson conducted initial offsite sampling for PFAS in summer 2018 at select existing groundwater monitoring wells and private drinking water wells for the six PFAS for which DEC set action levels in August 2018 (PFOS, PFOA, PFNA, PFHxS, PFHpA, PFBS). Results showed PFAS detections above action levels in a number of offsite private wells that were sampled (S&W, 2019i), prompting DEC to expand sampling efforts to include a six square mile area north and northwest of the former North Pole Refinery. In fall/early winter 2018, an additional 35 private drinking water wells (20 of which already had point of entry—or POE—treatment systems as a result of sulfolane contamination) and 42 groundwater monitoring wells were sampled (DEC, 2019g).

As with most PFAS-contaminated sites in Alaska, the full extent of contamination in North Pole remains unknown. High concentrations of PFAS at monitoring well (MW) #316-15 located upgradient from the North Pole Terminal (and downgradient from the North Pole Fire Station), suggest that the fire station may be a potential AFFF source area affecting groundwater. In October 2018, the following concentrations were detected in MW #316-15: PFNA at 2,400 ppt, PFOS at 790 ppt, PFHxS at 440 ppt, PFOA at 280 ppt, and PFHpA at 180 ppt downgradient of the North Pole Fire Station.

North Pole Fire Department training rosters provided to DEC and later obtained by ACAT through a public records act request suggest that AFFF may have been used at the North Pole Fire Station (and on a few occasions at the North Pole Refinery) beginning in the early 1990s. Notes on the rosters indicate that several of the drills and training exercises were related to "foam". While not all "foam" used may have been AFFF, several of the rosters specifically mention the use of AFFF (see training roster below).

Drinking Water Impacts – Public Water System

The North Pole Water and Sewer Utility supplies public drinking water to approximately 650 North Pole residents (City of North Pole, n.d.). A piped water extension project is in the works to connect North Pole properties with sulfolane- and PFAS-contaminated wells to the public water supply. This extension project will also connect the community of Moose Creek to the public utility. Beginning in August 2015, the Utility has been testing its water

Training Class Detail Roster (Modified)

Class Date Between {11/01/2000} And {11/27/2017}
and Default Training Category = "FFIIFOM "

Date: 05/06/2012 Time: 15:00 Description: FFII Foam Fire Streams

Category: FFIIFOM FFII Foam Fire Streams
Method: DM Drill, Manipulative
Location: NPFD North Pole Fire Department
Agency: NPFD North Pole Fire Department
Station: NPF Unit: Shift: C
Default Hours: 01:00 Hrs Pd: 01:00 Pts: 0.00 CEU: no

Instructors: KUHNERT Dan Kuhnert

Notes: Use of AFFF on class B fires. How to set up eductor and flow bank down, roll on, rain down, how to approach fire, from uphill upwind, and how to back away from fire. Face fire while walking backward.

supply on a roughly quarterly basis for certain PFAS. From August 2015 to August 2016, drinking water was analyzed by for 6 PFAS with all results below the reporting limits of the laboratory doing the analysis; however, the reporting limits were high: 9.0 ppt for PFBS, 1.0 ppt for PFHpA, 3.0 ppt PFHxS, 2.0 ppt for PFNA, 4.0 ppt for PFOS and 2.0 ppt for PFOA. Thereafter, the Utility alternated between testing for PFOS and PFOA only and testing for 12 PFAS and used a lab with a minimum reporting limit of 2.0 ppt for each compound. All results were below 2.0 ppt for the compounds tested, except for PFHxS which was detected on three sampling dates at 2.2 ppt, 2.3 ppt, and 2.5 ppt. While this concentration is relatively low, it is possible that there are levels of other PFAS in the water at less than 2.0 ppt. Without the complete data set, there is no way to know the values of the summed concentrations. PFAS are not mentioned in the North Pole Water & Sewer Utility's 2018 *Water Quality Report* which is the first report to be published since 2016. Wastewater from the Utility passes through four lagoons before discharging to the Tanana River, according to the City of North Pole website. North Pole's wastewater has not been tested for PFAS.

Other Concerns

The continued use of PFAS-contaminated drinking and non-drinking water wells after households are connected to the public water supply remains a concern because this will disperse PFAS to the surface and potentially result in further exposures.

Produce sampled from a farm in the North Pole area in 2018 to evaluate the uptake of PFAS by plants showed low detections of PFBA (a 4-carbon chain compound) in kale, brussels sprouts and cabbage; and PFOA, also at low levels, was present in strawberries (DEC, 2019t). As a precautionary measure, the farm, which also supplies food to local schools, installed a granular activated carbon (GAC) filter for its drip irrigation system. The Alaska Department of Health and Social Services (DHSS) determined that "the hazard associated with exposure to PFAS through eating vegetables and strawberries grown at the local farm is negligible" (DEC, 2019t).

Potential Impacts on Fish

Kimberly Lake, located downgradient of the North Pole Refinery was tested for PFAS in October 2018. Surface water test results showed the sum of five PFAS to be 120 ppt and 122 ppt in two samples, prompting fish from the lake to be tested. Fish tissue from three fish from the lake (stocked by ADF&G) showed PFAS at levels causing ADF&G to issue an emergency order on April 3, 2019 closing Kimberly Lake to sport fishing. PFNA ranged from 16-22 parts per billion (ppb) and PFOS concentrations ranged from 47–68 ppb in fish tissue (DEC, 2019e).

Photo: WATER, Wake Up Alaskans to the Toxic Environmental Reality

If one were to apply New Jersey's fish consumption advisory levels established for PFOS, PFOA and PFNA, to the fish sampled from Kimberly Lake, it would only be safe to consume Kimberly Lake fish once every three months and it would be unsafe for high risk populations including infants, children, pregnant women, nursing mothers and women of childbearing age to eat them at all (Goodrow, 2019).

F. BLOOM ENTERPRISES FIRE

The University Fire Department, with support from the Fairbanks International Airport Fire Department, used aqueous film forming foam (AFFF) to extinguish a fire at Bloom Enterprises' 2448 Arvilla Street property in Fairbanks on May 9, 2017 (DEC SPAR, 2018a). The fire melted plastic storage totes containing used vegetable oil causing large amounts of oil to ignite (DEC, 2019j). Petroleum-based Seal Cote was also released during the fire (Alaska Resources and Environmental Services, LLC, 2019).

After the fire, the Fairbanks North Star Borough HAZMAT team and DEC collected about 8,000 gallons of the oil and water / AFFF mixture which was temporarily stored offsite and later transferred into two 6,000 gallon tanks on site for future treatment and disposal (Alaska Resources and Environmental Services, LLC, 2019); however, as of June 2019, these storage tanks had not been removed (R. Burgess, personal communication, June 17, 2019). Liquids that could not be contained during the initial response effort flowed towards the Arvilla Street roadbed and pooled there (DEC SPAR, 2018a). An estimated 3,000 gallons of AFFF contaminated media were transported to Organic Incineration Technologies the day after the fire (DEC SPAR, 2017).

Soil contaminated with AFFF from the emergency response has been improperly transported and improperly stored, potentially spreading contamination even further, and into groundwater at a second property owned by Bloom Enterprises. Contaminated soils excavated at the site of the fire were stockpiled, and then transferred to Bloom Enterprises' property at 2900 Chena Point for short term storage (DEC, 2019j). The contaminated soil was later transferred back to the Arvilla Street property after a citizen filed a complaint with DEC citing concerns that the stockpile was uncovered and rainwater may be draining into an 80-foot deep gravel pit nearby, potentially contaminating groundwater; the improper storage of the soil at Chena Point was confirmed by DEC staff during a site visit (DEC, 2019j). Results from testing in late October 2018 of the Chena Point Stockpile Footprint/Drainage show

Oily debris from May 2017 fire at Bloom Enterprises in Fairbanks. AFFF was used to help extinguish the fire. *Photo: DEC*

Response to May 9, 2017 fire at Bloom Enterprises in Fairbanks. *Photo: DEC*

that PFAS is present at this location, suggesting that the contamination could be a result of the temporary stockpile. A sample taken of soil in the area that would have received drainage from the temporary stockpile at Chena Point showed PFOS at .0032 mg/kg, just above DEC's soil migration to groundwater cleanup levels (Alaska Resources and Environmental Services, LLC, 2019, Table 3).

To date, the stockpile containing 4,800 cubic yards (Alaska Resources and Environmental Services, LLC, 2019) of PFAS and DRO contaminated soil remains in a bermed containment area at the Arvilla Street property. Results of sampling of the berm soil (which was clean when it was placed) showed that it was contaminated, indicating that the berm is insufficient to contain the soil. In addition, the cover is deteriorating.

In addition to their failure to meet deadlines to remove and properly dispose of contaminated material, Bloom Enterprises also failed to meet their responsibility to identify and sample wells on properties within a quarter mile of the Arvilla Street property. DEC stepped in to lead sampling in June 2019 of four private wells downgradient of Bloom Enterprises for PFOS, PFOA and VOCs; results showed low level detections of PFOS and PFOA in all wells and VOCs in one well. All results were well below DEC's current action levels (DEC, 2019j).

On October 3, 2018 DEC sent a notice of violation (NOV) to Bloom Enterprises alleging that the company had failed to conduct site characterization, failed to conduct cleanup operations and failed to properly store and dispose of contaminated soil as required under 18 AAC 75 Article 3 (DEC SPAR, 2018b).

G. NAPA AUTO PARTS STORE

Five fire departments responded to a fire at the Napa Auto Parts store and warehouse at 1937 Van Horn road in Fairbanks on May 26, 2011 before ultimately, an ARFF vehicle from Fairbanks International Airport (FAI) was sent to provide foam for fire suppression (Nortech, 2019). A number of contaminants, including volatile organic compounds (VOCs) and Diesel Range Organics (DRO) are known to have been released into the environment as a result of the fire which consumed both the store and the warehouse (DEC, 2019o). What was not known until May 2018 is that PFAS contamination is also present at the site.

To determine whether the site should be investigated for PFAS contamination, DEC requested that the Responsible Party (General Parts Company) find out more from FAI Fire Department about what product was used in the emergency response. An incidence report confirmed that FAI Fire Department had used up to 100 gallons of Ansulite 3% Freeze Protected AFFF to extinguish the fire (Nortech, 2019, p. 2). DEC then requested that sampling for PFAS occur during the next groundwater monitoring event (DEC, 2019o).

Preliminary groundwater testing for PFAS occurred in October 2018 and results showed levels of PFOS and PFOA far exceeding EPA's LHA in all four existing monitoring wells. The highest concentrations of the sum of PFOS and PFOA were reported in MW2 and MW1R at 25,900 ppt and 24,300 ppt, respectively (Nortech, 2019, p. 8). Results for PFOS/PFOA in the other two wells were also found to be above health advisory levels (Nortech, 2019, p. 8). Results of sampling in February 2019 showed similar results with levels of PFOS/PFOA exceeding action levels in all four monitoring wells. The February PFOS/PFOA results for MW2 were even higher than in October at 43,100 ppt (Nortech, 2019, Table 2). The laboratory analyzed and reported for 24 PFAS analytes for both monitoring events. Of these, eleven were detected above the reporting limit in each of the four wells in October 2018 and February 2019 (Nortech, 2019, Table 2).

Drinking Water Impacts – Private Wells

Upon receiving the first round of PFAS test results from the October 2018 groundwater monitoring, DEC requested in January 2019 that General Parts Company/Nortech conduct a well search to identify and sample any private wells in the neighborhood that may be contaminated with PFAS from the AFFF release in the 2011 fire (DEC, 2019o). Nortech collected groundwater samples from ten private wells identified within a one quarter mile radius of Napa Auto Parts in February/March 2019. According to data presented in laboratory reports from SGS North America available on DEC's Contaminated Sites Database (Hazard ID 25865), five of ten wells had detectable PFAS compounds in their groundwater; none had PFOS/PFOA above the LHA of 70 ppt. Summed concentrations of PFOS/PFOA ranged from 5.7 ppt – 21.6 ppt in the five wells with detectable PFOS/PFOA. The laboratory analyzed for 23 PFAS. When adding concentrations of PFHxS, PFNA, and PFHpA, to the PFOS and PFOA detections, none of these wells exceeded DEC's previous stricter action level of 70 ppt for the sum of five.

H. ALYESKA NORDALE STORAGE YARD

Testing for PFAS at Alyeska Pipeline Service Company's (APSC) Nordale Storage Yard, located in North Pole, began in October 2018. Equipment historically stored onsite includes a foam fire suppression system containing AFFF. Results from initial sampling of two onsite wells (one non-potable and one inactive) showed that the non-potable well contained PFAS at 76 ppt for the sum concentration of PFHpA, PFHxS, PFNA, PFOS and PFOA, prompting an off-site investigation of private drinking water wells to the north, northwest and southwest of APSC's Nordale Storage Yard. Shannon & Wilson conducted sampling of 30 private wells in February 2019 and results were compared to DEC's August 2018 Action Levels. No wells exceeded 70 ppt for the "sum of five" (DEC, n.d.-a).

III. ANCHORAGE

Two military installations are under investigation for PFAS contamination in Anchorage: active Joint Base Elmendorf-Richardson (JBER) and former Kulis Air National Guard Base (ANGB), now the Kulis Business Park. Preliminary Assessments were completed in 2015 and Site Inspection reports in 2018 for both JBER and Kulis. Anchorage International Airport is in the early stages of evaluation for PFAS contamination.

A. JOINT BASE ELMENDORF-RICHARDSON (JBER)

Alaska's largest military base, Joint Base Elmendorf-Richardson (JBER) is located in the Anchorage Bowl, bordered by the Chugach National Forest, residential, commercial, and industrial properties, and the Knik Arm of Cook Inlet. Neither on-site nor off-site drinking water sources are suspected to be at risk for PFAS contamination. This may help to explain why there is so little progress to further investigate and monitor PFAS source areas, despite DEC's promulgated cleanup levels for PFOS/PFOA and assertions to the Air Force Civil Engineering Center (AFCEC) that in order to comply with Federal Facility Agreements (FFAs), new source areas require remedial investigation and/or remediation. In February 2019, DEC Project Manager Louis Howard noted that "ADEC believes AFCEC is out of compliance with the terms of the FFAs for not scheduling and investigating PFOA and PFOS source areas in a timelier manner in accordance with CERCLA" (DEC, 2019n).

During the 2016 field season 29 new monitoring wells were developed (based on recommendations in a preliminary assessment) to test and monitor groundwater at JBER for PFAS (AFCEC, 2018f). Sampling results from 2016 show that PFOS and/or PFOA were detected in groundwater above EPA's LHA at 20 of the 26 AFFF areas, including eight hangars, two former AFFF Spray Test Areas, the current Fire Training Area, three Fire Stations, a storage yard for debris from the C-17 that crashed in 2010, Fire

Fire suppression foam test in airplane hangar at JBER. *Photo: Airman 1st Class Caitlin Russell*

Suppression Foam Storage area, the UC35A Cessna Crash Location, and the Cherry Hill Ditch drainage system (AFCEC, 2018f). Two seep areas at the boundary of JBER were also sampled and results showed PFOS/PFOA at concentrations above screening levels raising concerns that PFAS "may be migrating off base in groundwater and surface water" (AFCEC, 2018f, Section 5, p. 3). Thirteen AFFF areas had detections of PFOS and/or PFOA in soil at concentrations above DEC Migration to Groundwater cleanup levels (AFCEC, 2018f). PFBS was not found to exceed screening levels in either groundwater or soil at any of the AFFF areas (AFCEC, 2018f, Table 5-1).

The highest sum concentration of PFOS and PFOA in groundwater was 29,100 ppt at Fire Station 7 (AFFF Area #15) (AFCEC, 2018f, Table 3-6). The fact that there are no confirmed AFFF releases at Fire Station 7, suggests that the contamination may be originating from another area. Hangar 18 (AFFF Area #24), upgradient of Fire Station 7, had the second highest concentration of PFOS and PFOA (8,330 ppt) detected in groundwater at JBER. Several large (approximately 1,000 gallons each) unintentional releases of AFFF are known to have occurred at Hangar 18 (AFCEC, 2015d).

A number of unplanned AFFF releases have occurred as a result of accidental activations of fire suppression systems in hangars. When the system activates and the hangar fills up with foam, the AFFF that is not captured by the floor drains (which connect to the wastewater system) may be pushed out of hangar doors. AFFF that reaches grassy or gravel areas may have infiltrated to groundwater (AFCEC, 2015d). A conservative tally of accidental releases described in the preliminary assessment, suggests that at least 5,000 gallons of AFFF concentrate were released unintentionally between the years 2000-2014 at six different hangars (AFCEC, 2015d). Between three and five accidental activations of the fire suppression system at Hangar 18 occurred around 2005, "including at least one instance when all four cannons activated simultaneously and a number of other instances where one or both cannons in the east or west end activated. The estimated maximum volume for each of these discharges is 1,000 gallons of AFFF concentrate." (AFCEC, 2015d, Section 3, p. 18).

As required by DoD, AFFF meeting MILSPEC requirements is currently used at JBER. During testing of systems on eight emergency vehicles, an estimated 40-80 gallons of AFFF concentrate has been discharged annually and allowed to dissipate on site (AFCEC, 2015d, Table 4.1). Until 2010, these tests were conducted at the Former Spray Test Area. The Current Spray Test Area is an unlined, gravel, bermed area that also serves as a snow dump (2015d, Table 4.1). The brands of AFFF reported to have been used on JBER at the time of the preliminary assessment included remaining stocks of 3M and Ansulite 3 percent (AFCEC,

FROM CHERRY HILL DITCH TO KNIK ARM

Cherry Hill Ditch is an artificial drainage system (with closed pipe and open drainage pathways) that directs surface water runoff from JBER (Elmendorf) to Knik Arm of Cook Inlet, where it discharges at a point 1,500 feet out in Knik Arm (AFCEC, 2018f). The drainage network "runs adjacent to or near, and receives runoff from, many of the hangars, training areas, and other locations where releases of AFFF may have occurred" (AFCEC, 2018f, Section 2, p. 10). PFOS was detected at concentrations exceeding screening levels in shallow subsurface soil, groundwater, and surface water samples taken at Cherry Hill Ditch. The highest concentration of PFOS detected in Cherry Hill Ditch was 480 ppt in a surface water sample and 340 ppt in one of the three groundwater samples that exceeded action levels (AFCEC, 2018f, Table 5-1).

It is concerning that runoff containing PFAS is discharged into Knik Arm, designated critical habitat for the Cook Inlet beluga whale (National Oceanic & Atmospheric Administration, 2011). Potential impacts to anadromous and resident fish species, and other wildlife are also of concern. The Air Force acknowledges that the outflow from Cherry Hill ditch "does have the potential for ecological impact on marine species in the Knik Arm" (AFCEC, 2015d, Section 3, p. 61). The Air Force also recognizes that PFAS may be migrating offsite from seeps where groundwater emerges along the face of a bluff above Knik Arm. PFOS was detected at a concentration of 420 ppt in a sample taken from one seep at the bluff (LF004) (AFCEC, 2018f, Table 3-6). The potential impact of offsite migration of PFAS (via Cherry Hill Ditch and the bluff seeps) into the marine environment should be investigated.

2015d). The Air Force announced in June 2018 that it had completed its transition from PFOS-containing "legacy foams" in firefighting vehicles and stockpiles to the "environmentally responsible" foam Phos-Chek 3% AFFF manufactured by ICL Performance Products (AFCEC Public Affairs, 2018), the company awarded the contract to supply AFFF to the Air Force. Indeed, a *Freedom of Information Act* (FOIA) request for current labels of AFFF used at JBER confirmed that the installation uses Phos-Chek 3%. The Air Force is not as clear about the formulation of AFFF used in hangars and stated in its 2018 announcement that it will "replace AFFF contained in aircraft hangar fire protection systems in conjunction with hangar renovations." This begs the question—if no renovations are required to hangars at JBER, might the hangar fire suppression systems be fully loaded with legacy AFFF for years to come?

Potential Offsite Migration of PFAS into Ship Creek

The preliminary assessment (PA) for JBER indicates that for 10 AFFF areas, "Groundwater in the shallow aquifer [20-45 feet below ground surface (bgs)] has been shown to discharge to Ship Creek west of Boniface Parkway. Contaminants that reach the shallow aquifer therefore have the potential to impact Ship Creek, indicating a potentially complete exposure pathway for non-ingestion exposures such as dermal exposure to humans. There is also a potential ecological impact to aquatic and marine species, including salmon, which are found in Ship Creek, and to humans and other animals that ingest these fish and other aquatic or marine species" (AFCEC, 2015d). Results of sampling conducted in 2016 showed PFAS in groundwater at the highest concentrations at JBER in three of these areas: Fire Station 7, Hangar 18, and the C-17 Debris Storage Yard (AFCEC, 2018f).

Ship Creek surface waters should be sampled for PFAS since shallow groundwater from AFFF areas has the potential to reach Ship Creek. An additional concern is the groundwater that seeps to the surface at several locations along a steep cliff (ST037) at the southern boundary of JBER and is ultimately discharged into Ship Creek after going through an engineered wetland remediation system that passively treats groundwater for other contaminants associated with a diesel spill. When sampled, PFOA was detected at a concentration of 2,700 ppt and PFOS at 4,900 ppt (AFCEC, 2018f, Table 3-5).

The William Jack Hernandez Sport Fish Hatchery located on Ship Creek is close to the southern boundary of JBER. According to the Hatchery's manager, fish are raised in well water taken from the deep aquifer at 300

A popular salmon fishing area on Ship Creek, located downstream from JBER. Offsite migration of PFAS from AFFF releases on JBER has not been investigated. *Photo: (top) Senior Airman Kyle Johnson, (bottom) USFWS/Katrina Mueller*

bgs. The hatchery uses Ship Creek for its brood raceways and fish are in contact with Ship Creek surface waters for approximately three days for egg harvest (G. George, personal communication, April 23, 2019). Alaska Department of Fish and Game should test not only the hatchery fish for PFAS but also wild salmon that return to Ship Creek to spawn, as well as resident fish and other wildlife species.

Drinking Water Impacts

Doyon Utilities provides the majority of JBER's drinking water. The source is surface water from a diversion dam located on upper Ship Creek. Three wells located on JBER-R (Richardson) tap into the deep confined aquifer and are used to supplement the reservoir water when water levels are low. None of these wells are located downgradient of any of the AFFF areas that have been investigated (AFCEC, 2018f). Doyon Utilities supplies water to Elmendorf, but at the boundary between former Richardson and Elmendorf, the 673d Civil Engineer Group (CEG) takes over to distribute the water on the Elmendorf side of the base, and Bioenvironmental Engineering monitors water quality (Doyon Utilities, 2019c).

In addition to the water supplied by Doyon Utilities, there are 17 drinking water supply wells on JBER-E (Elmendorf) owned and operated by the Air Force. Of these, five are backup supply wells that draw from the deeper, confined aquifer. Other wells include dedicated building wells and recreational facility wells. Twelve of the 17 water supply wells are located downgradient from AFFF areas (AFCEC, 2018f). The well nearest to an AFFF area is Well 2, a backup well located one mile downgradient of the C-17 Debris Storage Yard where the third highest concentrations of PFOS were detected. The other downgradient wells are two or more miles from AFFF areas and the remaining eight wells are not believed to be located downgradient of the AFFF areas investigated (AFCEC, 2018f).

Both Doyon Utilities and Bioenvironmental Engineering sample drinking water for regulated chemical contaminants (Doyon Utilities, 2019c). Doyon Utilities has not sampled their water for PFOS or PFOA. The Department of Defense issued a memo requiring the Air Force (and Army and Navy) to test for PFOS and PFOA at installations where DoD provides the water but did not require that private contractors providing water to military installations test for PFAS.

Results of Air Force led sampling showed no detections for PFOS, PFOA, or PFBS.

Other Concerns

Wastewater from JBER has not been sampled for PFAS and it should be. We know that releases of AFFF from the activation of hangar fire suppression systems and other sources have released into floor drains connected to the sanitary sewer system. Wastewater generated on JBER is collected and then transferred to the City of Anchorage Water and Wastewater Utility (AWWU) for treatment (Doyon Utilities, n.d.-c). Wastewater treatment systems are not designed to remove PFAS, so PFAS-contaminated water treated at AWWU's *John M. Asplund Wastewater Treatment Facility located at* Point Woronzof (Anchorage Water and Wastewater Utility (AWWU), n.d.) is discharging directly to Cook Inlet.

Mt. Spurr Elementary School is located just under a mile south of Fire Station 7, where PFOS was detected at 24,000 ppt in groundwater from a monitoring well that screens in the shallow aquifer. The direction of groundwater flow from Fire Station 7 is believed to be to the southwest (AFCEC, 2018f). Investigation of offsite migration of PFAS contamination should include identifying and evaluating possible exposure routes that might affect children and staff at Mt. Spurr Elementary School. Sitka and Denali

Child Development Centers are within one mile of AFFF areas and should also be evaluated to determine if there are exposure routes that may impact children and staff.

A question that should be asked—and answered—is whether the magnitude 7.1 earthquake on November 30, 2018 (University of Alaska Fairbanks, Alaska Earthquake Center, 2019; USGS, 2018) had any effects on the distribution of PFAS in groundwater.

B. FORMER KULIS AIR NATIONAL GUARD BASE (ANGB)

The 129-acre Kulis Air National Guard Base (Kulis ANGB) was established in 1955 and permanently closed and returned to the State of Alaska in August 2011. The property is now managed by Ted Stevens Anchorage International Airport as the Kulis Business Park. Former Kulis ANGB was home to the 176th wing of the Alaska Air National Guard (now stationed at JBER) from 1969 until its closure in 2011. During this time, AFFF was likely stored, handled, accidentally released and/or used at ten areas identified during a preliminary assessment (AFCEC, 2015a) all of which were recommended for further investigation based on groundwater, stormwater, and soil sample results (AFCEC, 2018b).

Fourteen permanent groundwater wells were installed after a 2015 preliminary assessment to identify where sampling should occur. Sampling for 14 PFAS analytes

MAY 11, 2017 FIRE TRAINING EXERCISE AT KULIS

On May 11, 2017, the ASL [Aerostar SES, LLC] team members observed a fire training exercise being conducted on the concrete tarmac (AFFF Area 10) located east of Building 42 Fire Rescue Station (AFFF Area 4). The exercise included spraying foam from a fire truck to extinguish the mock burning of a fuel tanker truck. The field team observed foam on the concrete tarmac and noted foam in the ditch that directs stormwater drainage toward the main drainage ditch and in the grassy area located next to the newly installed monitoring well KULPMW13. The foam was suspected to be a mixture of water and Chemguard 3 percent AFFF C-301MS, however, it was uncertain if this was the product that was used, if the product contained PFAS, and how it affected the soil in the immediate area. Therefore, two grab surface soil samples and a field duplicate were collected in the ditch and in the grassy area next to the well. According to personnel contacted at the Alaska Department of Transportation and Public Facilities, both AIA [Anchorage International Airport] and the local municipality use this facility for fire-related training purposes that include simulation of car fires, Connex fires and building fires. These training exercises represent a recent past and current potential discharge of AFFF by parties other than the USAF. (AFCEC, 2018b, Section 3.8, p. 7)

Field team members observed where the foam flowed, and four days later collected two opportunistic grab soil samples from a grassy area and in a ditch. Concentrations of both PFOS and PFOA were detected in the grab soil samples at levels far exceeding DEC's Migration to Groundwater screening level, confirming that the foam used during the training exercise was AFFF. Ten additional PFAS compounds were also detected in both grab samples. The soil sample collected from the grassy area contained 0.02 mg/kg PFOA (compared to DEC's screening level of 0.0017 mg/kg) and .039 mg/kg PFOS (compared to DEC's screening level of 0.0030 mg/kg). The soil sample from the drainage ditch contained 0.028 mg/kg for PFOS and .0911 mg/kg PFOA (AFCEC, 2018b, Exhibit 5-14).

On May 11, 2017 the field team conducting sampling for PFAS observed a fire training exercise and witnessed foam flow from the tarmac into a grassy area and drainage ditch (AFCEC, 2018b). *Photo: Aerostar SES, LLC*

The field team took two grab surface soil samples where they observed foam in a grassy area and in the drainage ditch "to determine if the foam contained PFAS" (AFCEC, 2018b, Section 3, p. 7). Results indicate that the foam used had 12 different PFAS compounds, with PFOS concentrations the highest, at 50 times greater than DEC Soil Migration to Groundwater levels. *Photo: Aerostar SES, LLC* in groundwater, stormwater runoff, and soil at the site in September/October 2016 confirmed the presence of PFAS in groundwater at levels exceeding EPA's LHA and in soil exceeding DEC's Soil Migration to Groundwater cleanup levels. Further sampling occurred in May 2017. All ten AFFF areas showed concentrations of PFOS and/or PFOA and/or PFBS in soil exceeding DEC's screening levels (AFCEC, 2018b, Table 6-1). In groundwater, concentrations of PFOS/PFOA in the three AFFF areas that comprise "Investigative Cluster A" were above EPA's LHA (AFCEC, 2018b, Table 5-7). The highest concentrations detected in groundwater wells at Investigative Cluster A were PFOS at 7,600 ppt, PFOA at 8,440 ppt, and PFBS at 2,560 ppt (AFCEC, 2018b, Exhibit 5-10).

Most stormwater on the former Base drains into ditches that empty into Meadow Lake and DeLong Lake (stocked with fish) and the surrounding wetlands (AFCEC, 2018b). Important wetland habitat is located within just 140 feet of the eastern boundary of Kulis (AFCEC, 2018b) and extends to the east into the above mentioned open ponds and lakes area. The highest PFAS concentrations in stormwater were detected in samples collected in September 2016 from the drainage ditch near Investigative Cluster A (AFCEC, 2018b, Table 5-8). In one sample, PFOS was detected at 40,400 ppt and PFOA at 2,200 ppt and in another PFOS was detected at 37,000 ppt and PFOA at 2,140 (AFCEC, 2018b, Exhibit 5-11). PFHxS was the next highest detected compound after PFOS in stormwater runoff from this area and was found at a concentration of more than 13,000 ppt in one sample (AFCEC, 2018b, Exhibit 5-11). Any lakes in the vicinity that are potentially contaminated with PFAS should be tested, as should fish.

Drinking Water Impacts – Public Water System

Kulis ANG base was connected to the public Anchorage Water and Wastewater Utility (AWWU) in 1990. Prior to that time, the base obtained its drinking water from groundwater wells located on the base (AFCEC, 2015a). Therefore, it is possible that people who were drinking the water on base prior to 1990 may have been exposed to PFAS.

There are two DEC-identified water protection areas (WPAs)—recharge areas for drinking water sources—within a one mile radius of Kulis (DEC, 2018f). The WPAs are to the south and protect the Sand Lake Services community water system (ID AK2210485) (DEC DWP, n.d.-a) which supplies water to a homeowners association (C. Christian, personal communication June 17, 2019). Further site characterization is necessary to determine whether PFAS migrating offsite has the potential to reach Sand Lake Services' drinking water supply, which serves 465 residents (DEC DWP, n.d.-b).

The SI report notes that there are 303 private wells within a one-mile radius of Kulis ANGB and that most of these properties are now served by the public utility, AWWU (AFCEC, 2018b). It is unknown at this time how many drinking water wells are still in use. There is also the possibility that residents connected to the public water system may use their private wells for irrigation or other purposes. The nearest private wells are in residential areas to the east of the former base (AFCEC, 2018b). At a November 2018 meeting of DEC and Air Force Project managers it was decided to "not continue with adding additional monitoring wells at this site, but instead to concentrate on the drinking water well sampling in the easterly direction within a one mile radius of the site" (DEC, 2018f). As of August 2019, the Air Force still had not submitted its work plan to DEC for private well sampling (L. Howard, personal communication, August 12, 2019).

Other Concerns

Ongoing investigation of offsite migration of PFAS contamination should include an investigation of any possible exposure routes that might affect children and staff at Kincaid Elementary school (less than 550 feet to the south) or Sand Lake Elementary (a little over one half mile to the southeast) may be exposed. In addition, site characterization efforts should include determining whether there is the possibility for PFAS to migrate to Kincaid Park, just a little over a mile to the west including Little Campbell Lake located in the northeast corner of the park.

The incidental ingestion of fish has been identified as a potential human exposure pathway at former Kulis ANGB (AFCEC, 2018b, Figure 3-12), yet the site investigation report does not explicitly recommend that any specific wetland area, ponds, or lakes surface waters and/or sediments be sampled for PFAS in the future to determine the extent to which contaminated groundwater and surface water runoff could be impacting the area. Out of precaution, efforts should be made to determine whether PFAS compounds are present in the surface waters of DeLong Lake (roughly one half mile to the east of the former Kulis ANGB boundary) and any other lakes in the vicinity, and if so, stocked fish should also be sampled.

Based on results of onsite sampling, the SI report recommends further ecological evaluation of six of the ten AFFF areas to determine if mammals, including moose and bear, or birds may be exposed to PFAS (AFCEC, 2018b). Until a "site inspection" (i.e. sampling) is initiated for offsite areas, there is nothing to support investigation of PFAS migration offsite.

C. ANCHORAGE INTERNATIONAL AIRPORT

The Ted Stevens Anchorage International Airport is in the early stages of PFAS investigation with the first sampling for PFOS and PFOA conducted in the summer of 2019. Airport personnel sampled groundwater at the Aircraft Rescue and Fire Training Facility (ARFF) and found PFOS at 23,000 ppt in shallow groundwater and 6,600 ppt in surface water (DEC, 2019u). Samples were also taken from a monitoring well at the airport's land spreading area. Drinking water at the Salvation Army Clitheroe Center and Amateur Radio Club was also tested. Results were below EPA's LHA or not detected (DEC, 2019u).

The results of preliminary investigative sampling showing high concentrations of PFAS calls for further investigation. At this time, Anchorage International Airport has received a waiver to conduct its own sampling, but according to DEC, "Further in depth sampling to delineate sources and extent of contamination by an impartial third party will be required" (DEC, 2019u). The proximity of the airport to Cook Inlet also warrants investigation of possible contamination of adjacent coastal waters, fish, and wildlife.

IV. CLEAR AIR FORCE STATION (AFS)

Clear AFS is an active radar station near Anderson, 78 miles southwest of Fairbanks along the George Parks Highway. There is no airfield at Clear AFS (AFCEC, 2015b). The first sampling for PFAS at Clear AFS was conducted in summer 2016 at five AFFF areas identified in a preliminary assessment. PFAS field sampling results for soil and groundwater indicate that all five AFFF areas warrant further investigation: two fire training areas (FTAs), Fire Station 1, AFFF Spray Test Area, and Sludge Drying Beds/ Pit and Leach Fields (AFCEC, 2018e).

Nine groundwater samples and 16 soil samples were collected and analyzed for 12 PFAS in June and July 2016 and results were reported in a final SI report (AFCEC, 2018e, Table 5-1). PFOS and/or PFOA was detected in all groundwater samples taken and at levels above EPA's LHA at four of the five AFFF areas (AFCEC, 2018e, Table 5-1). The highest concentrations of PFAS in groundwater were detected in monitoring wells at the AFFF Spray Test Area (AFFF Area 4), followed by the Sludge Drying Bed/Pit and Leach Field (AFFF Area 5) (AFCEC, 2018e, Table 3-4). At the AFFF Spray Test Area, PFOA was detected at a concentration of 2,200 ppt and PFOS at 13 ppt. At the Sludge Drying Bed/Pit and Leach Field, PFOA was detected at a concentration of 860 ppt and PFOS at 120 ppt. Other PFAS detected in groundwater at Clear AFS in 2016 include PFHpA, PFHxA, PFHxS and PFBS, with the highest levels of these compounds also found at AFFF areas 4 and 5 (AFCEC, 2018b, Table 3-4). Groundwater samples were screened at a depth of approximately 60 – 70 feet.

Drinking Water Impacts

Three on-base groundwater wells that draw from an unprotected, unconfined aquifer at depths of 100 – 150 bgs supply Clear AFS's drinking water (AFCEC, 2018e). The community water system (PWS ID: AK2390756) serves 307 residents (DEC DWP, n.d.-e). The primary water supply well, located approximately 1,000 feet cross-gradient from the current fire training area and the AFFF spray Test Area (AFCEC, 2018e), where PFAS was detected at the highest concentrations, was not tested as part of the USAF site inspection field sampling that occurred in 2016. It is noted in the Final SI Report that "PFAS in groundwater may pose a potential risk to the primary water supply well" and that "a better understanding of seasonal variations in groundwater flow directions and the impact of pumping from the primary supply well on the local flow directions is necessary to assess potential impacts" (AFCEC, 2018e pp. 5-1, 5-2).

In November 2016, USAF's Bioenvironmental Engineering office tested for PFOS and PFOA in post-treatment water from primary, backup and dedicated building wells as part of routine water testing (J. McKellar, personal communication, June 7, 2019). In May 2019, DEC received a spreadsheet from the USAF indicating that the 2016 drinking water test results were non-detect. The pre-treatment groundwater from the on-base drinking wells has not been tested for PFAS compounds. The raw water supply for Clear AFS should be tested for the 18 PFAS listed in EPA's analytical method 537.1 for drinking water to evaluate whether or not people are at risk of being exposed and at what levels.

According to research presented in the preliminary assessment for Clear AFS, the direction of groundwater flow is to the north-northwest and the nearest offsite drinking water wells are between 3-4 miles north of Clear AFS. These include one local government well and five private wells serving lodges, roadhouses and other recreational facilities. These could serve up to 330 people during peak season (AFCEC, 2015b). As a precautionary measure, the USAF should conduct offsite testing.

Current use of AFFF at Clear AFS includes Phos-Check firefighting foam, as documented by the release of 0.5 gallons of concentrate on November 1, 2018 while a fire truck was being washed. (DEC, 2018c).

V. DILLINGHAM

The Alaska Department of Environmental Conservation (DEC) led initial sampling of nine wells at properties near the Dillingham Airport in December 2018. Wells were analyzed for 14 PFAS and results were compared to DEC's August 2018 Action Levels of 70 ppt for the "sum of five" (PFOS, PFOA, PFNA, PFHxS and PFHpA) with a separate action level of 2,000 ppt for PFBS.

> **"Bristol Bay Native Association (BBNA) fully supports the proposal to adopt regulation changes dealing with the PFAS contaminants. PFAS have been found to be persistent in the environment especially in water sources and bioaccumulates in food sources. Access to clean water and contaminate free subsistence foods is essential for healthy communities. If PFAS contamination exists in our communities and it has the potential to cause adverse health effects then action must be taken to protect our people and the subsistence food we rely on."**
>
> ***—Ralph Anderson, President & CEO Bristol Bay Native Association (October 31, 2018 Notice of Public Comment adopting regulation changes in Title 18, Chapter 75 of the Alaska Administrative Code dealing with six per- and poly-fluoroalkyl substances [PFAS])***

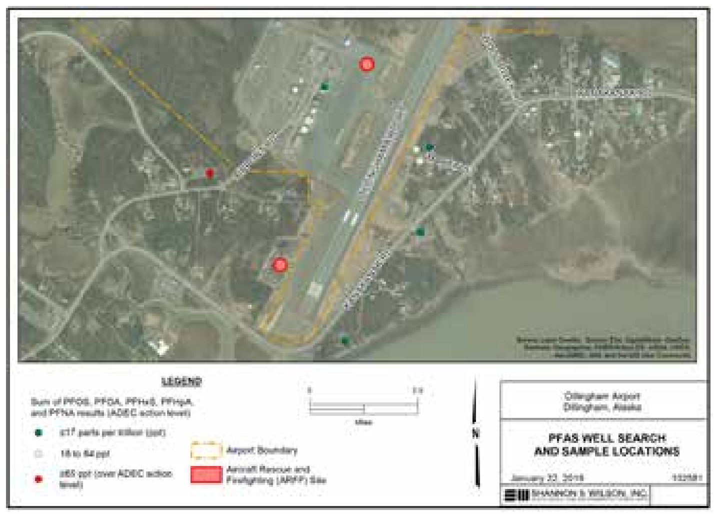
Drinking Water Impacts – Public Water System

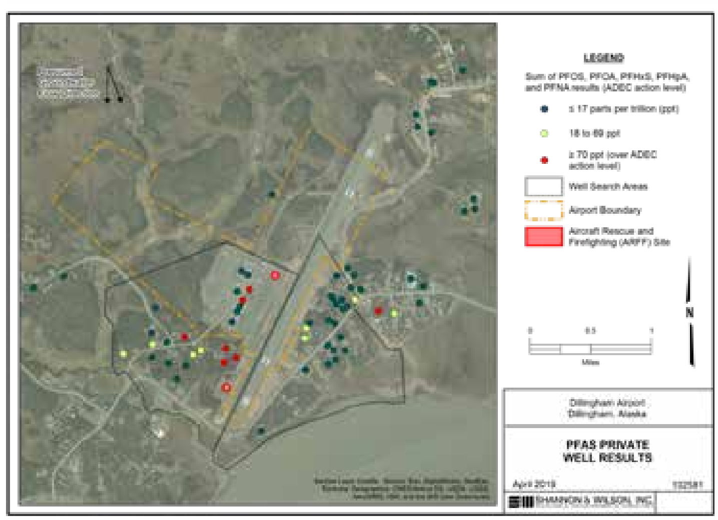
The Holy Rosary Church well, used as a public drinking water supply (PWS ID AK2263018), tested positive for PFAS contamination at levels more than twice DEC action levels (DOT&PF, 2019b; Lill, 2019). The church groundwater well serves as the year-round water supply for 280 people (DEC DWP, n.d.-d) who prefer to fill jugs at the church because of varying degrees of rust/sulfur in private wells in the area (Lill, 2019). The church immediately discontinued use of the well when it received notification from DEC of the contamination and community members who relied on the church well were directed to get their water from the Dillingham Senior Center until "an alternative permanent water solution has been established" (DOT&PF, 2019a).

Initial groundwater testing results for the church well in December 2018 showed PFAS concentrations of 186 ppt for the sum of five; results for PFOS + PFOA were 42 ppt (TestAmerica, 2019b, p. 13). The church well contained 140 ppt PFHxS according to laboratory analysis (TestAmerica, 2019b, p. 13). Had the church well first been tested in April 2019, it would not have exceeded DEC's new, less stringent standards, and it is possible that expanded sampling of other private wells in the area would never have occurred. Subsequent testing of the same nine wells in early 2019 showed similar results with the Holy Rosary Church well having concentrations above DEC's August 2018 Action Levels, four wells had PFAS concentrations of 18 ppt to 64 ppt range, and four wells contained less than 17 ppt. PFBS was not detected in any of the wells at levels that exceeded the action level of 2000 ppt (S&W, 2019f).

Drinking Water Impacts – Private Wells

To determine the extent of contamination and further characterize which PFAS compounds are present in Dillingham groundwater, expanded testing took place in late February/Early March, 2019 (Ross, 2019). This sampling effort included 65 private residential and business wells (the nine previously tested plus 56 additional wells) located west and east of the airport. Seven wells tested at 70 ppt or higher for the sum of five PFAS, eight wells had results in the 18-69 ppt range, 20 wells had detectable levels below 17ppt, and 30 wells did not have detections of PFAS (DOT&PF, 2019d; S&W, 2019e). Based on these results, Shannon & Wilson conducted further sampling in June 2019 focusing on properties in an area to the east of the airport (DOT&PF, 2019d). Only results for PFOS and





PFOA were reported for this sampling effort per the state's April 2019 PFAS Tech Memo. Of 30 previously untested wells, one contained PFOS + PFOA in the 18-69 ppt range; six contained detectable PFOS + PFOA at levels below 17 ppt, and the remaining wells had no detections of PFOS and/or PFOA (S&W, 2019b, 2019g). According to the site report on DEC's Contaminated Sites Program, "the most recent sampling event showed no new exceedances so the sampling area will not be expanded further. DOT&PF intends to begin a feasibility study into long-term drinking water options for the impacted well owner" (DEC, 2019i). The "impacted well owner" is the Holy Rosary Church recognized as a public water system supplying nearly 300 people, and the high levels of PFAS in the water would have gone unnoticed under current state action levels.

DOT&PF maintains a Dillingham Airport Firefighting Foam Contamination webpage with updates and documents related to the PFAS contamination plume originating from the airport: **http://dot.alaska.gov/airportwater/dillingham/**.

VI. EARECKSON AIR STATION

Eareckson Air Station is located on Shemya Island in the western Aleutian Islands and was established in 1943 by the U.S. Army to support WWII operations against nearby Japanese occupation forces on Attu, Agattu, and Kiska. The site was abandoned in 1954 and resumed operations in 1958 as an Army and Air Force strategic intelligence gathering site. In 1995, the station was downsized and reverted to caretaker status, maintained and operated by private contractors (DEC, 2019l). The drinking water system (PWS ID: AK2260511) serves approximately 100 people (DEC DWP, n.d.-c). The Air Force first became aware of PFAS in the drinking water supply in February 2017; the concentration of the sum of PFOS and PFOA was 54.3 ppt (DEC, 2019l). Concentrations of PFOS and PFOA in a groundwater monitoring well (Well WGW7) in the water source area were 100 ppt and 20 ppt, respectively when sampled in March 2017 at DECs request (AFCEC, 2018a, Table 5-4).

To date, the highest concentrations of PFOS/PFOA detected in groundwater at Eareckson Air Station have been from a monitoring well at former fire training area (Site FT002) where PFOS was detected at 93,000 ppt and PFOA at 3,900 ppt in September 2014 (AFCEC, 2015f, Table 6-1) and at even higher concentrations when sampled in December 2016: approximately 250,00 ppt for PFOS and 2,800 ppt for PFOA (AFCEC, 2018a, Table 5-2a). Four surface water samples taken in December 2016 from the Aircraft Mock Up Area (within FT002) showed PFOS concentrations ranging from 38,000 ppt to 46,000 ppt (AFCEC, 2018a, Table 5-2b).

Drinking Water Impacts

Eareckson's drinking water comes from a water collection system known as the Water Gallery, comprised of underground perforated pipes which infiltrate shallow groundwater originating from a series of ponds to the north (AFCEC, 2017). Water treatment consists of an air stripper unit installed in 1994 to remove the volatile organic compound trichloroethylene (TCE), a type of volatile organic compound (AFCEC, 2017). Air strippers are not effective for removing PFAS compounds (Adomaitis & Adams, 2016) and may result in PFAS being released as aerosols (EPA, n.d.-b).

Results from sampling of Eareckson's drinking water in February 2017 showed a less than 2 ppt difference between concentrations of PFAS in pre- and post-treatment drinking water:

	Result Raw Water (ng/L = ppt)	Result Treated Water (ng/L = ppt)
Perfluorobutanesulfonic acid (PFBS)	< 2.0	< 2.0
Perfluoroheptanoic acid (PFHpA)	2.5	2.4
Perfluorohexanesulfonic acid (PFHxS)	40	40
Perfluorononanoic acid (PFNA)	< 2.0	< 2.0
Perfluorooctane sulfonate (PFOS)	47	45
Perfluorooctanoic acid (PFOA)	7.3	7.8

The sum of PFOS and PFOA in Eareckson's treated drinking water was 52.8 ppt and the sum of five (PFHpA, PFHxS, PFNA, PFOS and PFOA) was 95.2 ppt (Eurofins Eaton Analytical, 2017a). While below EPA's LHA for PFOS/PFOA, the concentrations of PFAS in Eareckson's drinking water present a public health concern given the current scientific understanding.

DEC requested that samples be collected from Monitoring Well WGW7 at the Water Gallery (AFCEC, 2018a). The laboratory analytical results for the sample collected on March 1, 2017 were 100 ppt for PFOS and 20 ppt for PFOA (AFCEC, 2018a, Table 5-4). Testing of Eareckson's drinking water for PFOS and PFOA in June 2018 showed 46 ppt PFOS and 7.9 ppt for PFOA (Eurofins Eaton Analytical, 2018a). The laboratory report did not include results for any other PFAS analytes. Notably, in its Draft Preliminary Assessment Report, the Air Force recommended "no further action" for PFAS investigation of Hangar 4 which lies just 300 feet to the north and upgradient from the Water Gallery (AFCEC, 2017).

The Air Force has consistently minimized the PFAS problem and potential impacts to drinking water safety at Eareckson Air Station. A draft report for long-term monitoring and site inspections for numerous contaminated sites at Eareckson failed to recommend further investigation of PFOS/PFOA at all of the fire training areas despite the initial sampling results showing concentrations of PFOS in groundwater and surface water at concentrations in the tens of thousands parts per trillion at site FT002 (AFCEC, 2015f). The Air Force was unresponsive to a DEC request in September 2018 that the Air Force take immediate action to determine concentrations of an additional four PFAS in Eareckson's drinking water per the August 2018 Tech Memo. A draft preliminary assessment (PA) dated October 2017 was not provided to DEC until April 30, 2019 (M. Brunner, personal communication, July 22, 2019), too late for DEC's comments to be considered in the final PA received by DEC at the end of July 2019. The PA guides which areas are sampled for PFAS during the field season and is critically important for site characterization, risk assessment and remediation.

A May 8, 2019 DEC letter to the Air Force (DEC, 2019c) obtained by ACAT through a public records act request asserts that:

> *DEC disagrees with the recommendations in the PA for no further action at the following sites: Hangars 2,3,4,6 and 7; the Fire Station; the Vehicle Maintenance Facility; AFFF Release Area; and the POL Facility. Each of these sites has a history of AFFF use or storage, and while in some instances no documentation of a discharge may exist, historical documentation of releases is spotty at best, and nonexistent at worst…. Additionally, DEC asserts that the following potential source areas should be included in the PA, and should be investigated during site inspection efforts in the future: 1) The wastewater treatment settling pond(s) and wastewater discharge point, since the drinking water gallery is known to be contaminated with PFAS; 2) any areas where biosolids were spread or disposed of on the island, since the water gallery is known to be contaminated with PFAS; and 3) any landfills/disposal sites on the island where materials used during AFFF release cleanups, such as the cleanup after the release in Hangar 8, were placed. (DEC, 2019c)*

VII. FORT GREELY

Fort Greely Alaska (FGA) is a U.S. Army Garrison located roughly 100 miles southeast of Fairbanks and a few miles south of Delta Junction. Fort Greely was established in 1942 during World War II. Portions of the base have been closed and transferred to the City of Delta Junction, a process which began in 1995 under Base Realignment and Closure (BRAC). Fort Greely has a working and resident population of approximately 820 persons, according to Doyon Utilities the private utility that provides water and electric service to FGA (Doyon Utilities, n.d.-a).

There is little PFAS data or site characterization information for Fort Greely to date. Groundwater on the installation is monitored for BTEX, DRO, GRO, EDB and other contaminants of concern (COC). The U.S. Army has yet to conduct a Preliminary Assessment (PA) to determine if AFFF releases at Fort Greely warrant further investigation. PFOS and PFOA were first tested for in 2016 when they were added to Fort Greely's groundwater monitoring program for four wells at former fire training areas (Sites 85N/85S and 133) (Bering-KAYA Support Services, 2017) that were used from the mid 1970s until 1985 (CH2M Hill, 1992). PFOS was detected in all four wells. Concentrations exceeded EPA's lifetime health advisory (LHA) levels in three of the four wells (Bering-KAYA Support Services, 2017), but did not exceed DECs action level of 400 ppt. PFOA was detected in two of the wells at levels below health advisory levels. The combined concentrations of PFOS and PFOA in three of the wells were: 90 ppt; 94 ppt; 99 ppt (Bering-KAYA Support Services, 2017 Table 9-2). PFOS and PFOA were not sampled for during 2017 groundwater monitoring.

Drinking Water Impacts

The community water supply for Fort Greely Main Post (PWS ID: AK2370780) consists of a primary groundwater well (Pump #9) and a secondary back up well (Doyon Utilities, 2019a). Additional supply wells serve individual buildings (C. Christian, personal communication August 1, 2019). According to Doyon Utilities, the installation's water comes from nine on-base raw water supply wells that tap into an aquifer approximately 200-400 feet bgs (Doyon Utilities, n.d.-a). Five supply wells are monitored on a quarterly basis and analyzed for VOCs and EDB (Bering-KAYA Support Services, 2018). A June 2016 DoD Memo issued after EPA published its LHA, requires that installations "test the finished drinking water for PFOS and PFOA at all installations where DoD is the water purveyor," and "where DoD is not the water purveyor, installations are encouraged to contact their water purveyor to determine their response to the new HA for PFOS and PFOA" (DoD, 2016). There is no mention of PFAS in Doyon Utilities' annual 2016, 2017, 2018, or 2019 *Consumer Confidence Reports* for Fort Greely.

Given that the fire training areas are upgradient from Jarvis Creek (Bering-KAYA Support Services, 2018), PFAS in the groundwater, soil, or surface water at these sites could potentially migrate off-site. DEC requested in September 2018 that the Army determine if there are off-site wells that could be impacted by PFAS migrating off post. As of April 2019, the Army had twice indicated that it did not plan to identify or sample downgradient wells. A June 4, 2019 letter from DEC to the Army, details the inadequate U.S. Army investigation of off-site migration of PFAS contamination at Fort Greely. The letter also calls into question the U.S. Army's claim that there were reporting and data quality validation issues and its intention to discard PFAS groundwater sampling results from 2016 and 2017 monitoring (DEC, 2019d).

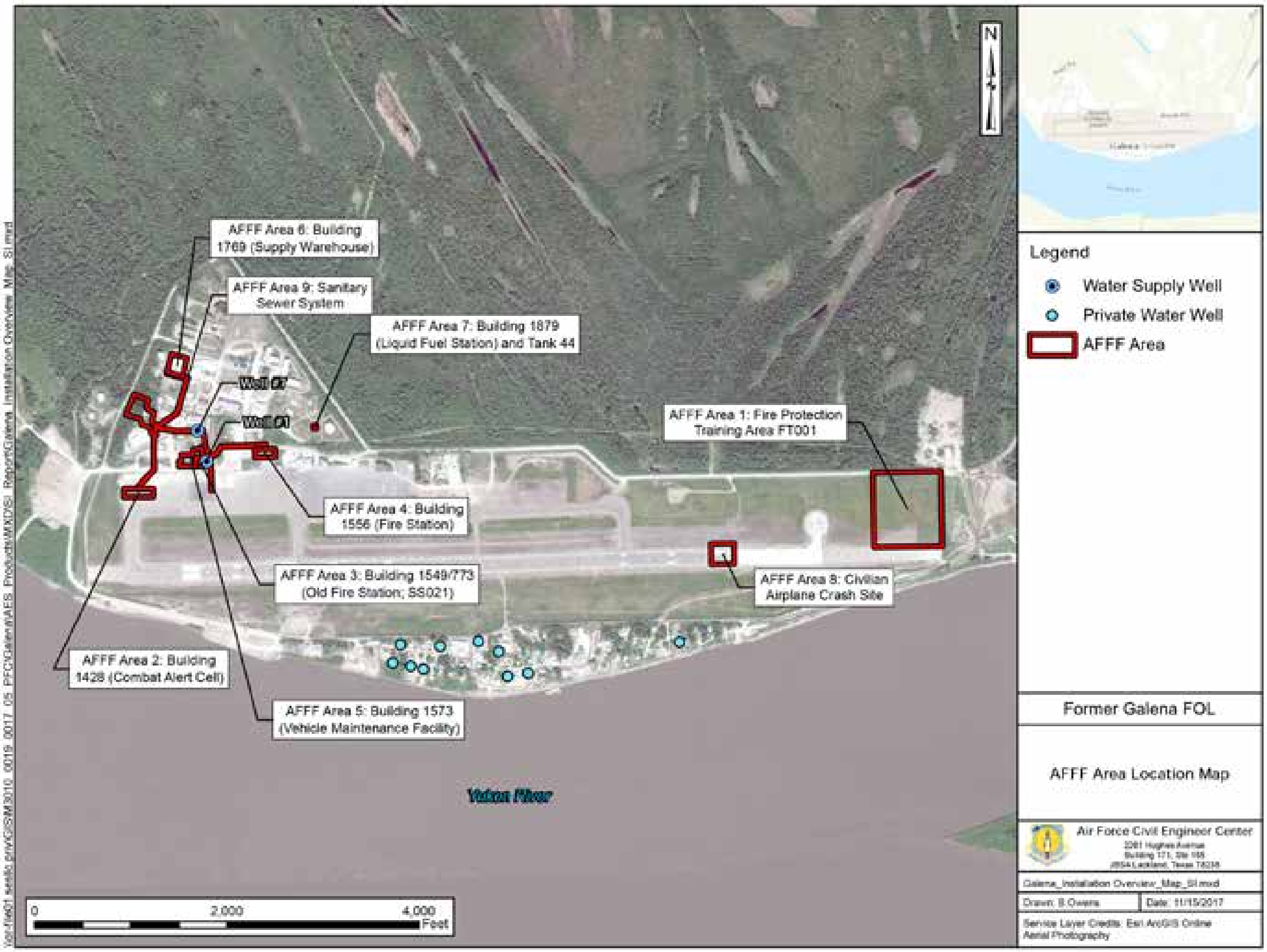
The Army responded to DEC on July 17, 2019 that it had contracted to conduct a PFAS Preliminary Assessment and Site Inspection (PA/SI) for Fort Greely in accordance with CERCLA. The Army stated that it will sample 13 areas across Fort Greely and will re-sample monitoring wells that previously had PFAS detections. The Army also stated that it would install new wells at the northern boundary of Fort Greely across Jarvis Creek to determine if there is any offsite migration. The work is planned for September 2019 (United States Army, 2019).

VIII. GALENA

The community of Galena is located along the Yukon River in Interior Alaska roughly 270 miles west of Fairbanks. The Former Galena Forward Operating Location (FOL) was established in World War II. By 1993, permanent personnel had been withdrawn and facilities that had not been transferred by the USAF for use by local, state and federal entities reverted to caretaker status. The former Galena FOL was officially closed in 2008. The USAF remains responsible for cleanup of contamination that resulted from Air Force activities, including PFAS contamination from AFFF releases. Contaminants that have previously been known to be present in Galena's groundwater include diesel-range organics (DROs), benzene, and trichloroethylene (TCE) among others. PFOS has been detected at up to 239,000 ppt and PFOA at 49,900 ppt in Galena's groundwater (AFCEC, 2018c), among the highest concentrations of PFAS detected in groundwater anywhere in Alaska to date.

Galena Air Force FOL was one of the first sites in Alaska to be tested for PFAS. The former fire training protection area (FT001), an unlined area where training exercises included igniting a mock-up of an aircraft and extinguishing the fire with AFFF (USAF, 2015), was selected for a limited investigation of PFOA and PFOS. In spring 2012, groundwater samples from two wells at FT001 were analyzed for PFOA and PFOS as part of a base-wide, semi-annual groundwater monitoring event (AFCEC, 2016). PFOA was found in groundwater at concentrations of 21,700 ppt in both monitoring wells. PFOS was detected in groundwater at 25,200 ppt in one well and 49,500 ppt in the other well (AFCEC, 2016). These initial results far exceeded EPA's 2009 provisional health advisory levels of 400 ppt PFOA and 200 ppt for PFOS (EPA, 2009) prompting further investigation. Sampling in fall 2013 included PFOA/PFOS analysis of one groundwater sample each from six monitoring wells at FT001. PFAS were detected in all six wells at sample depths ranging from 7-80 feet (CH2M Hill, 2014, Table 5). The highest PFOA detected in September 2013 was 15,500 ppt and 116,000 ppt for PFOS in well 01-MW-01 (CH2M Hill, 2014, Table 5). Results of groundwater sampling conducted in 2014 detected even higher concentrations of PFOS and PFOA from monitoring well 01-MW-01 at FT001 -- 239,000 ppt for PFOS and 49,900 ppt for PFOA (AFCEC, 2018c).

Of nine AFFF release areas identified in a preliminary assessment at Galena FOL (AFCEC, 2016), five were recommended for further investigation: the Fire Protection Training Area (FT001), old Fire Station (AFFF Area 3), current Fire Station (AFFF Area 4), Vehicle Maintenance Facility (AFFF Area 5), and the Sanitary Sewer System (AFFF Area 9) (AFCEC, 2018c). AFFF Areas 1, 3, 4 and 5 are owned by DOT&PF; the Sanitary Sewer System is owned by the City of Galena (DEC, n.d.-c). Of these five AFFF Areas, sampling in 2016 and 2017 confirmed PFOS and PFOA in soil and groundwater above DEC cleanup levels at four AFFF areas and PFOS in soil above DEC migration to groundwater clean-up levels in two areas (AFCEC, 2018c), including AFFF Area 9 where wastewater, potentially containing AFFF, from the old and current fire was processed (AFCEC, 2016).



Drinking Water Impacts

Galena's 470 residents obtain their drinking water from one of three sources (all groundwater): public supply wells located on the former Air Force base, the "New Town" public supply wells, and private wells. Groundwater beneath the former Galena FOL is the primary source of drinking water at Galena FOL (AFCEC, 2018c) serving the Galena Airport (operated by ADOT & PF), the Galena Interior Learning Academy (a statewide boarding school for grades 9-12 operated by the City of Galena) and a number of state and federal government offices (AFCEC, 2018c). Groundwater exists in an unconfined alluvial aquifer with levels fluctuating in relation to seasonal stages of the Yukon River (AFCEC, 2016).

Historically on-base water was supplied by seven wells (AFCEC, 2018c). Currently, the on-base water is supplied by two on-site public drinking water supply wells (Well No. 1 and Well No. 7) at 200 bgs that are located downgradient and cross-gradient (respectively) from the vehicle maintenance facility (AFFF Area 5). The drinking water is treated using a granular activated carbon (GAC) filter (AFCEC, 2018c). Samples were analyzed from Well No. 1 in September 2016 and from Well No. 7 in February 2017. Neither tested at or above the detection limit of 6.4 ppt (AFCEC, 2018c, Table 3-1).

Results from sampling of the monitoring well at AFFF area 5 (upgradient from drinking water supply Well No. 1) in late July 2016 showed a total sum of 2,680 ppt for PFOA/PFOS in the groundwater. Of the 14 PFAS tested, PFHxA, PFHpA, PFBS, and PFHxS were also detected in the sample taken from a depth of 12-37 feet bgs (AFCEC, 2018c, Table 5-18).

The public drinking water wells at Galena FOL also supply the Old Town of Galena. However, many residents rely on private wells or opt to have their drinking water trucked in from the "New Town" Galena water supply located off-base and upgradient from the Former Galena FOL (AFCEC, 2018c). Domestic well survey results indicate that there are ten private wells in Old Town Galena, three of which are still used for potable water, including a 5+ unit apartment house (AFCEC, 2018c). No testing of private wells for PFAS has occurred to date and according to DEC, "any future PFAS sampling in Galena will be conducted by the USAF" (J. MacKellar, personal communication, June 7, 2019).

The City of Galena utilizes conventional water treatment. "New Town" Galena tested post treatment water from its two public water supply wells, #1 Well (West Well) and #2 Well (East Well), in November 2016. None of the 14 PFAS compounds analyzed for in Galena's public water system (PWS ID: AK360272) were detected at or above the Method Reporting Limit of 2 ppt (ARS Aleut Analytical, LLC, 2017). The City of Galena tested its public water supply wells again in June 2018, this time for PFOS and PFOA only. Chemical Sample Reports from Eurofins Eaton Analytical, LCC show that both compounds were below the minimum reporting limit (MRL) of 2 ppt (Eurofins Eaton Analytical, 2018b, 2018c).

Other Concerns

In addition to groundwater contamination that may affect drinking water safety, a potential route of PFAS exposure for Galena residents identified in the PA is consumption of anadromous fish from the stretch of the Yukon River nearest the former fire protection training area (AFCEC, 2016). However, there is no recommendation or plan to sample Yukon River surface waters and/or fish in the site characterization documents that have been published to date. The use of the non-potable well on base (Well No. 3) by the City of Galena is of concern, as concentrations of PFAS in that well are unknown at this time and there is the potential for PFAS to be spread to other areas.

Another concern is the ultimate fate of eight 55-gallon drums and a number of 5-gallon plastic pails of AFFF concentrate that were stored at the Fire Station (Building 1556) and reportedly lost when, in May 2013, the Yukon River flooded much of Galena as a result of an ice dam that had formed down river (National Aeronautics and Space Administration (NASA), 2013). When asked about current AFFF use in a 2015 interview conducted for the preliminary assessment, Chief Tim Bodony of the City of Galena Volunteer Fire Department reported that the Air Force had given remaining supplies of AFFF concentrate (eight 55-gallon drums and 30, five-gallon containers) to the local fire department when the base was closed in 2008 (AFCEC, 2016, Appendix A). According to Bodony, AFFF that had not been used by the City was lost in the 2013 Yukon River flood.

IX. GUSTAVUS

Gustavus is the gateway community to Glacier Bay National Park and Preserve. With a year round population of approximately 540, the small community 30 miles west of Juneau sees an influx of visitors, National Park Service employees and other seasonal workers from May – September.

The DEC and DOT&PF prioritized Gustavus for PFAS investigation based on known historical use of AFFF at the Gustavus Airport and potential impacts to drinking water. Gustavus does not have a municipal water system; most people rely on private wells, generally drilled at a shallow depth of 15-25 feet bgs (S&W, 2019c). Results of initial sampling of two public drinking water supply wells confirmed that PFAS was present in groundwater at unsafe levels in one of the wells (DOT&PF, 2018b), prompting further investigation to evaluate the extent of offsite PFAS migration.

Drinking Water Impacts – Public Water System

Initial PFAS sampling of two public water supply wells occurred in late June 2018. Results of PFOS and PFOA in groundwater samples from the Gustavus Airport well (PWS ID: 2111476) and the Gustavus Water System (PWS ID: 2130596) were compared to EPA's LHA.

"I am not a chemist or a toxicologist. I am a concerned citizen with two children who attend the Gustavus School, where students and staff have been drinking water that measures 38-44 ppt PFASs. These levels make me uncomfortable, given the uncertainties surrounding these chemicals and the fact that professionals in the contaminants field say they expect that with more research, the current "safe" threshold levels will decrease over time."

—Janet Neilson, Gustavus resident, public comments to DEC

"My elderly father, my siblings and I, my children and my grandchildren are counting on you to do the right thing."

—Sally McLaughlin, Gustavus resident, public comments to DEC

The Gustavus Airport well contained PFOS/PFOA at levels exceeding EPA's LHA with an estimated concentration of 250 ppt PFOS and 3 ppt PFOA (TestAmerica, 2018a, p. 5), results which were confirmed a month later when the well was resampled (S&W, 2018a). The drinking water fountain at the airport terminal had been shut off prior to the discovery of PFAS contamination due to low levels of petroleum contaminants from heating oil that had been leaking from a 500 gallon underground storage tank before it was removed in 2014 (DEC, 2018d).

The Gustavus Water System, (hereafter referred to as the "NPS Well") is owned by the National Park Service and is located adjacent to airport property. The well supplies water to Park Service housing and to the Gustavus School, attended by approximately 80 students, grades K- 12 (Public School Review, 2019). When tested in June 2018, the NPS Well had detectable PFOS/PFOA; however concentrations were below action levels (DOT&PF, 2018b). Results were 16 ppt PFOS and 6 ppt PFOA (TestAmerica, 2018a, p. 5). Results of samples from the NPS well collected in August and September of 2018 reported the sum of five PFAS per DEC's August 2018 Action Levels. In results from August 2018, PFOS was detected at 23 ppt, PFHxS at 12 ppt, PFOA at 5 ppt, and PFHpA and PFNA at less than 2 ppt each (TestAmerica, 2018b, p. 5) and in September concentrations were 22 ppt PFOS, 11 ppt PFHxS, and 4 ppt PFOA and less than 2 ppt for PFHpA and PFNA (TestAmerica, 2018c, p. 11). The results for the sum of five PFAS in the NPW Well groundwater samples were 44 ppt in June (S&W, 2018d), 41 ppt in August and 39 ppt in September, all below the level requiring DOT&PF to provide alternative water. However, in an effort led by Superintendent Philip Hooge, the National Park Service installed a GAC filter to remove PFAS from the NPS well and provide safer water to Park Service employees and Gustavus students and staff (Hohenstatt, 2019a).

The State of Alaska contracted with Shannon & Wilson to lead a well search and sampling effort to evaluate impacts to drinking water wells off of airport property after DOT&PF discovered PFAS at levels exceeding DEC and EPA action levels in the airport well (DOT&PF, 2018b). Results of the first round of sampling confirmed that PFAS are migrating offsite and that concentrations of PFAS in some private groundwater wells were at levels posing unacceptable risk to human health (Gullufsen, 2018; Jenkins, 2018). Shannon & Wilson sampled for six PFAS compounds (PFOS, PFOA, PFHxS, PFHpA, PFNA, and PFBS) in four rounds of testing between late August 2018 and December 2018. Each sampling event included new areas with the goal of determining the boundary beyond which it would not be expected that groundwater concentrations of PFAS would exceed action levels. After the first two rounds of sampling, the northern and eastern edges of the plume had been defined (DOT&PF, 2018a). Sampling results indicate that the highest PFAS concentrations in groundwater extend to the south and west of the airport (S&W, 2019d). The full extent of contamination is unknown.

All private well water sample results from Gustavus were compared to the DEC action level of 65 ppt or greater for the sum of five (PFOS, PFOA, PFHxS, PFHpA, PFNA), and 2,000 ppt for PFBS. Beginning with 43 private wells in late August 2018, Shannon & Wilson expanded their sampling effort and tested an additional 23 wells in late September 2018, 28 wells in late October/early November, and three wells in December (S&W, 2019a, Table 1). As of December 2018, Shannon & Wilson had sampled 101 discrete wells (97 private, offsite wells and the Airport Terminal well, National Park Service well, City Hall well, and Firehouse well). Based on an April 2019 map (S&W, 2019d) showing the highest reported analytical results for the sum of five PFAS detected in these 101 wells, there were:

19 wells ≥ 65 ppt

3 wells 35 to 64 ppt

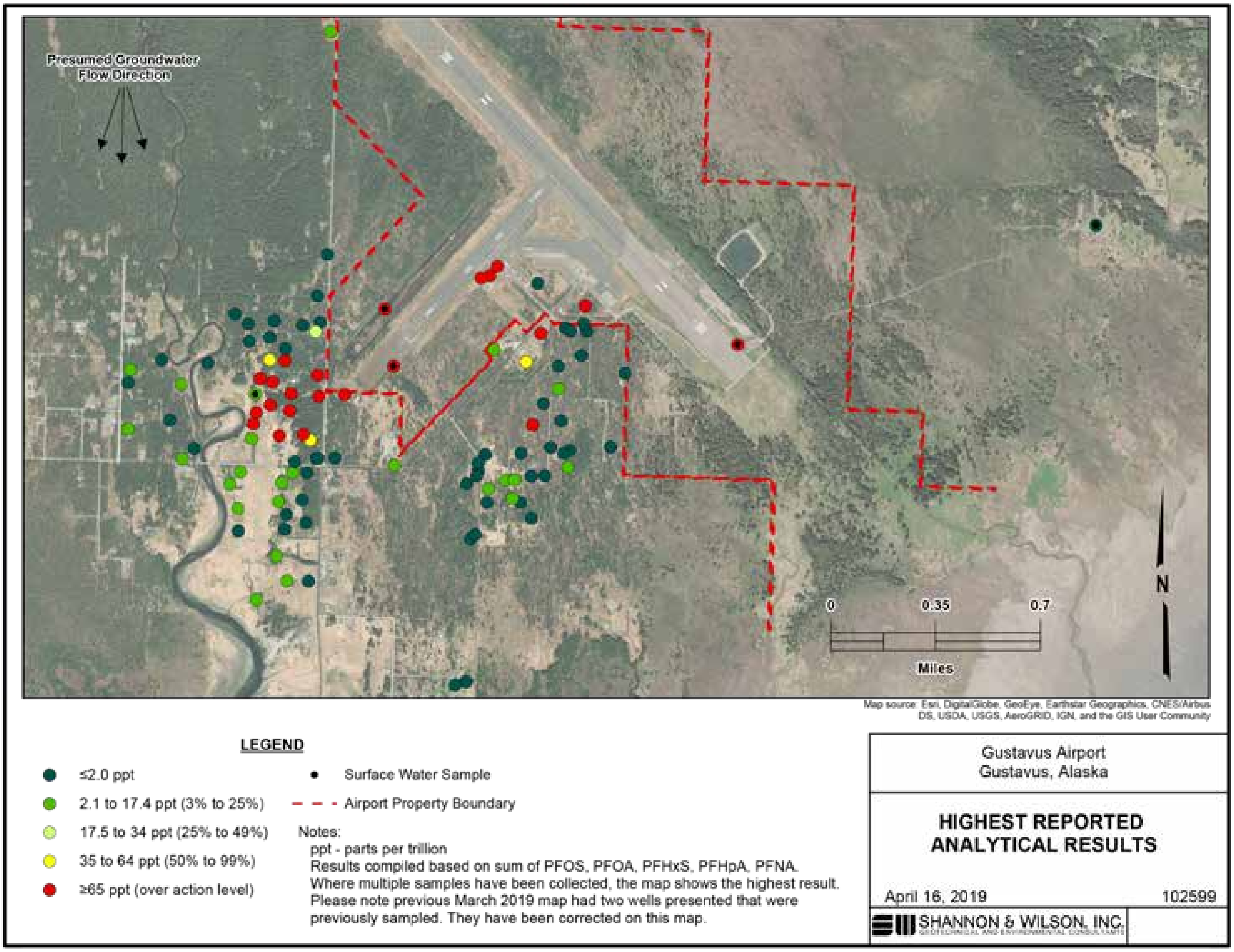
1 well 17.5 to 34 ppt

23 wells 2.1 to 17.4 ppt

55 wells ≤ 2.0 ppt

Of the 19 wells that had PFAS concentrations of 65 ppt or higher, eleven wells contained PFAS concentrations in the

DOT&PF began bottled water delivery on September 17, 2018 to properties where PFAS concentrations exceeded action levels. Until a long term solution is implemented, people with contaminated well water must rely on bottled water for drinking and cooking. Some are also choosing to water their gardens with the bottled water. A few impacted properties have been provided with point of entry (POE) filtration. *Photo: Kelly McLaughlin*



100 ppt to 200 ppt range and five wells had detections of PFAS above 2,000 ppt. The highest concentration of PFAS in any one well in the airport PFAS plume was 6,729 ppt (S&W, 2019a, Table 1). The data show highest concentrations of PFOS, PFHxS, and PFOA (in that order) in Gustavus groundwater (S&W, 2019a, Table 1; Table 2). All three of these PFAS compounds are among those known to stay in the human body the longest; PFHxS has a longer half-life than either PFOS or PFOA (Li et al., 2018) (See Health Outcomes section, page 12.) Given the known persistence, toxicity and bioaccumulative nature of PFHxS, and its widespread presence in Gustavus groundwater, it is concerning that under DEC's April 2019 Tech Memo, DEC will not ask for PFHxS results even though the compound will continue to be analyzed for in samples. Under current DEC policy, concentrations of PFHxS will not be taken into account in site characterization or when making recommendations for future monitoring and remediation. The laboratory doing the analysis will retain the data for 10 years and will provide the full analytical data only upon request by the State of Alaska.

Further sampling is planned to evaluate the horizontal and vertical extent of PFAS contamination in groundwater and soils (S&W, 2019c). A draft site characterization work plan proposes to establish two new onsite monitoring well locations and eight offsite groundwater monitoring locations to the south and west of the airport and several soil boring locations (S&W, 2019c). The plan also includes additional surface water sampling of drainage ditches along the edge of the airport runways to determine if surface water runoff is contributing to off-site groundwater contamination (S&W, 2019c). Results will be reported for PFOS and PFOA only.

Gustavus PFAS Action Coalition (GPAC)

The State of Alaska held two public informational meetings in 2018, one shortly after the discovery of Gustavus' contaminated groundwater and one a few months later

(DOT&PF, 2018c, 2018d). Many residents left the meetings with more questions than answers, prompting the formation of the Gustavus PFAS Action Coalition (GPAC) in December 2018 (K. McLaughlin, personal communication, June 14, 2019).

The mission of the GPAC is to bring awareness to the PFAS crisis. GPAC will facilitate, encourage, and work with the appropriate entities to 1) Stop further use of PFAS; 2) Create public understanding of the full extent of the damage; and 3) facilitate the correction of the PFAS damage to the fullest extent possible. They hope to work in a non-adversarial and cooperative fashion, with the full spectrum of local, state, and federal agencies, non-profits, and community partners needed to address this complex issue.

Upon learning that they and/or their neighbors had been drinking contaminated water for years or even decades, several GPAC members embarked on what they describe as a "crash course on PFAS." They continue to learn as much as they can about this complex class of chemicals and their use in Alaska. The GPAC shares this information within the Gustavus community and with other communities that are also facing PFAS contamination; they take action at every opportunity to engage in the public process and hold responsible parties accountable.

GPAC members have expressed concern over the possibility that Gustavus residents and visitors may be exposed to PFAS through consumption of wild foods, including mushrooms, berries, herbaceous plants, fish and wild game and have asked the State to test for PFAS in biota. The group was successful in getting ADF&G to agree to sample tissue (meat) from wild game that may have ingested surface water and plants within the airport PFAS contamination plume. Results from the limited study were reported in July 2019 (KINY Radio, 2019). One sample each was taken from 13 animals (12 moose, 1 bear) that were harvested in the 2017 and 2018 hunting seasons. Samples were analyzed for 15 PFAS analytes; PFAS was detected in the meat and liver samples from the bear and three moose. Five PFAS analytes were detected in the bear tissue sample at concentrations ranging from 0.092 ppb – 0.110 ppb. PFOS was detected at 7.31 ppb in a liver sample from one moose and PFHxS at 0.741 ppb in a liver sample from another moose (National Institute of Standards and Technology, 2019, Table 3). Alaska does not have consumption advisory levels for any fish or game; however the moose and bear meat analyzed from Gustavus tested well below the advisory level of 300 ppb that the Michigan Department of Health and Human Services established for deer meat (State of Michigan, 2019).

At a two-day community meeting held in Gustavus in May 2019 and attended by ACAT and members of other PFAS-impacted communities, participants voiced concern over the lack of opportunities for community input in the state-led PFAS investigation process. Participants pointed out that their local knowledge could help inform the identification of sampling locations for site characterization. Members of GPAC contacted the State to request the opportunity to comment on a draft site characterization work plan for their community and were successful. PFAS Coordinator for DOT&PF, Sammy Loud, confirmed that DOT&PF ultimately invited public input on the plan as a

CITY OF GUSTAVUS EMERGENCY RESPONSE TO BRUSH FIRE

During the first round of private well sampling conducted as part of the Gustavus Airport off-site PFAS investigation, PFOS was detected at 47,000 ppt in groundwater at a residence where the City of Gustavus Volunteer Fire Department had used AFFF to extinguish a brush fire on May 18, 2015(DEC, 2019q). Firefighters sprayed AFFF from an Aircraft Rescue and Fire Fighting (ARFF) vehicle that the City had purchased from the State in 2011 (State of Alaska, 2011).

Results of groundwater analysis for six PFAS when the well was first sampled in August 2018 were: 40,000 ppt PFOS; 7,300 ppt PFHxS; 240 ppt PFOA; 48 ppt PFHpA; 48 ppt PFNA; 170 ppt PFBS (S&W, 2019a, Table 1). A site characterization work plan to delineate the extent of soil and groundwater contamination includes further sampling of soil and groundwater at the site and collection and analysis of drinking water samples from five residences downgradient of the property where AFFF was used (Weston Solutions, 2019).

In June 2019, DOT&PF stated that the Gustavus airport had 165 gallons of Ansulite 3% AFC-3MS-C AFFF product stored in the airport shop and 400 gallons of ChemGuard C301-MS-C 3% product in the ARFF truck.

result of GPAC's request (personal communication, August 12, 2019). GPAC members continue to work together to address PFAS contamination to protect the health of their families, neighbors, future generations, and fish and wildlife and to hold polluters accountable.

The first priority of the State of Alaska is to address impacts to people, specifically through the most likely primary exposure route—drinking water. However, addressing ecological impacts beyond those affecting humans is also important. Participants at the May 2019 meeting expressed concerns about the impacts to fish, birds, and other animals to ensure that they are not harmed.

DOT&PF maintains a Gustavus Airport Firefighting Foam Contamination webpage with updates and documents related to the PFAS contamination plume originating from the airport:

http://www.dot.state.ak.us/airportwater/gustavus/.

X. JUNEAU

Hagevig Fire Training Center

An initial round of groundwater and soil sampling at the City and Borough of Juneau's Hagevig Fire Training Center detected PFOS at concentrations above DEC soil and groundwater cleanup levels in June 2019 (Hohenstatt, 2019b). The highest concentration of PFOS in groundwater was 11,000 ppt. The maximum reported level of PFOA in groundwater was 320 ppt. Consistent with results from groundwater testing at many other PFAS contaminated areas in Alaska, the PFAS compound detected at the second highest concentration after PFOS was PFHxS, which was found at 2,100 ppt. A private well search conducted within a one half mile radius of the fire training center found that all properties were connected to the municipal water system and no wells were currently in use (DEC, 2019k). Consulting firm Cox Environmental will conduct a second round of sampling (City and Borough of Juneau, 2019).

Airport Rescue Firefighter Jason Tarver takes a foam sample as southeast firefighters update their airport rescue firefighting skills at the Hagevig Regional Fire Training Center on Thursday, April 13, 2017. *Photo: Michael Penn, Juneau Empire File*

XI. KING SALMON

PFAS Contamination of King Salmon's groundwater is associated with AFFF releases at King Salmon Air Station (AS) and at the state-owned King Salmon Airport which occupies a portion of the former AS. Military personnel were drawn down from King Salmon in 1994 and today the AS serves as a long range radar site and a diversion landing strip for aircraft. The State of Alaska, National Park Service, and Bristol Bay Borough among others lease installation buildings. The majority of the Air Force property was conveyed to DOT&PF (S. Loud, personal communication, May 3, 2019); however, the Air Force remains responsible for its release of contaminants. The Air Force confirmed PFAS contamination at King Salmon Air Station during a limited investigation in 2013 (AFCEC, 2014); the State discovered PFAS contamination of drinking water after initial sampling of private wells on and near airport property in December 2018 (DOT&PF, 2019c). Both Responsible Parties—the Air Force and DOT&PF—are engaged in early site characterization efforts and it is unclear exactly where the plumes are in relation to each other (B. O'Connell, personal communication, April 29, 2019).

US Air Force PFAS Investigation

Groundwater, surface water and soil samples were analyzed for 16 PFAS compounds during an evaluation of diesel range organics (DRO) at former fire training areas

(FTAs) at King Salmon AS in July 2013. Results of PFOA and PFOS in groundwater were compared to EPA's 2009 provisional health advisory (HA) levels and were found to exceed these screening levels in 7 of 10 monitoring wells at the FTAs (United States Army Corps of Engineers (USACE), 2018).

The highest concentration of PFAS in groundwater was detected at Fire Training Area 1, an unlined burn pit where AFFF was used for monthly fire training exercises from 1980 to 1992 (AFCEC, 2014). PFOS was detected in monitoring well samples at up to 150,000 ppt and PFOA at up to 81,000 ppt at this location (AFCEC, 2014, Appendix A; Table 1). PFAS were detected at all but one of the soil and sediment sampling locations associated with the former fire training areas (AFCEC, 2014, Appendix A; Table 2).

A shallow, unconfined aquifer flows from the Air Station towards wetlands, rivers, creeks, and ditches. Surface water runoff from AFFF areas has been identified as a potential migration pathway to groundwater (USACE, 2018). All six surface water samples collected along Red Fox Creek in July 2013 contained concentrations of PFOA and PFOS exceeding EPAs 2009 HA levels. PFOA was detected at up to 16,000 ppt and PFOS at up to 18,000 ppt (AFCEC, 2014, Appendix A, Table 3). Red Fox Creek, King Salmon Creek, and Eskimo Creek plus a number of unnamed creeks run through the Air Station. Eskimo Creek, used by Coho and King Salmon for spawning, ultimately flows into the Naknek River which empties into Bristol Bay 15 miles to the southwest (USACE, 2018).

The sampling conducted by the Air Force in 2013 was limited to the former fire training areas (FTAs) and did not include a number of areas that have since been identified for further PFAS investigation (USACE, 2018, Table 4-1). A Preliminary Assessment finalized in March 2018 (nearly five years after DoD first discovered PFAS at King Salmon AS), recommends further investigation of three of the four former fire training areas (FTAs), as well as the landfarm and landfarm holding ponds (located upgradient from a public drinking water supply well) and Red Fox Creek (USACE, 2018, Table 4-1). The PA also recommends that site inspections be initiated for Building 160 (Combat Alert Cell), the former and current fire stations, spray test area, wastewater treatment plant and Eskimo Creek (USACE, 2018, Table 4-1). According to DEC, site inspection field activities, including sampling to further determine the extent of contamination at eleven areas at King Salmon AS were planned for the 2019 field season (S. Castle, personal communication, May 1, 2019), the only Air Force testing to occur since 2013.

Drinking Water Impacts – Public Water System

The installation drinking water is pumped from two water supply wells: "main water supply well" and "public supply well C," drawing from the deeper aquifer at 228 and 233 feet bgs respectively (USACE, 2018). The main water supply well is located approximately 1,900 feet downgradient of the current fire station (USACE, 2018), an area which was not sampled in 2013 and is recommended for site investigation. The other well, "public supply well C," is 1200 feet downgradient of the landfarm and landfarm holding ponds where treated leachate, according to a Pathway and Environmental Hazard Assessment, has the potential to have reached groundwater (USACE, 2018). The installation water supply has not been tested for PFAS.

Groundwater contamination of private drinking wells is noted in the PA as a potential concern because many residential areas near the north bank of Naknek River are downgradient of AFFF areas (USACE, 2018). The Air Force has not initiated any offsite sampling.

Drinking Water Impacts – Private Wells

The Alaska Department of Transportation and Public Facilities (DOT&PF) in collaboration with DEC conducted initial sampling of 10 drinking water wells associated with airport property on December 12, 2018. One well owned by a business that leases property from the airport tested at 155 ppt for the sum of five PFAS compounds (DOT&PF, 2019c), more than twice DEC's 2018 action level. In evaluating only PFOS and PFOA, the result of the sum is 63 ppt, below EPA's lifetime health advisory/DEC's April 2019 action levels, but because the results were received when DEC's August 2018 Action Levels were in effect, the property owner received alternative drinking water. Shannon & Wilson led a second round of testing in mid-March 2019 that included 20 drinking water wells. PFAS were detected in 17 of the wells. Two wells had concentrations above the DEC action level for the sum of five PFAS. Four wells had concentrations from 18-64 ppt and three wells had no detections of PFAS (S&W, 2019). Based on analysis of the results, no additional well search/sampling is planned (S. Loud, personal communication, May 15, 2019).

Other Concerns

Ingestion of fish that may be contaminated with PFAS is a concern for this region. Eskimo Creek is a salmon spawning stream, receives runoff from King Salmon Air Station, and flows into the Naknek River. Ultimately, the Naknek River empties into Bristol Bay.

XII. UTQIAGVIK (BARROW)

Contamination of drinking water sources with PFOS and/or PFOA at levels exceeding the EPA's LHA were confirmed in 2017 at Imikpuk Lake (near the former Naval Arctic Research Laboratory, or NARL) and Isatkoak Reservoir (near the airport). In both cases, the source of PFAS contamination is believed to be AFFF use on adjacent properties (DEC, 2019h; 2019p).

A. IMIKPUK LAKE

The Navy conducted surface water sampling for PFOS and PFOA at five locations in Imikpuk Lake in July 2017 and found combined concentrations of PFOS and PFOA ranging from 143 ppt to 262 ppt (United States Navy, 2017) – levels that are twice to nearly four times above EPA's LHA of 70 ppt for PFOS and/or PFOA.

Imikpuk Lake is at the southwest end of the one mile long air strip that runs between the Arctic Ocean and North Salt Lagoon (see map). The source of PFAS contamination at NARL is believed to be AFFF released during emergency responses to two airplane crashes that occurred at or near the Airstrip in the 1970s: A Lockheed L-1049H Super Constellation crash in 1970 and a de Havilland DHC-6 Twin Otter crash in 1978 (Naval Facilities Engineering Command (NAVFAC), 2019b). When not frozen, surface water drainage near the Airstrip Site may drain to any or all of the following: the Arctic Ocean (immediately northwest), Imikpuk Lake (immediately southwest), and North Salt Lagoon (immediately southeast) (NAVFAC, 2019b).

Historically, Imikpuk Lake was the primary drinking water source for the former NARL (NAVFAC, 2019b). The facility, conveyed to Ukpeagvik Inupiat Corporation in 1986, now obtains its water from the public utility Barrow Utilities and Electric Cooperative, Inc. (BUECI) (United States Navy, 2017).

Imikpuk Lake has been used traditionally as a seasonal water source by elders and others engaged in subsistence (United States Navy, 2017). People have relied on the lake for drinking, cooking and cleaning traditional foods during hunting and fishing activities. When PFOS and PFOA were discovered at levels two to three times higher than health advisory levels, the Navy and the Alaska Department of Health and Social Services (DHSS) responded with public outreach that included public meetings , the issuance of DHSS and Navy advisories not to ingest the lake water (DHSS, 2017; United States Navy, 2017), and the installation of signs at Imikpuk Lake warning against ingesting any lake water or allowing pets to drink from the Lake.

One of four signs installed in March 2018 warning hunters and fishers not to use Imikpuk Lake water for cooking or drinking. *Photo: CH2M*

The Naval Facilities Engineering Command (NAVFAC) is still in the early stages of assessing PFAS contamination on and surrounding the former NARL. According to a remedial project manager with the Navy, field work (including localized sampling of groundwater, soil, and surface water at the Airstrip) was planned to begin in mid-August 2019, followed by a remedial investigation anticipated in 2020. The purpose would be to delineate the extent of the PFAS contamination plume at the Airstrip site and evaluate the potential for human exposure (K. Leibman, personal communication, April 4, 2019). The Naval Facilities Engineering Command maintains a web page with information on the ongoing PFAS Drinking Water Investigation (NAVFAC, n.d.).

B. ISATKOAK RESERVOIR

Isatkoak Reservoir, bordering Post/Rogers Memorial Airport is the City of Utqiagvik's drinking water source, serving the community's approximately 4,000 residents. In August 2017, twelve surface water samples were taken across Isatkoak Reservoir and analyzed for PFOS and PFOA. The highest concentrations of PFAS were detected in three samples taken at the western edge of the Reservoir near the airstrip and ranged from 120 ppt - 1500 ppt for PFOS and 8 ppt – 44 ppt for PFOA (Eurofins Eaton Analytical, 2017b). Sampling conducted a month later included three additional sampling points at the eastern edge of the runway (Eurofins Eaton Analytical, 2017c), where the airstrip actually meets the western edge of the reservoir (DEC, 2019h). Of 15 surface water samples collected from Isatkoak Reservoir in September 2017, PFOS was detected at a range of 61 ppt – 6,000 ppt and PFOA at concentrations of 6.1 ppt – 170 ppt (DEC, 2019h; Eurofins Eaton Analytical, 2017c) with the highest concentrations detected in a sample taken from the same location bordering the airstrip that also had the highest levels in results from the month before. In March 2019, DEC sent a letter notifying DOT&PF of their liability as the party responsible for PFAS contamination originating from Airport property (DEC, 2019h).

The public utility, BUECI, has taken routine monthly samples from the location where the water is pulled from Isatkoak Reservoir ("raw water") and from post-treatment water (MG Tank) since August 2017 when the contamination of Utqiagvik's drinking water supply was first discovered. BUECI is having the water samples analyzed for PFOS and PFOA only. ACAT pulled together data from laboratory reports of raw water samples taken between October 2017 and February 2019 and found that the results ranged from 60 ppt – 90 ppt for PFOS and 5 ppt - 11 ppt for PFOA. Post-treatment drinking water results have consistently been ND (non-detect) for PFOS and for PFOA in all sampling that occurred October 2017 to February 2019. It is important to note that a result of ND does not mean that PFOS and PFOA have been completely removed from Utqiagvik's public drinking water; it is entirely possible that PFAS compounds other than PFOS and PFOA could be present but not reported.

Since 1984, BUECI has treated its drinking water using various high-pressure membrane filtration systems including conventional plant reverse osmosis water treatment technology (1984 – 1999), micro-filtration, followed by nano-filtration (1999 – 2018), and in 2019, BUECI upgraded their treatment to ultra-filtration (smaller pore size than microfiltration), followed by nano-filtration (J. Murphy, personal communication, May 28, 2019). According to research discussed in EPA's electronic newsletter Science Matters, high-pressure membrane filtration systems are "extremely effective at removing PFAS" and "are typically more than 90 percent effective at removing a wide range of PFAS, including shorter chain PFAS"(EPA, 2018d).

High-pressure membranes allow about 80% of the feedwater to pass through the membrane as treated water; the remaining 20% of the feedwater is a high strength concentrated waste which must be disposed of (EPA, 2018d). Given the high concentrations of PFAS compounds in Isatkoak Reservoir, the drinking water source for BUECI, it is likely that the water that does not pass through the membrane is highly contaminated with PFAS. According to BUECI Superintendent Jim Murphy, the concentrate from the filters is released into Isatkoak Lagoon which is not the same as the Isatkoak Reservoir, the drinking water source for Utqiagvik (personal communication, May 28, 2019).

Isatkoak Reservoir is the raw water source for Utqiagvik's drinking water. The Lagoon at left is where the water that does not pass through the filter is released. The airstrip borders Utqiagvik's drinking water supply. *Photo: DEC*

XIII. VALDEZ, KENAI, CORDOVA

Twelve wells near Valdez Airport, eight wells near Cordova Airport and six near Kenai Airport were sampled for 14 PFAS compounds in December 2018, with no wells showing detections of PFAS above DEC's August 2018 Action Levels. In Valdez, three wells had detections of PFAS ranging from less than 1 ppt to 3 ppt (TestAmerica, 2018d). The only PFAS compound detected in Kenai was perfluorohexanoic acid (PFHxA) at levels below 1 ppt in two wells (TestAmerica, 2018d). No PFAS were detected at or above detection limits in Cordova groundwater (TestAmerica, 2019a).

XIV. YAKUTAT

Sampling of 12 wells near the Yakutat Airport was conducted by Shannon & Wilson in early February 2019 and groundwater was found to be contaminated (Resneck, 2019a). Groundwater wells were tested for 14 PFAS compounds with the "sum of five" (PFOS, PFOA, PFNA, PFHxS, and PFHpA) and PFBS compared to DEC's August 2018 Action Levels. One well at a property adjacent to the airport tested at 90 ppt for the sum of five PFAS, exceeding action levels. The total concentration of the sum of PFOS and PFOA in this well was 48 ppt; PFHxS was detected at 36 ppt (TestAmerica, 2019a). This property's drinking water well would not be considered contaminated under the State's current, less stringent action level issued in April 2019. Three wells, including the DOT&PF office, had detectable PFAS at levels above 20 ppt for the sum of five, but below DEC action levels. One well had a detection of less than 3 ppt and seven wells had no detections above the detection limit. DEC received the results from initial sampling during the transition from DEC's August 2018 Action Levels for the "sum of five" to current action levels (EPA's LHA of 70 ppt) and initially indicated that the owner of the well would not be provided alternative drinking water, but later reversed its position and applied the 2018 action level.

In June 2019, Shannon & Wilson conducted a second round of sampling, testing a total of 21 wells, the 12 that had been tested in February and nine additional wells. Only results for PFOS and PFOA were reported and these were compared to EPA's LHA of 70 ppt. PFOS and PFOA were detected in a total of eight wells at concentrations ranging from 6 ppt – 60 ppt (DEC, 2019f), below levels that would require alternative water to be supplied by DOT&PF, the responsible party in this case. This is concerning to Yakutat City Manager Jon Erickson who said in a radio interview with Coast Alaska's Jacob Resneck in July, "basically, they're changing the test so that it will pass and it's very disappointing" (Resneck, 2019b). Laboratory results from February 2019 sampling show that PFHxS was detected at the second highest concentration (after PFOS) in all wells with detectable PFAS (TestAmerica, 2019a). Property owners whose wells were tested in June 2019 do not know what the PFHxS concentrations are in their groundwater because DEC requested results for PFOS and PFOA only. No further well search will be conducted in Yakutat because no new wells sampled in June exceeded actionable levels.

DOT&PF maintains a Yakutat Airport Firefighting Foam Contamination webpage with updates and documents related to the PFAS contamination plume originating from the airport: http://dot.alaska.gov/airportwater/yakutat/.

The State of Alaska Administration and Legislature have the responsibility and authority to act swiftly to protect the drinking water, environment and health of Alaskans from continued PFAS exposure. *Photo: Gillfoto*

PART THREE: RECOMMENDATIONS

The State of Alaska Administration and Legislature have the responsibility and authority to act swiftly on these recommendations to protect the drinking water, environment and health of Alaskans. The State should not defer to the federal government when actions can be taken now at the state level on most of these recommendations.

Summary of the statement from Sally Schlichting, Manager, Contaminated Sites Program at the Alaska Department of Environmental Conservation (see her memo in full on page 23): *"The best way to protect our citizens of the state of Alaska is not by rolling back standards. Such action goes against our responsibility as environmental and health professionals to ensure the drinking water of Alaskans is safe. As a science-based agency, we must use a science-based approach to set standards, investigate all potential contaminated areas and receptors, require complete reporting of all analytes, and do all that we can to protect Alaskans and the environment from additional exposures to PFAS. That's our job. To do otherwise is negligence."*

- **Prohibit any further use of firefighting foams that contain PFAS:**

  State and federal agencies should prevent further water contamination and harm by prohibiting any further use of aqueous film forming foams (AFFF) at military installations, airports, fire-training centers and industrial facilities. Require replacement of AFFF with safe, non-fluorinated alternatives. Fluorine-free firefighting foams are effective, meet necessary certifications, and are widely available and in use at major airports, defense sites, and oil and gas facilities around the world (IPEN, 2018; and IPEN, 2019). We further caution against the use of any PFAS in firefighting foam, including short-chain PFAS, as replacement formulations are regrettable substitutions that will only perpetuate harm to the environment and human health. The State of Washington and a number of other states have already enacted laws that prohibit PFAS-based firefighting foam.

- **Set health-protective drinking water standards:**

  The State of Alaska should take proactive measures by setting health-protective, enforceable maximum contaminant levels (MCLs) in drinking water for PFAS. Alaska should follow the lead of other states that are establishing stringent standards and not wait for action at the federal level. Given the evidence of harm to human health at extremely low exposure levels, we recommend establishing an MCL of 1 ppt for all PFAS.

- **Conduct a comprehensive monitoring program:**

  Require *all* public water systems in Alaska to test for PFAS. Institute a comprehensive monitoring program of all potentially contaminated areas and media to assess the full extent of PFAS contamination in Alaska—this should include soils, ground- and surface waters, drinking water sources, fish and wildlife, garden produce, and wild plants used for food or medicine. Monitoring should include vulnerable receiving waters, lands, and communities in proximity to military bases, aviation facilities, fire training areas, oil and gas facilities, and mining operations. The State of Alaska and Department of Defense should require analyses of the full panel of PFAS and report these to the public.

- **Provide safe water:**

  Ensure that those entities that are responsible for contaminating drinking water sources provide an immediate as well as long term safe drinking water source for all households, schools, and businesses. We caution against the use of public water supplies as "safe" if there is evidence of PFAS contamination, such as in Fairbanks.

- **Ensure responsible cleanup:**

  Require stringent and health-protective clean-up of contaminated areas and remediation of groundwater according to best available technologies and standards. Hold polluters accountable and ensure that they pay for cleanup. Include provisions to require the most complete destruction of PFAS possible.

- **Require biomonitoring and medical monitoring:**

  Institute a community-advised biomonitoring program to assess levels of PFAS in blood serum of people affected or likely to be affected by the drinking water contamination. Conduct health screening/medical monitoring of people within affected communities.

- **Prevent occupational exposures and assess adverse effects on firefighters and other workers:**

  Exposure assessments and medical monitoring should include firefighters and other first responders, as well as workers at contaminated facilities (such as the Golden Heart Utilities wastewater and compost facility).

- **Regulate the class of PFAS chemicals:**

  Regulate PFAS as a class under the *Clean Water Act*, the *Comprehensive Environmental Response, Compensation, and Liability Act* (Superfund), and the *Toxic Release Inventory, and the Resource Conservation and Recovery Act*. Do not allow the introduction of any new PFAS into commerce under the *Toxic Substances Control (Lautenberg) Act.*

- **Prohibit the use of PFAS in any food contact materials:**

  For example, non-stick cookware, food packaging, food processing equipment, beverage and ice cream dispensing machines.

- **Provide community members a "seat at the table:"**

  Value and include community members as critical participants in decision-making, including design of sampling, monitoring and clean-up plans, legislation and regulatory actions. "Nothing about us without us." Be fully transparent and honest with affected workers, community members and the general public in all action steps taken to address PFAS contamination.

A STATEMENT FROM THE ALASKA CITIZEN'S SUMMIT ON PFAS—MAY 17-19, 2019

We are community members directly harmed by PFAS contamination. From May 17-19, we met in Gustavus with allies from Alaska Community Action on Toxics and Southeast Alaska Conservation Council to gain a common understanding of the science concerning health effects of PFAS and current state and federal policies that pertain to PFAS; and to develop plans and strategies to address PFAS contamination and to work collectively for positive change.

We object to the State of Alaska's recent decision to "roll back" more protective standards for PFAS in drinking water. We additionally object to the State's decision to withhold further actions on chemicals that are known to harm human and environmental health at exceptionally low concentrations.

The State's decision is not protective of human health, particularly that of infants, children, and expectant mothers. A growing number of other states are establishing enforceable drinking water standards that are significantly more stringent than the EPA lifetime-health advisory (LHA). They rely on the scientific evidence that shows indisputably harmful biological activity of PFAS chemicals at low exposure levels.

The EPA LHA fails to incorporate critical risk factors such as placental and breast milk transfer to baby, nor does it include the sensitive end points of effects on the mammary gland and immune suppression.

The ever-growing body of scientific research and health studies has been incorporated into the regulation of drinking water in the form of maximum contaminant levels (MCLs) for PFAS chemicals in at least eight states that have committed to be more health protective of their residents than the EPA.

We urge you to reconsider the decision to defer to the EPA rather than to protect the health of children and all Alaskans from the harms of PFAS. This is an urgent public health crisis that needs immediate action.

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