Environmental & Health Impacts of PFAS

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Region 8 Pretreatment Association

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Presentation Outline
Per- and Polyfluorinated Alkyl Substances (PFAS)

- Introduction
- History
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- PFAS Sources
- Removal and Disposal Options
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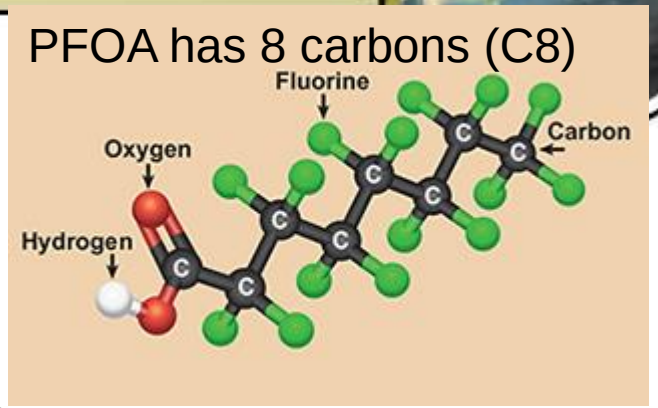
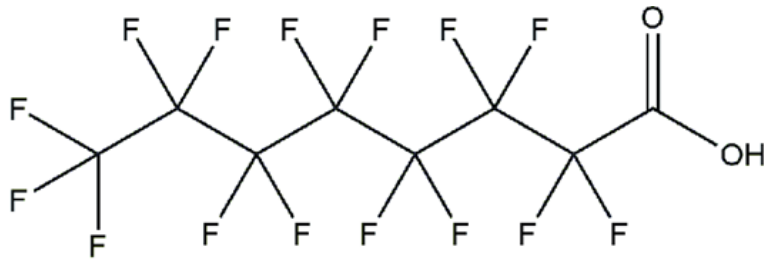
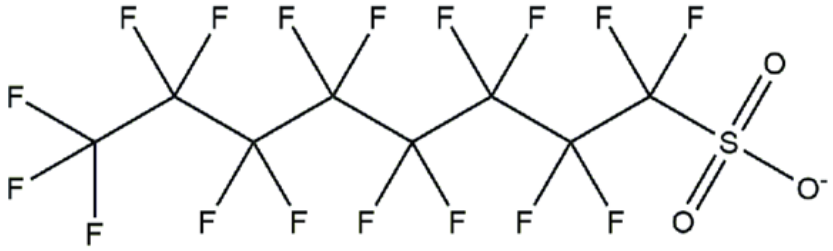
- Monitoring and Regulations
- Summary





Perfluorooctanoic acid (PFOA)



Perfluorooctane sulfonate (PFOS)

PFAS Introduction

- PFAS are not currently regulated under the Clean Water Act.
- Experts are predicting that PFAS could rival asbestos in bottom-line environmental impacts, litigation, burden and costs of responding to source water contamination. March 2022, Opflow.
- The movie *Dark Waters is* based a on true story, where perfluoroocatonic acid (PFOA) dumpling poisoned 70,000 people in West Virginia. Hundreds of local residents who were exposed to PFOA through their drinking water became extremely ill, suffering from cancer, facial deformities at birth and immunodeficiency.
- PFOA is contained in firefighting foams, non-stick pans, carpeting, furniture, cosmetics, household cleaners, water-proof clothing, packaged food containers. Some brand names are well-known: Teflon, Stainmaster, Scotchgard, SilverStone etc. All indoor residential carpet purchased by Lowe's and Home Depot will be free of PFAS by January 2020.

History of PFAS

- PFAS were first developed in the late 1930s and started to be used in commercial products in the late 1940s.
- 1947: 3M (then the Minnesota Mining and Manufacturing Company) along with the Naval Research Laboratory starts mass-manufacturing PFOA.
- 1951: DuPont starts using PFOA to make Teflon.
- 1953: A chemical called PFOS is accidentally spilled on a 3M chemist's tennis shoe. It leaves a coating that repels oil and water. Scotchgard is born.

History of PFAS

- 1960s: 3M and the U.S. Navy develop “aqueous film-forming foam” (AFFF) a firefighting foam containing PFOS and PFOA. By the late 1960’s, the U.S. Navy required all of its vessels to carry AFFF.
- 1970s: Military sites, civilian airports and firefighting training centers start using AFFF worldwide.
- 1978 & 1979: Animal studies conducted by 3M researches confirmed that at low doses PFOA and PFOS are toxic.
- 1980s: A U.S. Navy study finds that AFFF has “adverse effects environmentally” and kills aquatic life.
- 1993: DuPont understood that "PFOA caused cancerous testicular, pancreatic and liver tumors in lab animals"

History of PFAS

- 2000: 3M announces it will voluntarily halt production of PFOA and PFOS.
- 2002: Because of the 3M phaseout, DuPont built its own plant in to manufacture PFOS.
- 2005: An EPA advisory panel concludes that PFOA is a “likely” human carcinogen.
- 2006: An EPA program encourages all major manufacturers to stop making long-chain PFAS, citing potential birth defects and other risks.
- DuPont agrees to phase out production by 2015; like 3M, they started making new PFAS varieties, none proven safe.

History of PFAS

- 2013: Gore-Tex eliminated the use of PFOAs.
- 2014: PFOA was banned in the United States. After four decades of litigation and EPA investigations.
- Eight companies agreed to gradually phase out the manufacturing PFOS by 2015.
- 2016: EPA issued a drinking water health advisory limit for PFOA and PFOS at 70 ng/L. DoD stopped land-based use of AFFF in training, testing and maintenance through a department wide policy.
- 2018: PFAS contamination is detected at 121 military sites and at 564 drinking water supplies in nearby communities at levels that exceed the EPA's health advisory.

Health Effects Associated with PFAS

- Studies have found correlation between high PFOA exposure and six health outcomes: kidney cancer, testicular cancer, ulcerative colitis, thyroid disease, hypercholesterolemia (high cholesterol), and pregnancy-induced hypertension.
- GenX has been introduced as a replacement for PFOA, but in a 2015 study which tested the effects on rats, GenX caused many of the same health problems as PFOA, but required much higher concentrations.
- PFOA and PFOS are the two best-known in the class, little to no health-effects data are available for many PFAS.
- PFAS pose a threat to public health when they are absorbed and accumulate in the body.

Health Effects Associated with PFAS

- PFAS health effects include altered metabolism, fertility, reduced fetal growth and increased risk of being overweight or obese, and reduced ability of the immune system to fight infections.
  National Institute of Environmental Health Sciences, 4-2022

Expected Primary Sources of PFAS to WWTPs

- Landfill leachate
- Electroplating and Metals Finishing (mainly chrome plating)
- Centralized Waste Management Facilities
- Airfields – Commercial, Private, and Military.
- Department of Defense Facilities
- Fire Department Training Facilities
- Industrial Laundries
- Petroleum or Petrochemical
- Chemical Manufacturers
- Plastics Manufacturers
- Textile and Leather Facilities
- Paint Manufacturers
- Pulp and Paper Facilities

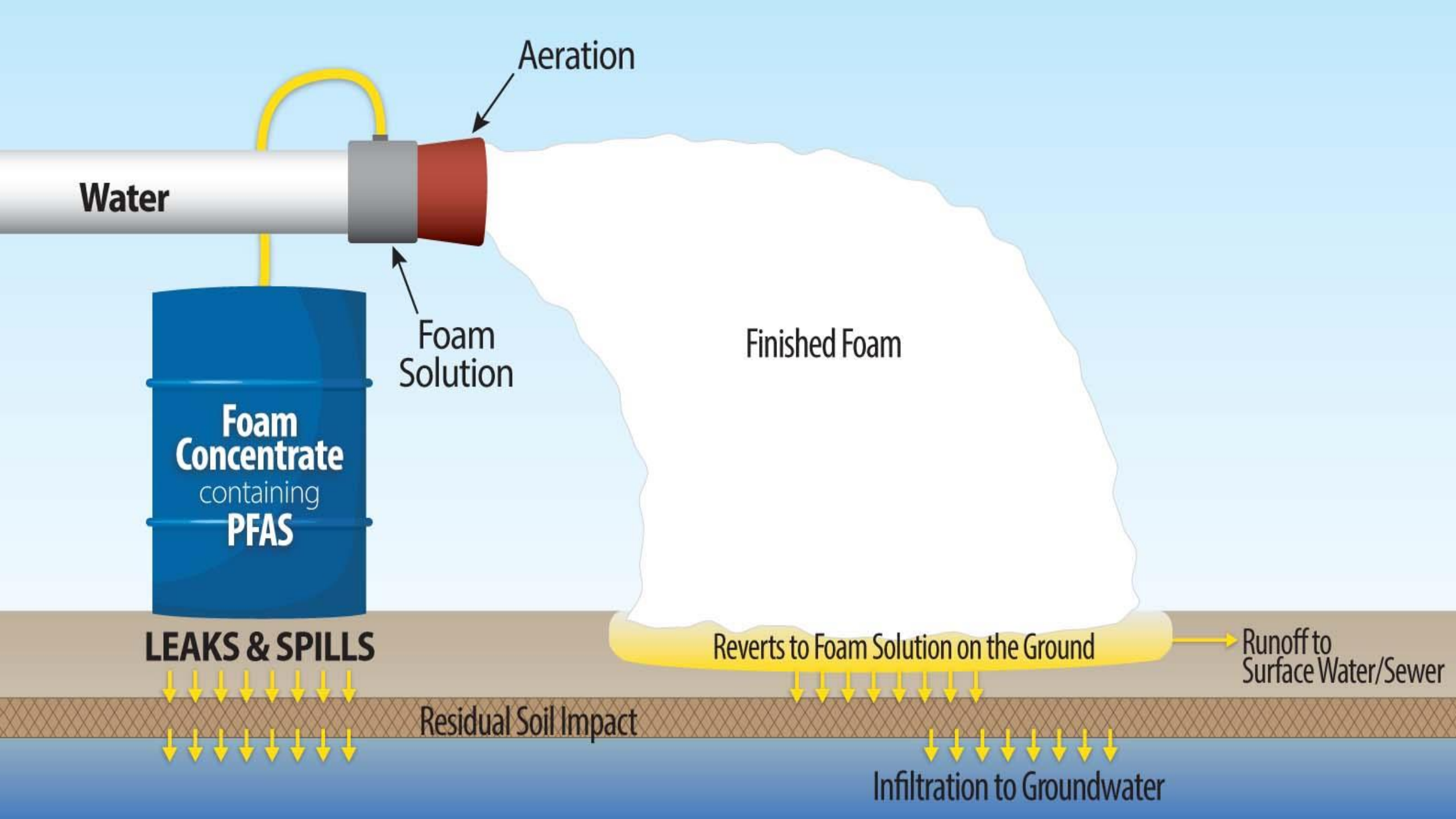
In this 2013 photo, a fire crew at Dover Air Force Base in Delaware responded to a massive inadvertent foam release from a hangar fire suppression system. (US. Air Force photo/Greg L. Davis)

PFAS Sources, Aqueous Film-Forming Foam

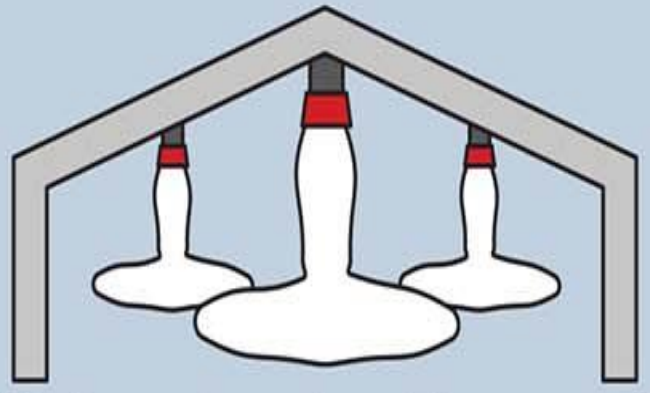
- Thousands of firefighters nationwide have been exposed to AFFF firefighting foam. Eligible firefighters, airport workers and service members are filing lawsuits against manufacturers.
- AFFF firefighting foam has been sold for decades by major chemical manufacturers like 3M, Tyco, DuPont and Chemguard.
- The Bismarck IPP did a PFAS inventory at the Bismarck Airport. Three sites had PFAS, a total of 4,000 gallons of the (C6) fluorosurfactants. 15 buildings/hangers were inspected. Two buildings have PFAS for fire suppression, ten buildings use water and two buildings did not have a water supply.

PFAS Sources in Bismarck

- The Bismarck IPP did a PFAS inventory at the Bismarck Airport. Identified three sites w/PFAS, total of 4,000 gallons of (C6) fluorosurfactants. 15 buildings/hangers were inspected. Two buildings have PFAS for fire suppression, ten buildings use water and two buildings did not have a water supply.

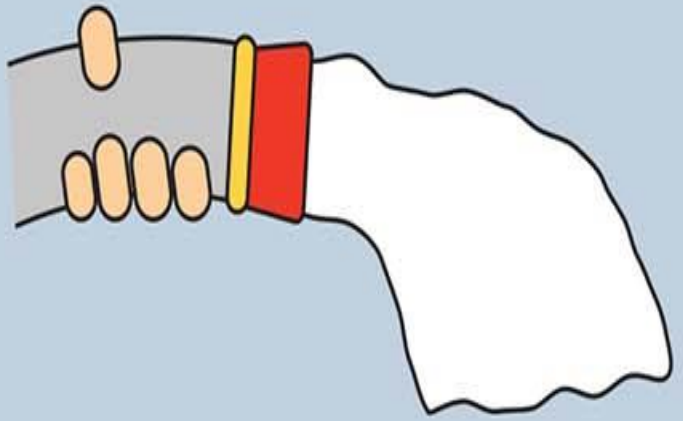

Aeration
Water
Foam Solution
Finished Foam
Foam Concentrate containing PFAS
LEAKS & SPILLS
Reverts to Foam Solution on the Ground
Runoff to Surface Water/Sewer
Residual Soil Impact
Infiltration to Groundwater

Discharge from fire trucks during emergency response to fires or aircraft incidents

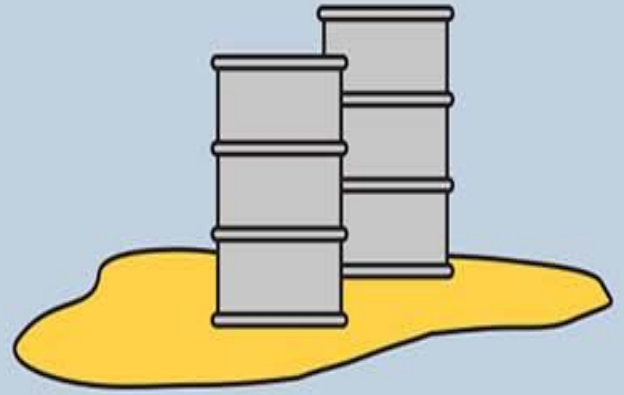


Discharge from aircraft hangar and fuel farm fire suppression systems in response to fire or accidental activation

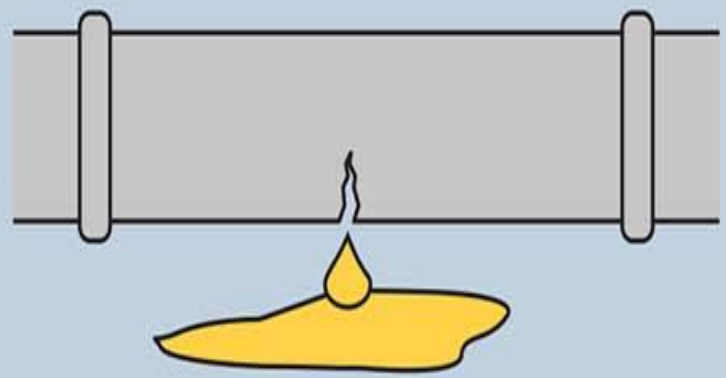
Equipment calibration and testing



Fire training exercises



Spills of concentrate during transfer and storage



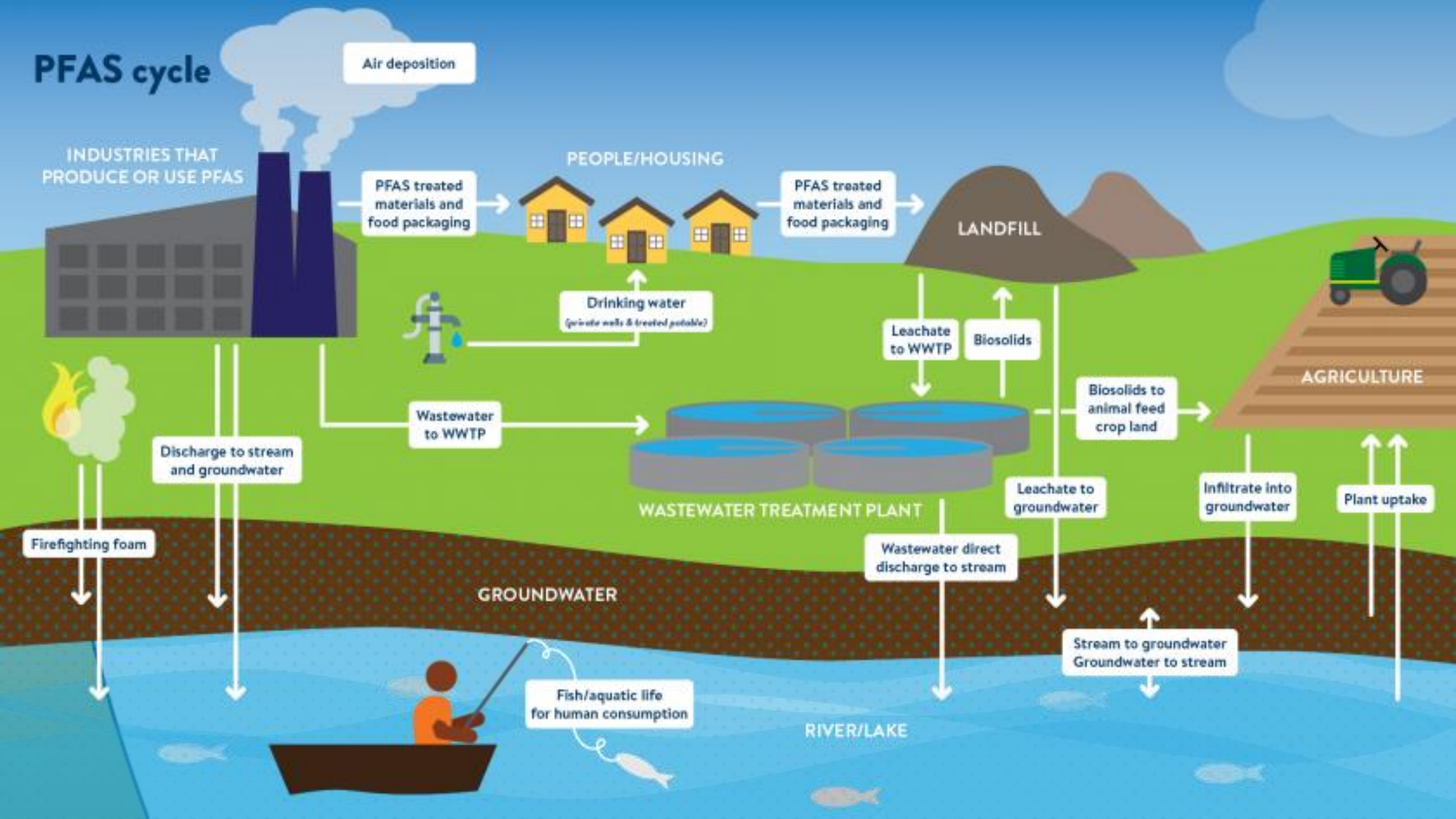
Accidental leaks from foam distribution piping

PFAS Sources

- Inks, varnishes, waxes, firefighting foams, metal plating, cleaning solutions, coating formulations, lubricants, water and oil repellents, paper and packaging and textiles.
- Examples of industries using PFAS include automotive, aviation, aerospace and defense, biocides, cable and wiring, construction, electronics, energy, food processing, household products, oil and mining production, medical articles, semiconductors, textiles, leather goods and apparel.

PFAS Sources

- PFAS incineration facilities pollute frontline and downwind communities. The process can cycle PFAS back into these areas and the environment. In February 2020, Earthjustice along with the Sierra Club and frontline communities, filed a lawsuit in federal district court challenging DoD's contracts to incinerate AFFF.
- Researchers found that short-chain PFAS ended up in the facility liquid or effluent, while long-chain PFAS were more abundant in the sludge due to their higher affinity toward solids. Science News Journey of PFAS in wastewater facilities highlights regulation challenges May 26, 2021


PFAS cycle
Air deposition
INDUSTRIES THAT PRODUCE OR USE PFAS
PFAS treated materials and food packaging
PEOPLE/HOUSING
PFAS treated materials and food packaging
LANDFILL
Drinking water
(private wells & treated potable)
Leachate to WWTP
Biosolids
AGRICULTURE
Biosolids to animal feed crop land
Wastewater to WWTP
Discharge to stream and groundwater
WASTEWATER TREATMENT PLANT
Leachate to groundwater
Infiltrate into groundwater
Plant uptake
Firefighting foam
Wastewater direct discharge to stream
GROUNDWATER
Stream to groundwater
Groundwater to stream
Fish/aquatic life for human consumption
RIVER/LAKE

Household PFAS Sources

- Stain-resistant carpets and fabrics, indoor dust
- Nonstick cookware
- Food packaging materials, water resistant clothing
- Cleaning products, floor wax, paints, varnishes and sealants
- Cosmetics, PFAS may be listed on the ingredient list as PTFE (polytetrafluoroethylene), perfluorooctyl triethoxysilane, perfluorononyl dimethicone, perfluorodecalin and perfluorohexane.
- Some dental floss, i.e. Glide
- Food, microwave popcorn bags
- Insecticides
- Water

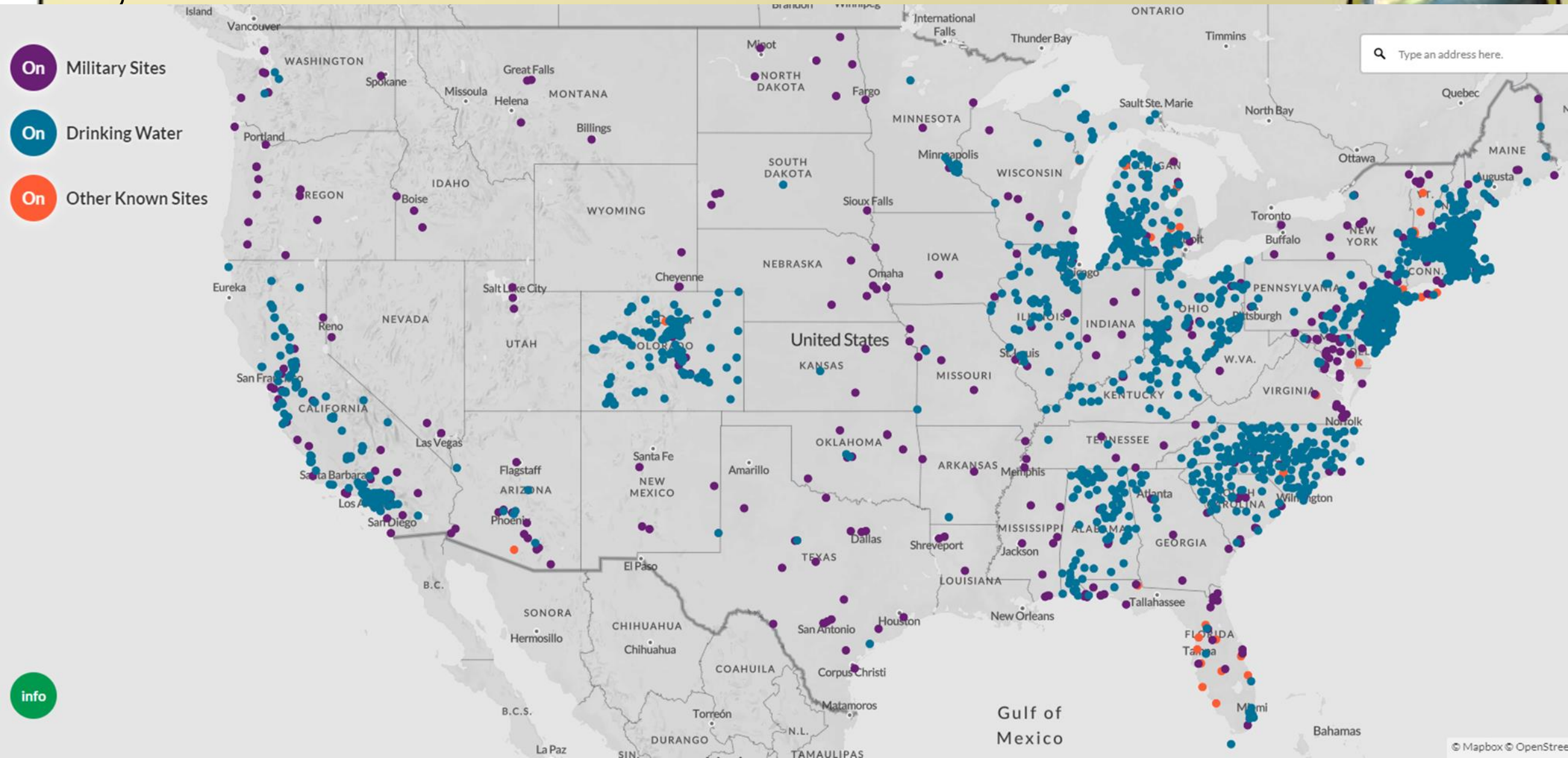
Removal and Disposal Options

- Three approaches are currently available for PFAS wastes: landfilling, wastewater treatment and incineration. Each disposal approach can return either the original PFAS or their degradation products back to the environment, illustrating that the PFAS problem is cyclical.
  - Landfill leachate is commonly sent to wastewater treatment plants.
  - Wastewater treatment plants PFAS are carried over to the sludge and effluent. Biosolids can be disposed of into landfills.
  - Sewage sludge can be landfilled, incinerated, or applied on agricultural fields.
  - PFAS from treated sludge (biosolids) can contaminate soil, water and crops.
  - PFAS incineration facilities can cycle PFAS contamination back into these areas and the environment.

Reduction Strategies

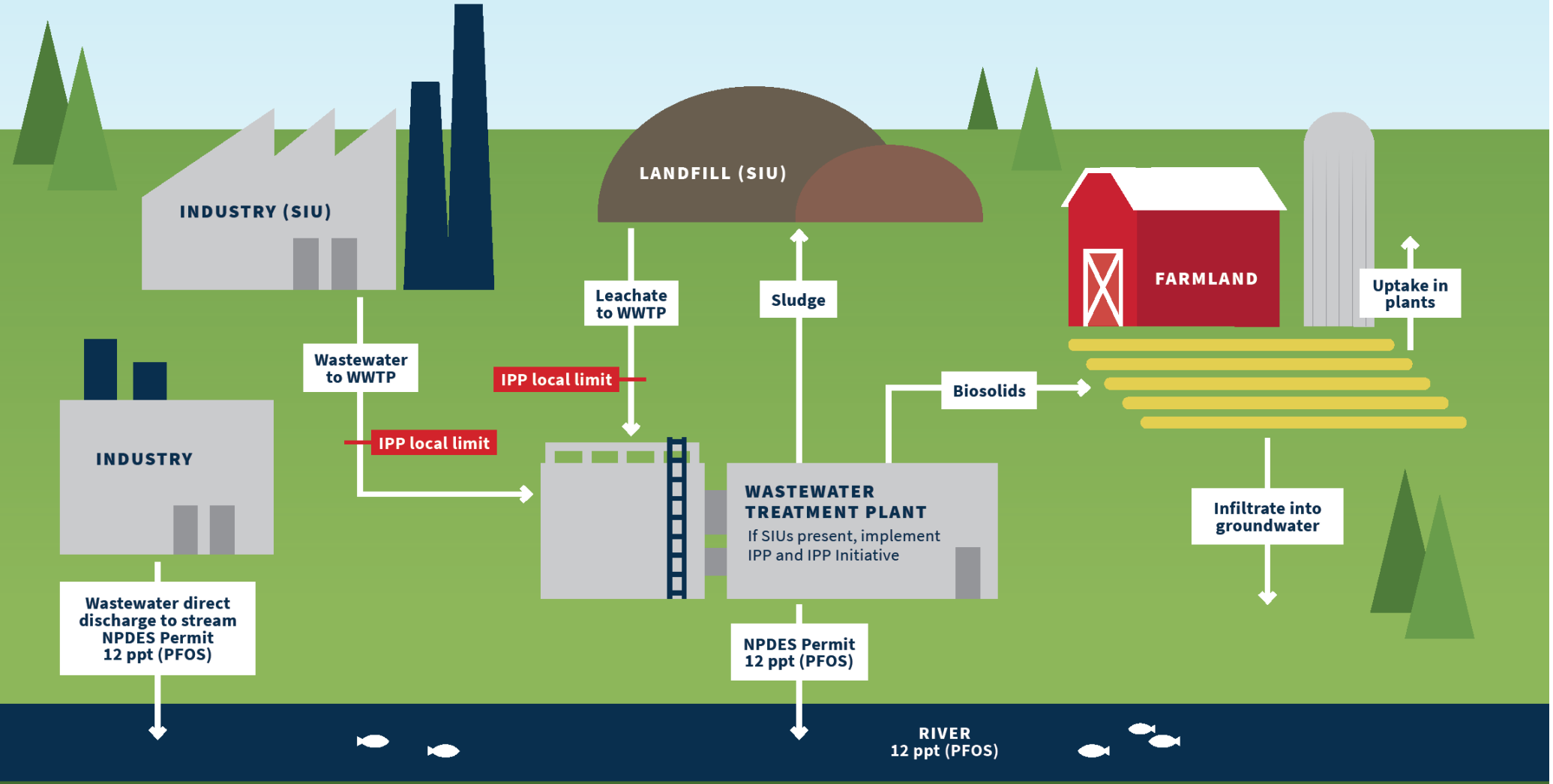
- One of the greatest public health accomplishments of the 20th century was the ability to deliver clean water and provide wastewater treatment at municipalities. Clean water has saved more lives than any other advancement in history.
- The U.S. Environmental Protection Agency (EPA) regulates more than 90 drinking water contaminants through the Safe Drinking Water Act (SDWA).
- State and federal officials, including the EPA, have been slow to enact meaningful standards or restrict the use of PFAS.
- PFAS are difficult to treat and resistant to conventional water treatment.
- Among the few standards for PFAS in sludge are in Maine, where the state government set screening levels for PFOA and PFOS, two common types of PFAS. It developed the standards after milk from cows on a dairy farm that spread sludge were found to be contaminated with high levels of PFAS. The cows had to be killed, and the farmers found extremely high PFAS levels in their blood.

PFAS Contamination in the U.S. (August 2021)
2,854 locations in 50 states and 2 territories



PFAS Water Cycle

IPP = Industrial Pretreatment Program
SIU = Significant Industrial User
NPDES = National Pollutant Discharge Elimination System
PPT = Parts Per Trillion
WWTP = Wastewater Treatment Plant



EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

800-662-9278 | *www.michigan.gov/pfasresponse*

05/2019

PFAS Minimum Detection Limit, 2018

Table 2: FDA's Method Detection Limits for 16 PFAS pursuant to its Method C-010.01

PFAS	Fruits & vegetables	Cheeses	Water*	Dairy	Breads & grains	Meats & other food products
PFOA	20	419	0.82	42	41	90
PFOS	33	344	2.7	24	33	82
PFBA	70	***	**	29	20	66
PFHpS	40	242	**	13	49	32
PFPeA	43	681	**	15	76	44
PFxA	45	376	1.7	7	93	26
PFHxS	88	421	2.4	17	58	59
PFHpA	36	197	0.63	27	62	73
PFBS	56	416	6.3	14	52	21
PFPeS	40	481	**	17	83	69
NaDONA	70	488	0.55	22	53	95
HFPO-DA	60	888	4.3	24	74	83
PFDA	48	901	3.3	28	46	43
PFNA	56	261	0.83	39	87	56
11Cl-PF3OUdS	107	386	1.5	28	90	107
9Cl-PF3ONs	91	372	1.8	23	62	91

All units are parts per trillion (ppt).

** Bottled drinking water samples were analyzed following using EPA 537.1 method and are based on Lowest Concentration Minimum Reporting Levels (LCMRL).*

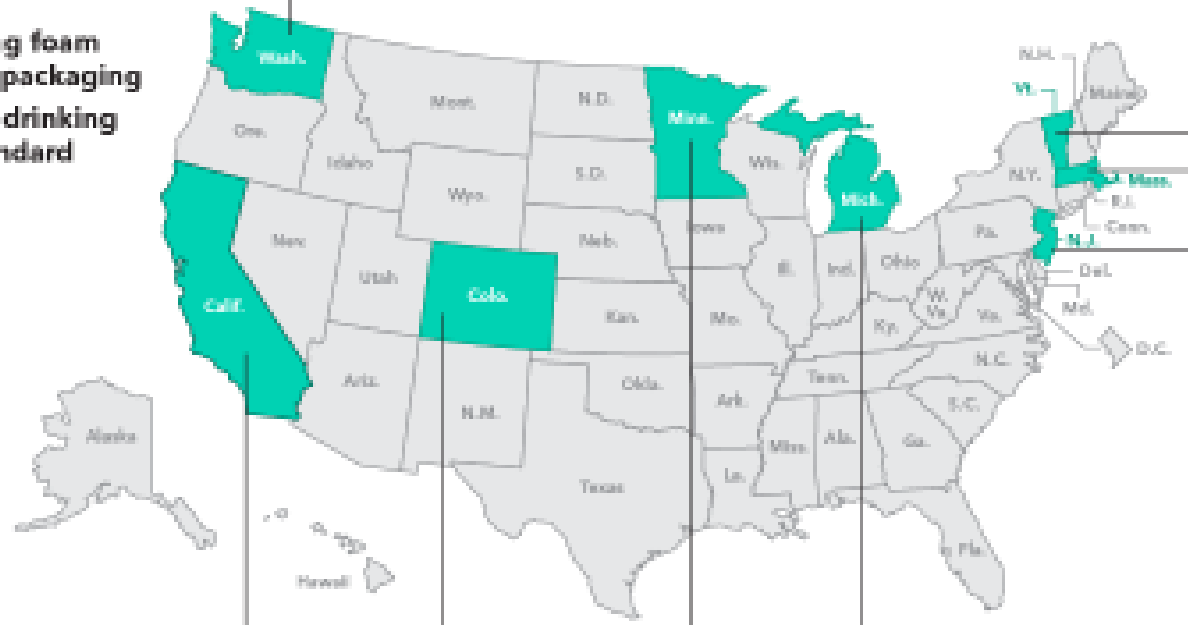
***Not Determined: FDA modified EPA 537.1 to include 4 PFAS that are not incorporated into the EPA method. FDA did not independently determine MDL values or LCMRL values for these.*

**** No MDL could be calculated for cheese due to an interference.*

States With Numerical PFAS Limits

Washington

- Banned in firefighting foam and food packaging
- Proposed drinking water standard



Vermont

- 20 PPT (PFAS)
- Drinking water health advisory for 5 PFAS

Massachusetts

- 70 PPT (PFAS)
- State guidance for concentrations of 5 PFAS in drinking water

New Jersey

- Set PFNA standard at 13 ppt
- Weighing proposed standards for:
  PFOA at 14 ppt
  PFOS at 13 ppt

California

- 14 PPT (PFOA)
- 13 PPT (PFOS)
- Drinking water notification guidance

Colorado

- PFOA/PFAS listed as hazardous waste
- 70 PPT (Combined PFOA/PFOS)
- Groundwater quality standard for El Paso County only

Minnesota

- 35 PPT (PFOA)
- 27 PPT (PFOS)
- Health-based guidance values

Michigan

- 70 PPT (Combined PFOA/PFOS)
- State standard for concentrations in drinking water

Summary of Federal and State PFAS Drinking Water Determinations

Jurisdiction	Chemical	Limit	RfD/Basis	Application to DW
USEPA Health Advisory, 2016	PFOS, PFOA, combination	70 ppt	PFOA: liver wt effects in rodents across multiple studies → PK adj for HED NOAEL /30 = 0.02 ug/kg/d PFOS: developmental effects in rats; NOAEL→PK adj for HED/30	Water ingestion to pregnant woman: approx 3L/60kg, RSC=20%
VT, 2016	PFOS, PFOA combination	20 ppt	Same as EPA	Water ingestion to 0-1 yr old child, approx. 1.75 liter per 10 kg child; RSC= 20%
NH, 2016	PFOS, PFOA combination	70 ppt	Same as EPA	Same as EPA
NJ, 2016	PFOA	14 ppt	0.002 ug/kg/d based upon BMDL for liver wt effects in adult mice; BMDL extrapolated to HED by PK adj, divided by 300x cumulative UF	Water ingestion to adult (2L/70kg), RSC = 20%
ME, 2014	PFOA	100 ppt	0.006 ug/kg/d; liver wt effects in rodents across 6 studies; BMDL → PK adj for HED /300	Water ingestion to adult, (2 L/70kg), RSC = 0.6 based upon NHANES upper 95th human serum level
MN 2008 HRL[2]	PFOA	300 ppt	0.077 ug/kg/d; liver wt effects in monkeys; BMDL → PK adj for HED / 30	Water ingestion to adult, 3.7 L/day for 70 kg, RSC = 20%
NJ, 2015 Interim GW Criterion	PFNA	13 ppt	$BMDL_{10}$ for liver wt ↑ in mice converted to human serum concentration and divided by cumulative UF of 1000x	Water ingestion to serum concentration ratio in human adults of 200:1

Abbreviations: the following have not been identified elsewhere in text and are not self-evident: adj – adjustment; HED – human equivalent dose; PK – pharmacokinetic; RSC – relative source contribution; BMDL – benchmark dose lower limit; UF – uncertainty factor; GW - groundwater Health Risk Limit: Minnesota is reviewing their 2008 determination in light of USEPA's 2016 Health Advisory of 70 ppt.

State Reduction Strategies

- On March 17, 2020, a revised Vermont Water Supply Rule was adopted to establish a Maximum Contaminant Level (MCL) as well as routine public drinking water monitoring frequencies for PFAS.
- The MCL is 20 ng/L and it is for five PFAS in drinking water: PFOA, PFOS, PFHxS (perfluorohexane sulfonic acid), PFHpA (perfluoroheptanoic acid), PFNA (perfluorononanoic acid). The sum of these five PFAS cannot exceed 20 ng/L.
- The majority of significant PFOS sources were metal finishers with a history of fume suppressant use, contaminated sites associated with industries or activities with PFOS usage, and landfills that accepted industrial wastes containing PFOS.

Vermont State Reduction Strategies

- The Health Advisory of 20 ppt for the combination of PFOA, PFOS, PFHxS, PFHpA and PFNA is based on a non-cancer endpoint and derived using the oral reference dose of 0.00002 mg/kgBW-d provided in US EPA's 2016 Health Effects Support Documents for PFOA and PFOS.
- The Health Advisory for the combination of PFOA, PFOS, PFHxS, PFHpA and PFNA is based on direct exposure via ingestion of drinking water only. As is standard practice, a relative source contribution is incorporated in the development of the advisory value to account for potential exposure to these chemicals from other sources.
- The Action Level involves the adoption of an chronic oral reference (RfD) for PFOS and PFOA of 0.02 ug/kg/d as per the USEPA determination, while no RfD is derived at this time for other PFAS.

Vermont equation used to derive a noncancer-based PFAS Drinking Water Health Advisory

- DWHA= (HQ)(RfDo)(1/BWAIR)(CF)(RSC)
- = (1)(2 x 10-5 mg/kg BW-day)(1/0.175 L/kg BW-day)(1000 µg/mg)(0.2)
- = 0.02285 µg/L (ppb)
- = 0.02285 µg/L (ppb) x 1000 ng/ µg = 22.9 ng/L (ppt) ≈ 20 ppt

DWHA= (HQ)(RfDo)(1/BWAIR)(CF)(RSC)

DWHA = Drinking Water Health Advisory

HQ= Hazard Quotient

RfDo= chronic oral reference dose

BWAIR= Body Weight adjusted Water Intake Rate

CF= Units Conversion Factor

RSC= Relative Source Contribution

https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_DW_PFAS_HealthAdvisory.pdf

Reduction Strategies

- Be wary of fabrics labeled stain or water-repellant.
- Minimize greasy fast foods, these foods often come in PFAS-treated containers.
- Avoid microwaveable popcorn, pop corn the old-fashioned way on the stovetop.
- Choose personal care products without “PTFE” or “fluoro” ingredients.
- Find products that haven’t been pre-treated and skip optional stain-repellant treatments on new carpets and furniture.
- Drinking water can be an additional source in a small percentage of communities.

Reduction Strategies

- The U.S. Department of Defense (DoD) and the Federal Aviation Administration (FAA) have not yet approved a suitable replacement among the available fluorine-free varieties. That is why airports, military bases and other highly combustible sites still integrate AFFFs into their safety protocols.
- The U.S. government has set a deadline of October 1, 2024 for the DoD to phase out all AFFF use at military facilities.
- The PFAS Action Act of 2021, a bill under consideration by the Congress, would designate PFAS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). If this bill becomes law, many sites where chemicals containing PFAS are used could be deemed CERCLA sites, legally obligating responsible parties or the EPA to pay for and conduct cleanup.

Water Treatment PFAS Reduction Options

- Low pressure reverse osmosis (LPRO) – effective option to remove a wide variety of PFAS compounds. Lowest cost of the three.
- Granular activated carbon – frequent change out of carbon is required for effective short chain removal.
- Ion exchange – frequent media change outs.
- Ozone with biologically active filtration and post-filter GAC. Highest cost.
- Post filter GAC with ion exchange and UV-AOP.
  - June 30, 2021 in Fountain Valley C.A. PFAS Treatment Plant started to treat up to 3,000 gallons of water per minute using an ion exchange treatment system made of highly porous resin that acts like powerful magnets that adsorb and hold onto contaminants.

PFAS Reduction Options, Nonstick Coatings

- Nonstick Coatings are either polytetrafluoroethylene (PTFE) or ceramic. Gen X is a tradename used to make PTFE nonstick coatings and is a direct replacement for PFOA.
- GenX shows kidney, blood, thyroid, and reproductive system damage.
- Nonstick coatings are on products such as: T-fal, Calphalon, Rachel Ray, Paula Deen, Emeril, All-Clad nonstick, Anolon, Farberware, Tramontina, ScanPan, ect. Anything with the words "diamond," "sapphire," "titanium," and "stone" in the name usually contains PTFE.

Monitoring and Regulations

- On October 18, 2021, EPA Administrator Michael Regan announced the agency's PFAS Strategic Roadmap. This law phases out the use of Aqueous Film Forming Foam (AFFF), subject to some limited exceptions, at all military sites by October 1, 2024.
- EPA expects in 2022 and ongoing to restrict PFAS discharges from industrial sources through a multi-faceted Effluent Limitations Guidance, and to leverage the National Pollutant Discharge Elimination System (NDPDES) to reduce PFAS discharges to waterways.
- In the Winter 2024, EPA expects the risk assessment for PFOA and PFOS in biosolids.


Crisco
Pure Vegetable Oil
DARING
FASCINATED
STIMULATED
AMUSED
PLAYFUL
OPTIMISTIC
SURPRISED
SUCCESSFUL
WORTHWHILE
VALUABLE
DISCERNING
CONFIDENT
RELAXED
PENSIVE
RESPONSIVE
EXCITED
SENSUOUS
ENERGETIC
CHEERFUL
CREATIVE
HOPEFUL
AWARE
PROUD
RESPECTED
APPRECIATED
IMPORTANT
FAITHFUL
CONTENT
THOUGHTFUL
INTIMATE
LOVING
TRUSTING
NURTURING
GUILTY
ASHAMED
EMBARRASSED
OVERWHELMED
ANXIOUS
INSECURE
SUBMISSIVE
HELPLESS
REJECTED
CONFUSED
CRITICAL
HATEFUL
SELFISH
ANGRY
HOSTILE
JEALOUS
IRRITATED
SKEPTICAL
BEWILDERED
DISCOURAGED
INSIGNIFICANT
INADEQUATE
SCARED
JOYFUL
POWERFUL
MAD
SLEEPY




Minimize health risk when cooking with Teflon or PTFE (non-stick)

- **Don’t preheat an empty pan.** Make sure you have some food or liquid in pots and pans before you preheat.
- **Avoid cooking on high heat.** Avoid broiling, since this cooking technique requires temperatures above those recommended for nonstick cookware.
- **Ventilate your kitchen.** When you’re cooking, turn on your exhaust fan or open up windows to help clear any fumes.
- **Use wooden, silicone, or plastic utensils.** Metal utensils can lead to scuffs and scratches on the nonstick surface, reducing the life of your cookware.
- **Hand wash.** Gently wash pots and pans with a sponge and soapy, warm water. Avoid using steel wool or scouring pads, since they can scratch the surface.
- **Replace old Teflon cookware.** When PTFE coatings start to visibly deteriorate with excessive scratches, peeling, flaking, and chipping, they are ready to be replaced.

PFAS Cookware High Heat Warning

- PTFE becomes unsafe and gives off toxic fumes around 464F - 492F. Manufacturers say to use medium heat <500F, and not use in an oven greater than 400F. An empty non-stick pan preheated over high heat reaches 507°F in 1 ¾ minutes. Cooking burgers for 8.5 minutes brings pan temperatures to 577°F. Cooking a steak on high resulted in a lightweight Teflon pan reaching 656 degrees Fahrenheit in 10 minutes.
- When PFAS begins to deteriorate, carcinogens and pollutants are emitted into the air. Household pet birds are known to die at low concentrations.
- When PTFE resins are subjected to high temperature, toxic pyrolytic products form. The toxicity of these decomposition products varies widely from the slightly toxic tetrafluoroethylene monomer to the highly toxic octafluoroisobutylene, hydrogen fluoride (HF) and carbonyl fluoride (COF2). Onset symptoms occurs about 4 to 8 hours after exposure to the pyrolysis products of PTFE,
- Polymer fume fever or fluoropolymer fever, also informally called Teflon flu, is an inhalation fever caused by the fumes released when polytetrafluoroethylene (PTFE, known under the trade name Teflon) reaches temperatures of 300 °C (572 °F). https://www.goodhousekeeping.com/cooking-tools/cookware-reviews/a17426/nonstick-cookware-safety-facts/

PFAS Cookware

- Although the health risks posed by ingesting particles of Teflon, such as might flake or scrape off a pan has yet to be determined, if your pan gets discolored, usually darkened, the PTFE has probably begun to degrade, which means it's time for a new pan.
- As of 2015, manufacturers stopped using PFOA in their nonstick cookware, and all PTFE cookware sold in the US today are PFOA-free.
- Consider avoiding any kitchen equipment that contains PTFE or other non-stick components that will be heated to high temperature during use. PTFE cookware does not hold up as well as non-toxic cookware for durability and the ability to handle high heat.

Safe Alternative to PFAS Free Cookware

- Stainless steel, Cast iron, Solid Ceramic, Porcelain Enamel, Glass, Carbon Steel, Ceramic coated - ensure it does not contain lead or cadmium.
- Stainless steel. Stainless steel is excellent for sautéing and browning food. It is durable and scratch-resistant. It’s also dishwasher safe, making it easy to clean.
- Cast-iron cookware. When it’s seasoned properly, cast iron is naturally nonstick. It also lasts a long time and can withstand temperatures well above those considered safe for nonstick pots and pans.
- Stoneware. Stoneware has been used for thousands of years. It heats evenly and is nonstick when seasoned. It is also scratch-resistant and can be heated to very high temperatures.
- Ceramic cookware. Ceramic cookware is a relatively new product. It has excellent nonstick properties, but the coating can be easily scratched.
- Silicone cookware. Silicone is a synthetic rubber that is mainly used in bakeware and kitchen utensils. It does not stand up well to direct heat, so it’s best suited for baking.

Summary

- The EPA and states will be adopting regulations and limits on PFAS compounds. The early PFAS requirements are complex and will be incomplete. The immediate concern will be the C8 fluorosurfactants, where limits will be adopted for PFOS and PFOA. This will be followed by limits on other fluorosurfactants as more toxicity data is collected.
- The Air Force began replacing both PFOS-based and other legacy AFFF products with a new formula in August 2016. The new formula is a mixture of short chain (C6) fluorosurfactants. There has been an industry rush to replace PFOA/C8 with the remarkably similar PFHxA/C6. There is a lack of information about the potential health effects of the C6 fluorosurfactants.

Summary

- The PFAS fluorosurfactants identified at the Bismarck Airport at are a mixture of the C6 fluorosurfactants and other fluorosurfactants. There is a potential risk that when elevated amounts of C6 fluorosurfactants or other fires suppression retardants to cause interference, pass through toxicity or bioaccumulation in biosolids if discharged.
- We currently have no authority to prevent elevated discharges of AFFF
- The chemical industry is trying to replace one toxic chemical with another toxic chemical and calling it green chemistry.
- PFAS is contained in many consumer products. There are potential health concerns with human absorption of PFAS from these products.

Reference Links

- www.awwa.org/PFAS
- https://erefdn.org/per-and-polyfluoroalkyl-substances-pfas-list-of-scientific-and-technical-studies-related-to-solid-waste/
- https://dec.vermont.gov/press-release/department-environmental-conservation-releases-reports-pfas-chemicals
- https://www.sciencedaily.com/releases/2021/05/210526115551.htm
- https://www.theguardian.com/environment/2021/may/28/home-fertilizer-toxic-pfas-forever-chemicals-sewage-sludge
- https://dec.vermont.gov/water/drinking-water/water-quality-monitoring/pfas