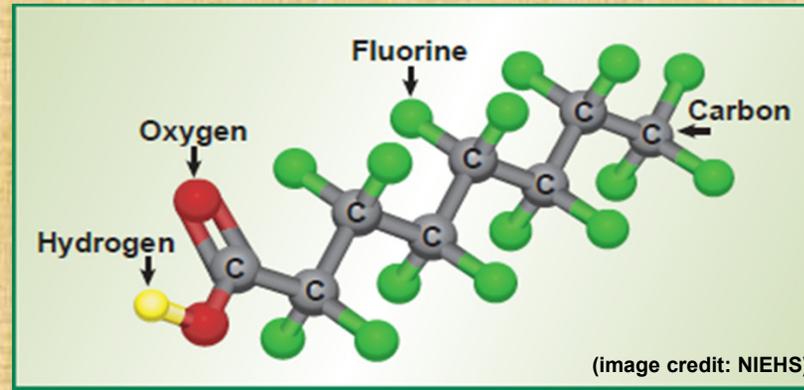


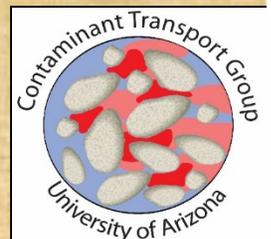
Per- and Poly-fluoroalkyl substances (PFAS) in the Environment



Southeast Arizona Citizens Forum
U.S. Section of the International Boundary and Water Commission

Mark Brusseau

September 12, 2019

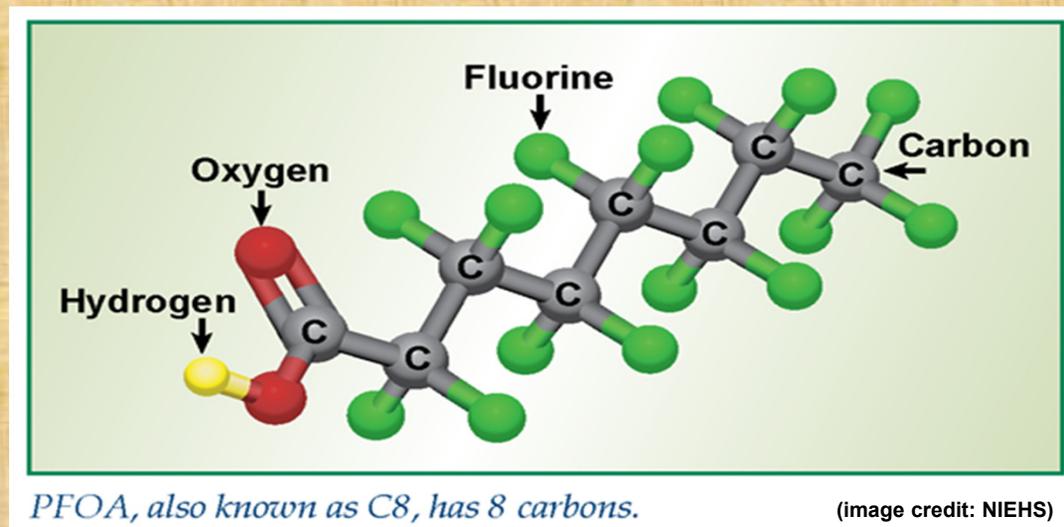


Terminology

- Originally referred to as PFCs --- Perfluorinated chemicals
 - Confusion with perfluorocarbons (refrigerants)
- EPA standardizing terminology
 - Per- and poly-fluorinated compounds (PFAS) or (PFASs)

PFAS Compounds

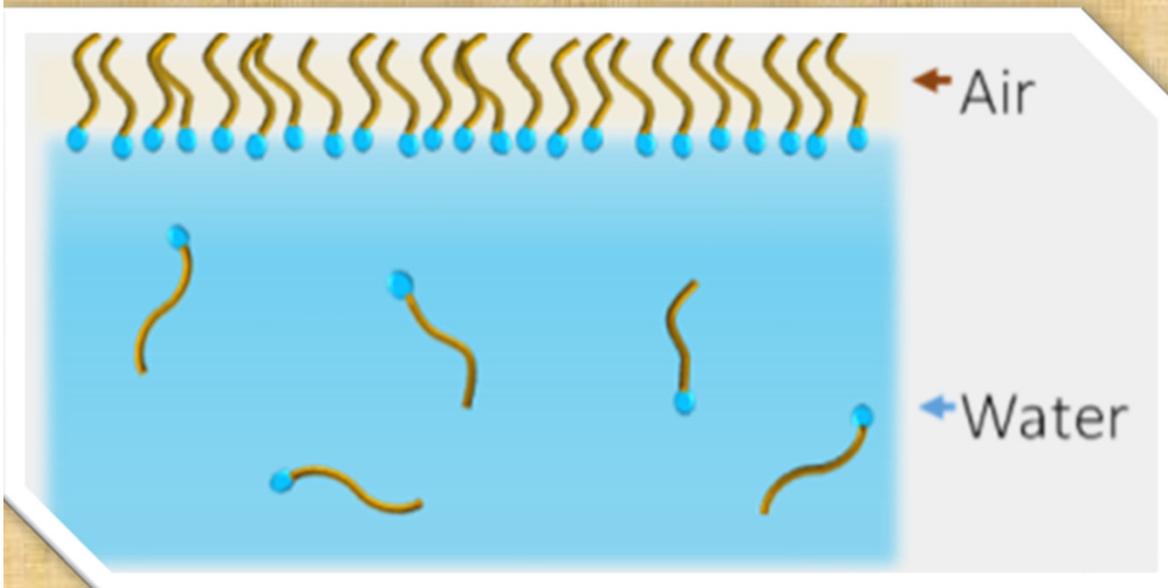
PFAS Molecule (example):



>>> There are several special attributes that make PFAS unique contaminants

Surfactants

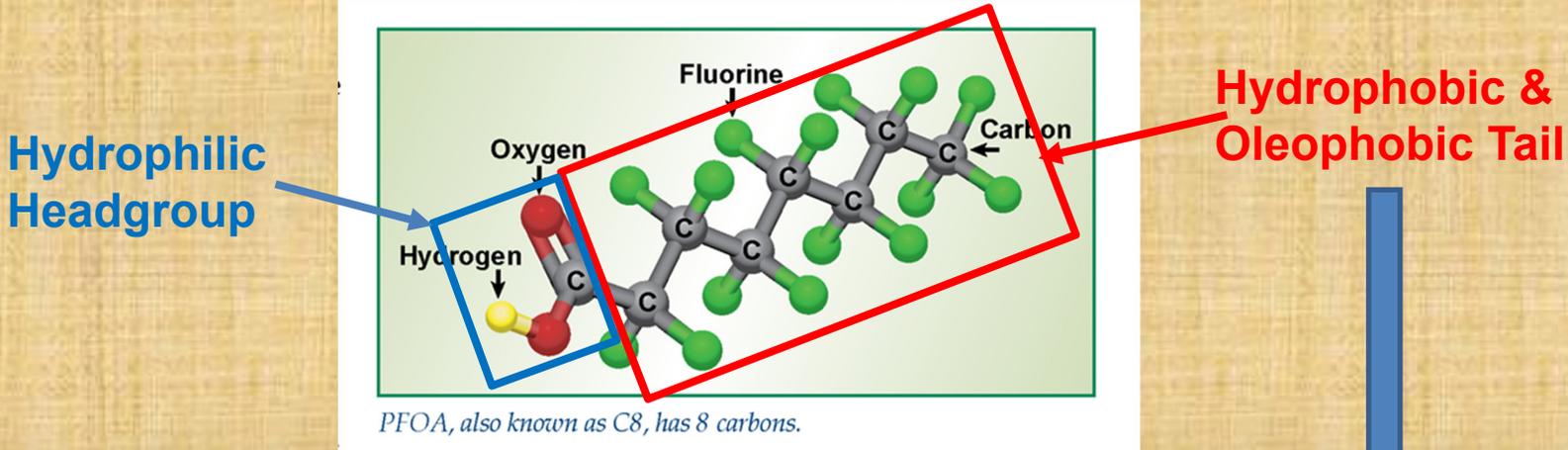
- Surfactant = Surface Active Agent
- Common surfactants – soaps and detergents



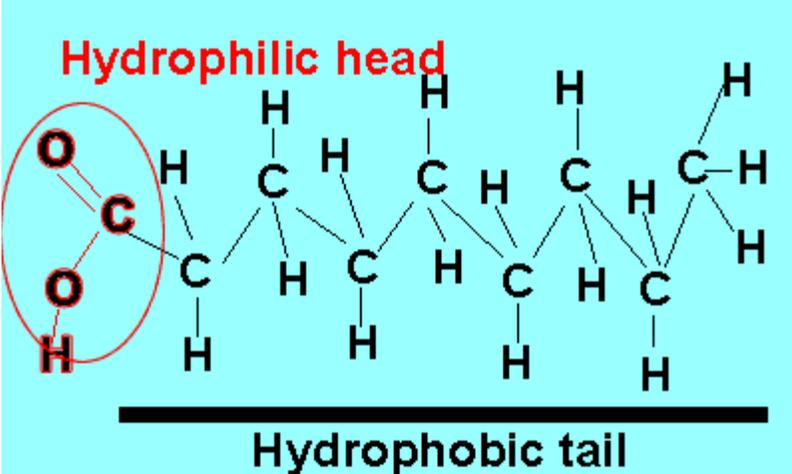
**Create air bubbles
and foam**

PFAS Properties

- Many PFAS are surfactants



*Provides water and oil repellency



← Standard Surfactant

Image from:
<http://www.dynamicscience.com.au/tester/solutions1/chemistry/foodchemistry/emulsions.htm>

Many PFAS Compounds



Organisation for Economic Co-operation and Development

May 2018

TOWARD A NEW COMPREHENSIVE GLOBAL DATABASE OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs):

SUMMARY REPORT ON UPDATING THE OECD 2007 LIST OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs)

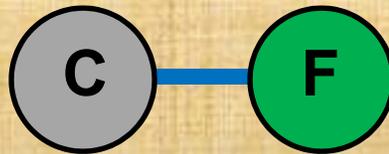
“In total, 4730 PFAS-related CAS numbers have been identified and manually categorised in this study”

CAS = Chemical Abstracts Service

PFAS are Persistent

- Carbon-fluorine bonds are very strong
- Therefore they are very resistant to transformation reactions

→ **difficult to break down**



They are labeled **persistent organic pollutants**

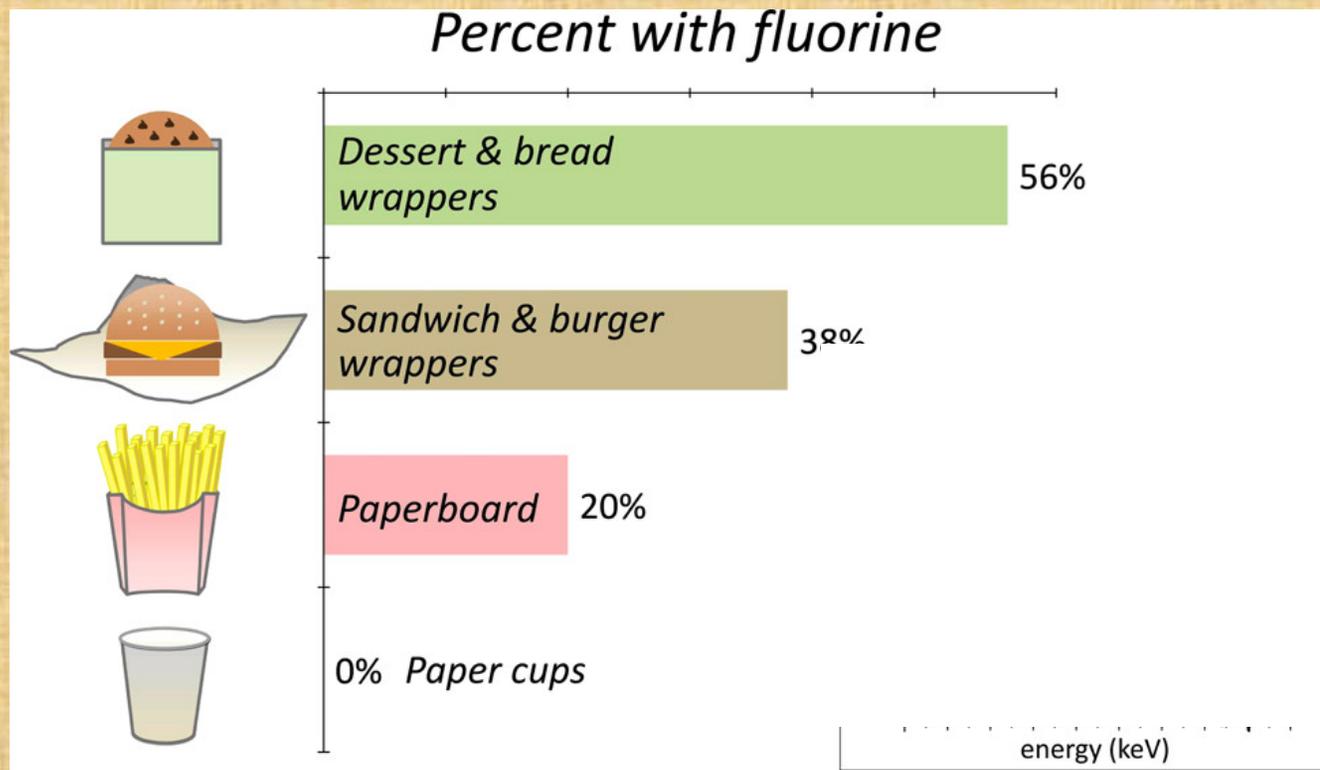
Uses- Coatings & Textiles

- Non-stick and stain-, grease-, and water-resistant properties



Uses- Food Packaging

Fluorinated Compounds in U.S. Fast Food Packaging



From: Schaider et al., 2017

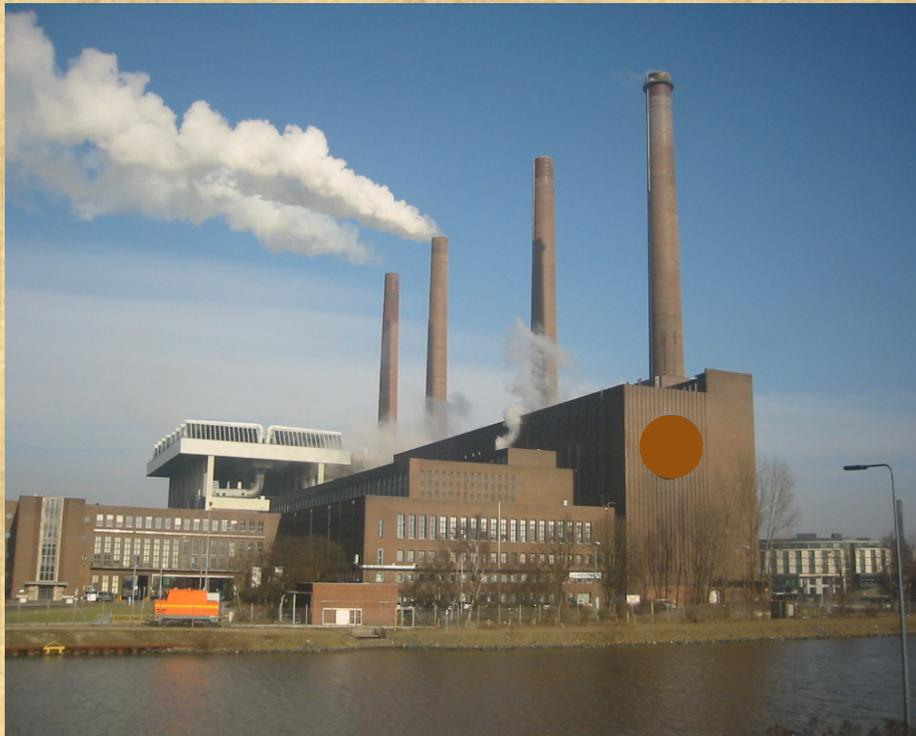
Uses- Fire Fighting Foam

- AFFF- aqueous film forming foam
 - for Class B: flammable liquids (hydrocarbons)
- Airports
- Military Bases



Sources to the Environment

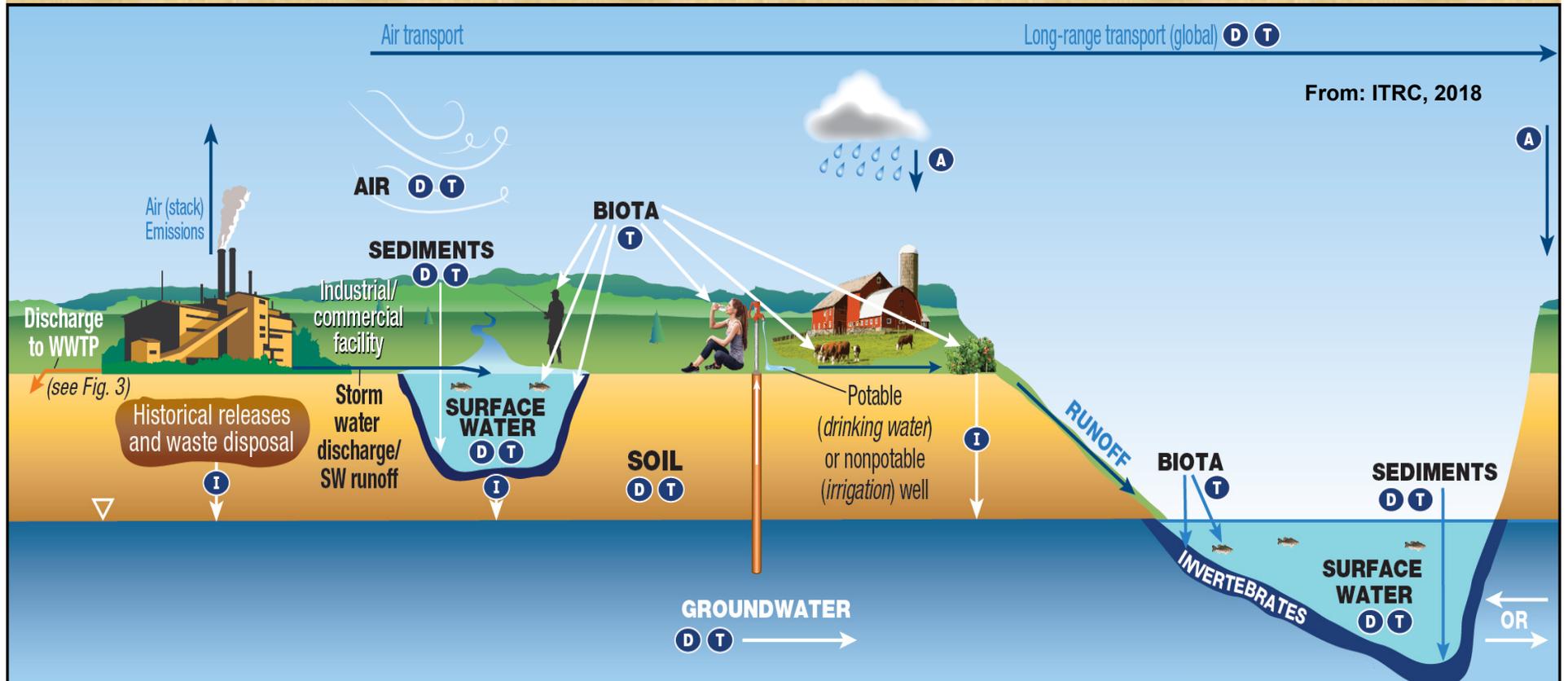
- Manufacturing & Industrial facilities
 - PFAS production
 - Metal plating
 - Treated textile and other product manufacturing



Transport in the Environment

>>> Release to:

- atmosphere
- surface water
- soil
- groundwater



KEY **A** Atmospheric Deposition **D** Diffusion/Dispersion/Advection **I** Infiltration **T** Transformation of precursors (abiotic/biotic)

Sources to the Environment

- Point of use Sites
 - Fire-training facilities
 - Crash sites

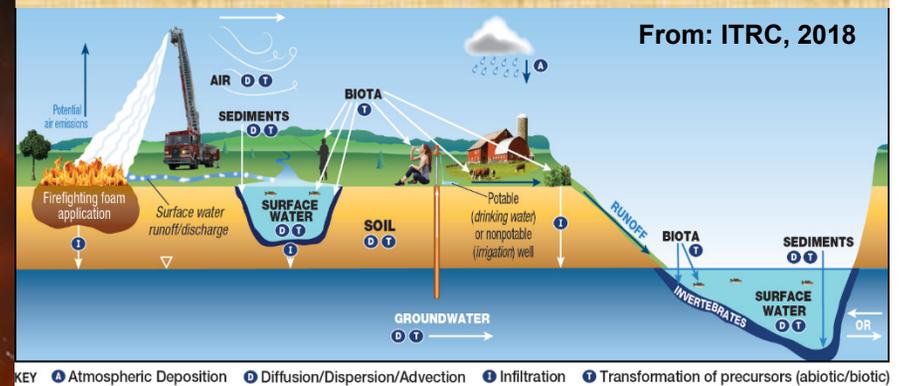
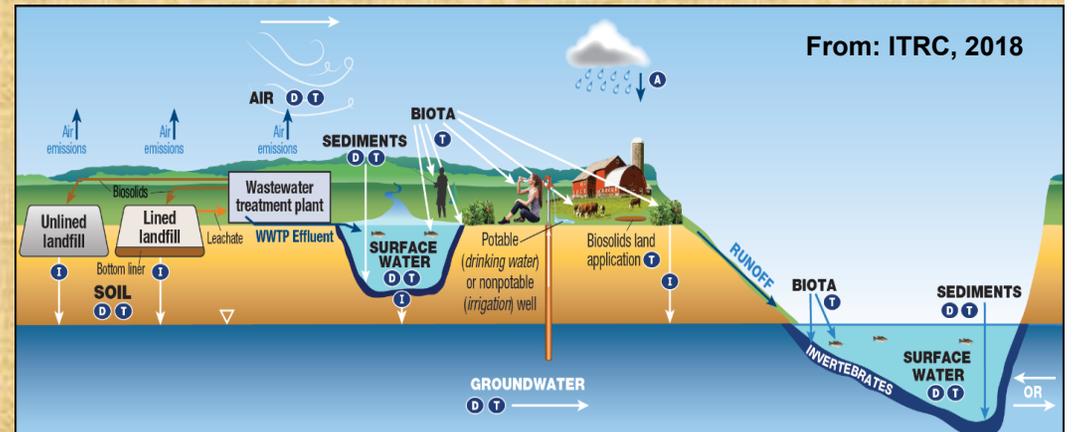


Figure 1. Conceptual site model for fire training areas.

Sources to the Environment

- Treatment & Disposal Sites

Landfills



KEY A Atmospheric Deposition D Diffusion/Dispersion/Advection I Infiltration T Transformation of precursors (abiotic/biotic)

Figure 3. Conceptual site model for landfills and WWTPs.

Wastewater treatment plants



Biosolids application sites

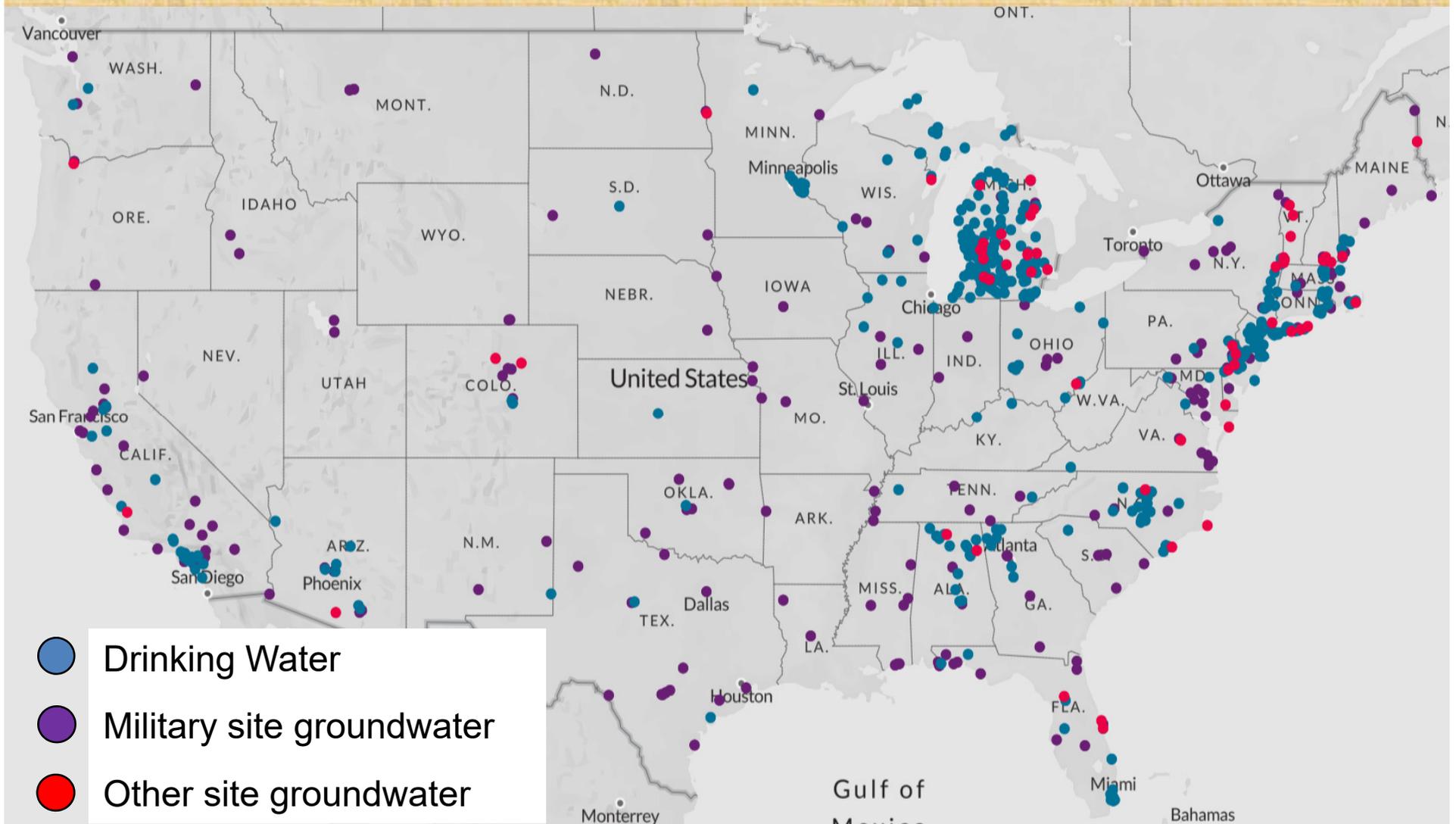


Occurrence

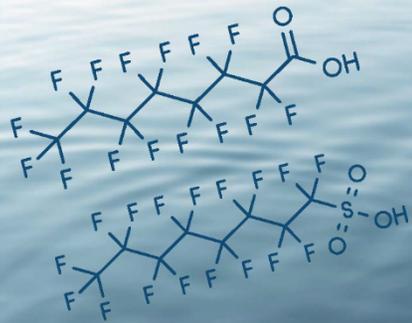
- Military installations
- Airports
- Industrial and manufacturing plants
- Landfills
- Biosolids application sites
- Wastewater treatment plants and application sites

Distribution: EWG Study- 2019

Source: Environmental Working Group & SSEHRI-Northeastern University
<https://www.ewg.org/research/update-mapping-expanding-pfas-crisis>



ADEQ PFAS Study 2018



Purpose: screen Public Water System (PWS) drinking water wells in Arizona for PFOA and PFOS

Focus: PWSs near facilities that currently or historically may have used PFOA/PFOS, including industrial, firefighting, manufacturing, airports, and military sites

Sampling: 109 samples collected from 68 PWSs

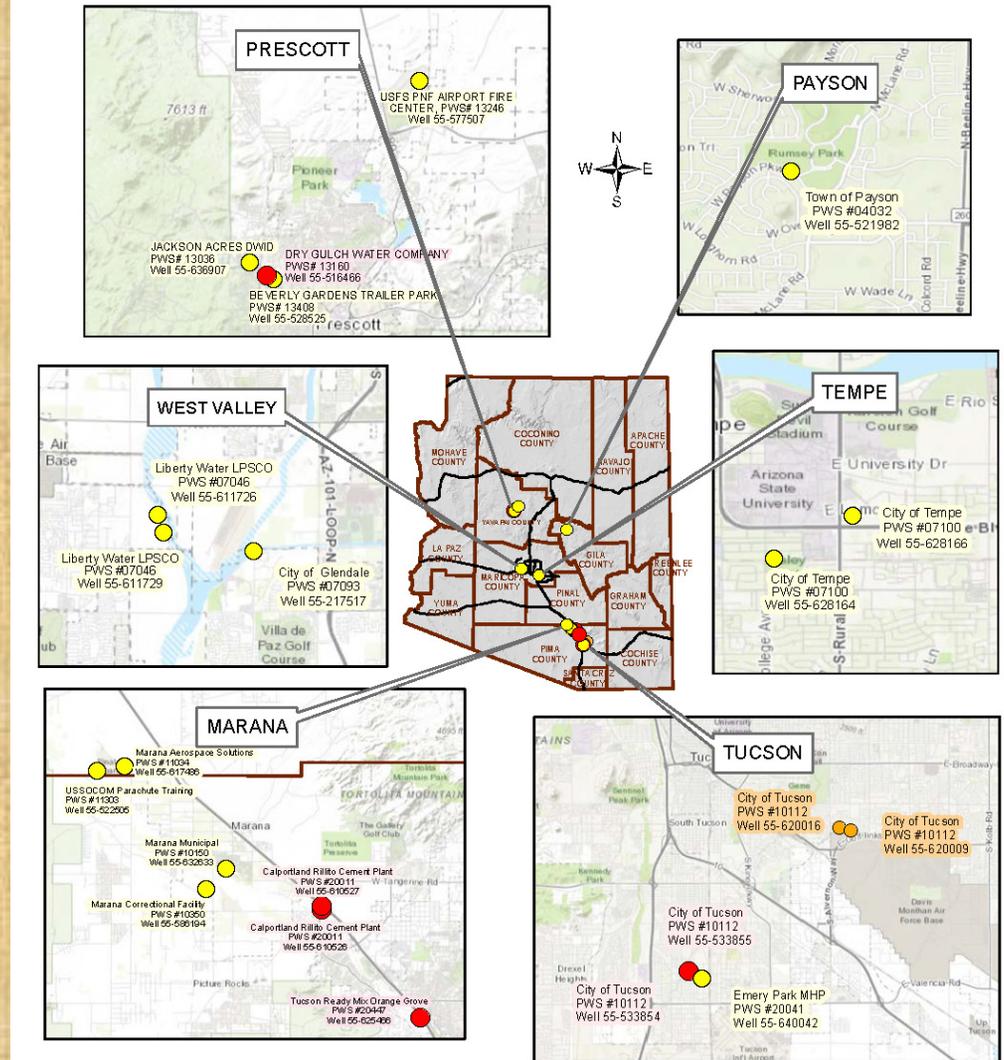
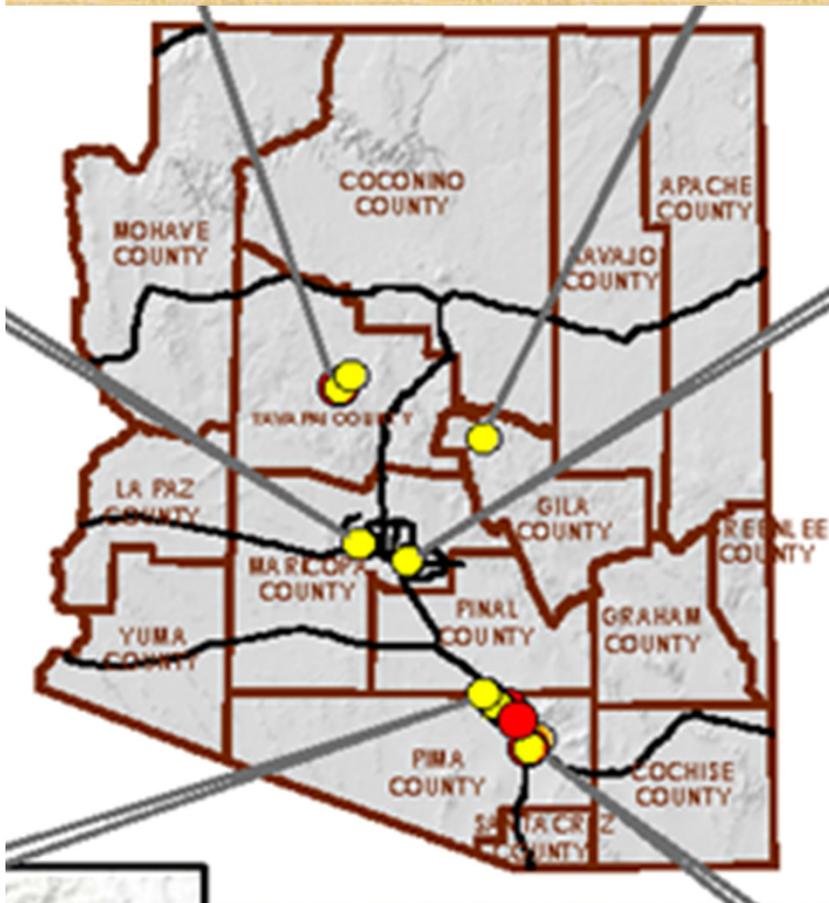


Arizona's Public Water System Screening for Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS) Final Report

NOVEMBER 2018



ADEQ PFAS Study 2018

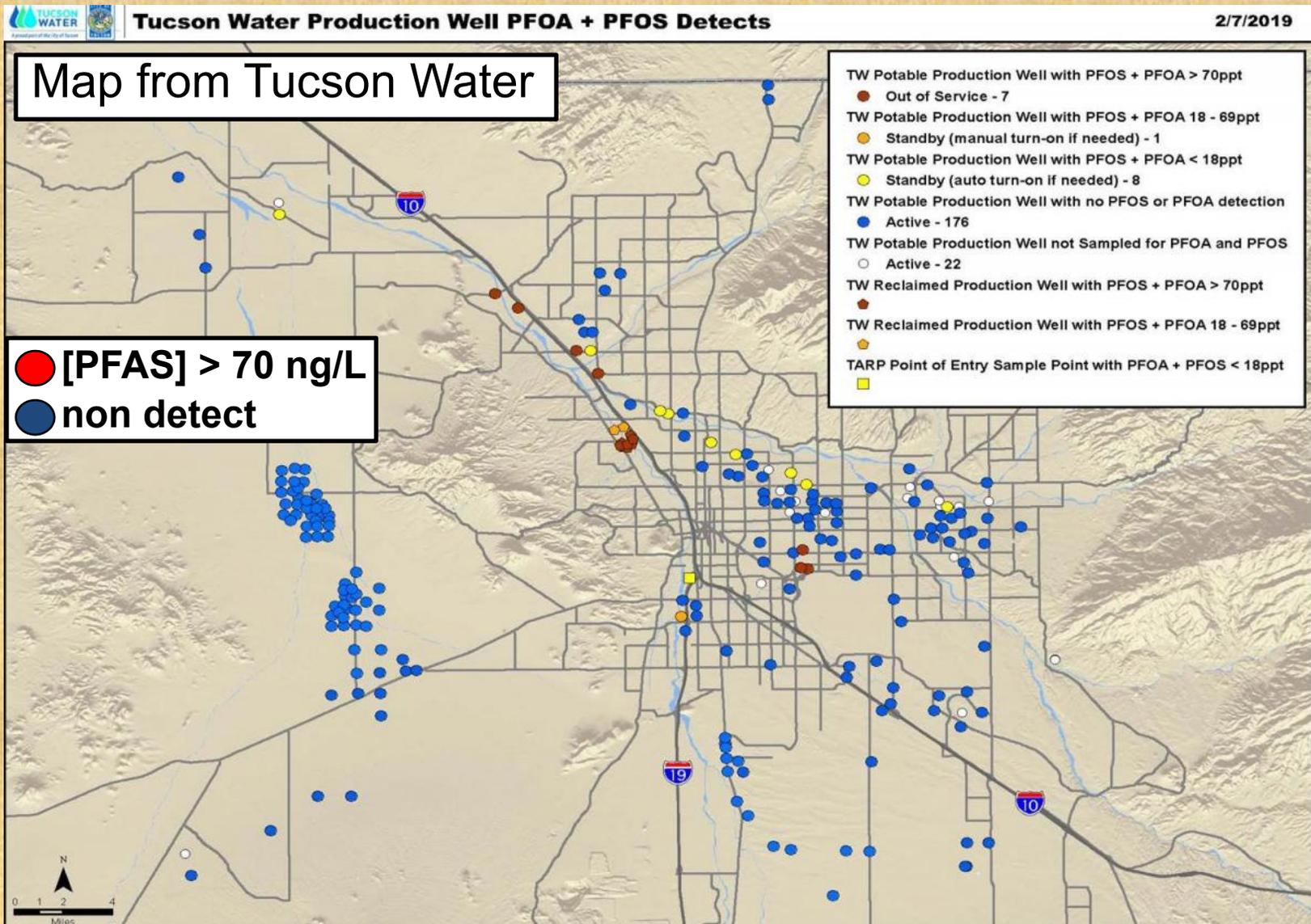


- Above Health Advisory
- Sampled, Below Health Advisory
- Outside Project Scope, Above HA

This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

PFOA & PFOS in Tucson GW

<https://www.tucsonaz.gov/water/pfas>



Health Effects

- **From ATSDR website:**

Some, but not all studies, in humans with PFAS exposure have shown that certain PFAS may:

- affect growth, learning, and behavior of infants and children
- lower a woman's chance of getting pregnant
- interfere with the body's natural hormones
- increase cholesterol levels
- affect the immune system
- increase the risk of cancer

- EPA and NIEHS— ongoing toxicological research

Regulations

- PFAS are not regulated under the Safe Drinking Water Act
 - No national primary drinking water regulations (MCLs)
- PFOS & PFOA listed in the EPA **Contaminant Candidate List 3** - 2009 {emerging contaminants}
- EPA issued lifetime health advisories (LHAs) for long-term exposures to PFOA and PFOS through drinking water (2016)

→ → **70 ng/L (combined) → parts per trillion**

Comparisons

Exposure via drinking water

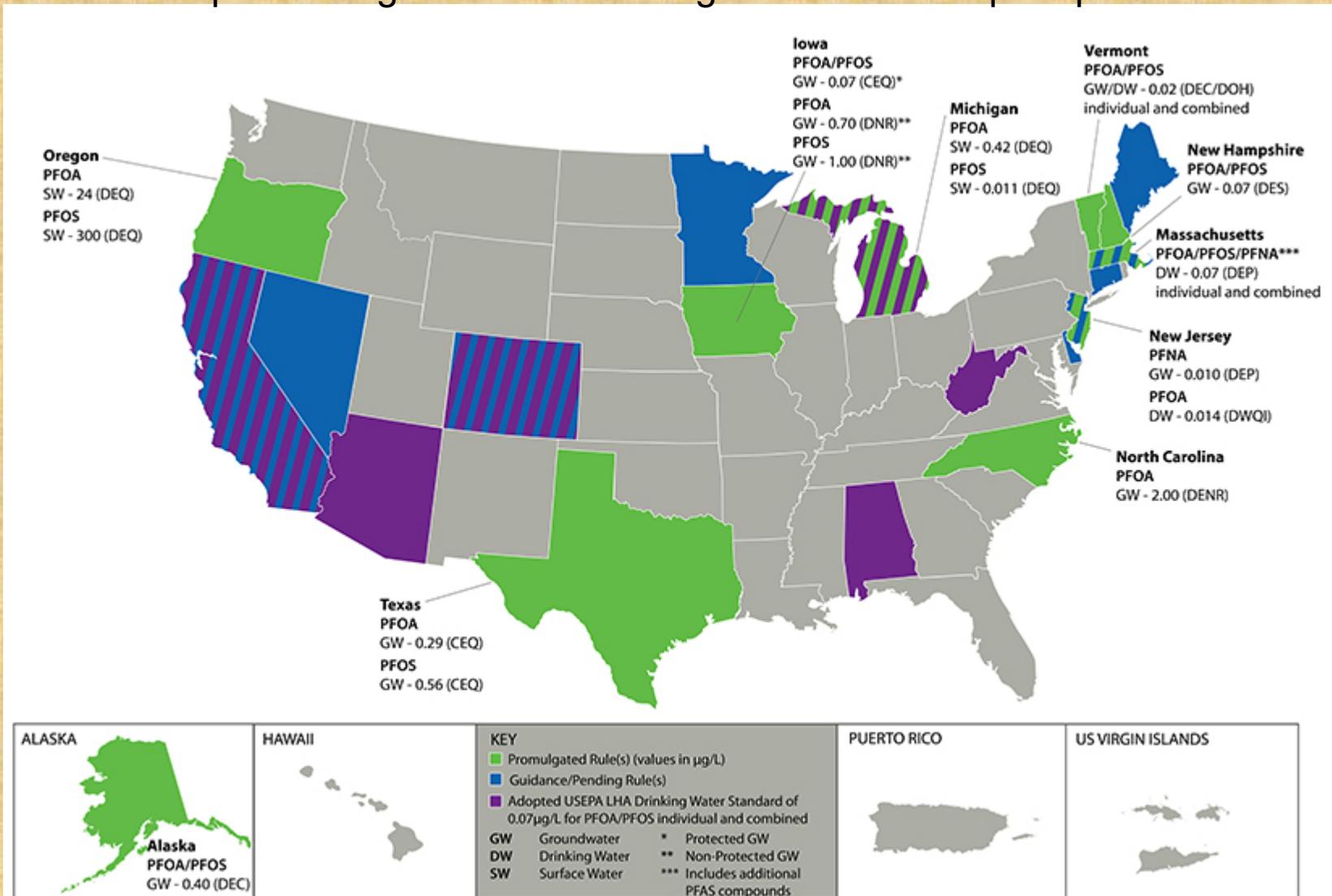
| Constituent | Reference Concentration ug/L (ppb) | Classification |
|-----------------|------------------------------------|----------------------------|
| PFOS/PFOA | 0.07 | Lifetime Health Advisory** |
| Arsenic | 10 | MCL |
| Benzene | 5 | MCL |
| Trichloroethene | 5 | MCL |
| 1,4-Dioxane | 200 | Lifetime Health Advisory** |

**non-enforceable, non-regulatory

MCL = maximum contaminant level--- enforceable standard

State-level Regulatory Activity

From: GES – Groundwater & Environmental Services, Inc
<https://www.gesonline.com/insights/2018-01-12/pfas-primer>

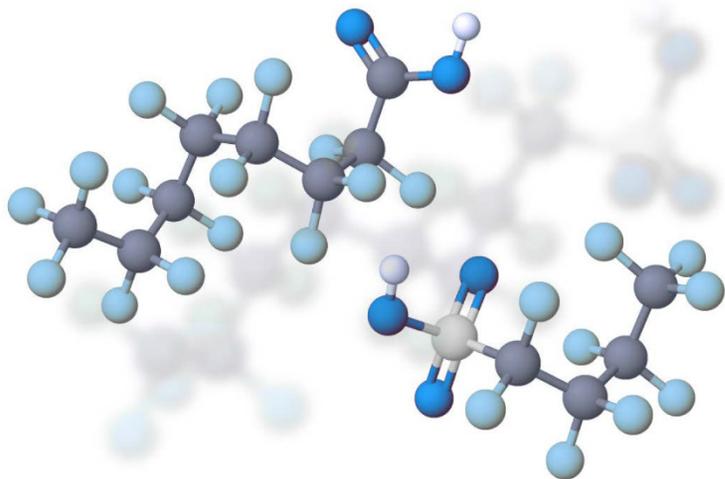


EPA Action Plan- 2019



EPA 823R18004 | February 2019 | www.epa.gov/pfas

EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan



U.S. Environmental Protection Agency

Plan Includes:

- Evaluate the need for a maximum contaminant level (MCL) for PFOA and PFOS
- Beginning the necessary steps to propose designating PFOA and PFOS as “hazardous substances”
- Developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites

<https://www.epa.gov/pfas/epas-pfas-action-plan>

Water Treatment

PFAS can be removed from drinking water using GAC or ion-exchange resins

Granular Activated Carbon (GAC)



Resin



<https://www.integral-corp.com/project/drinking-water-supply-new-jersey/>

Summary

- There are 1000's of PFAS
- PFAS have many uses and sources
- Widespread in the environment
- Persistent in the environment
- Toxicological effects are under investigation
- Can be removed from drinking water

Resources

Websites and Documents:

- EPA: <https://www.epa.gov/pfas>
- EPA: 2018 Edition of the Drinking Water Standards and Health Advisories Tables. <https://www.epa.gov/sites/production/files/2018-03/documents/dwtable2018.pdf>
- ITRC: <https://www.itrcweb.org/Team/Public?teamID=78>
- ATSDR: <https://www.atsdr.cdc.gov/pfas/>
- NIEHS: <https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm>
- ADEQ: PFAS Study.
http://static.azdeq.gov/wqd/reports/pfoapfosepareport_final.pdf
- Documentary Film: <https://thedevilweknow.com/>

Thank You

- Supported by the NIEHS Superfund Research Program