TETRA TECH

West Plains Area and PFAS

A General Overview

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Tetra Tech

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What are PFAS?

- Per- and polyfluoroalkyl substances
- 5,000 – 12,000 chemical substances (no universally agreed upon definition for PFAS)
- Tendency to bioaccumulate; are persistent in the environment (“forever chemicals”)
- Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic (PFOS) acid – most commonly studied/found
- Widely used due to their unique chemical and physical properties
- The following are considered ‘PFAS’ in this presentation: PFOA, PFOS, Perfluorobutanesulfonic acid (PFBS), Perfluorononaoic acid (PFNA), Perfluorohexanesulfonoic acid (PFHxS), Perfluoroheptanoic acid (PFHpA)

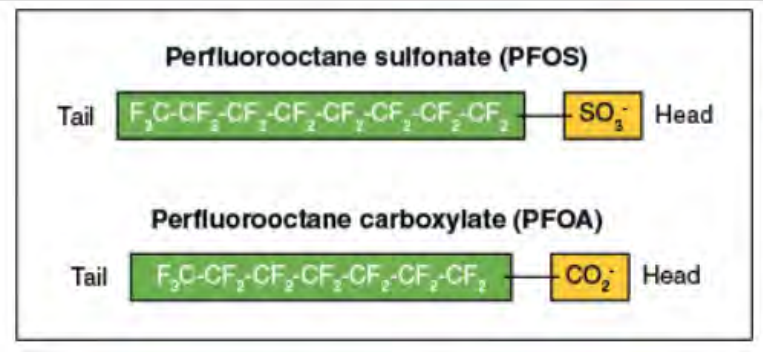


Figure Source: ITRC, 2022

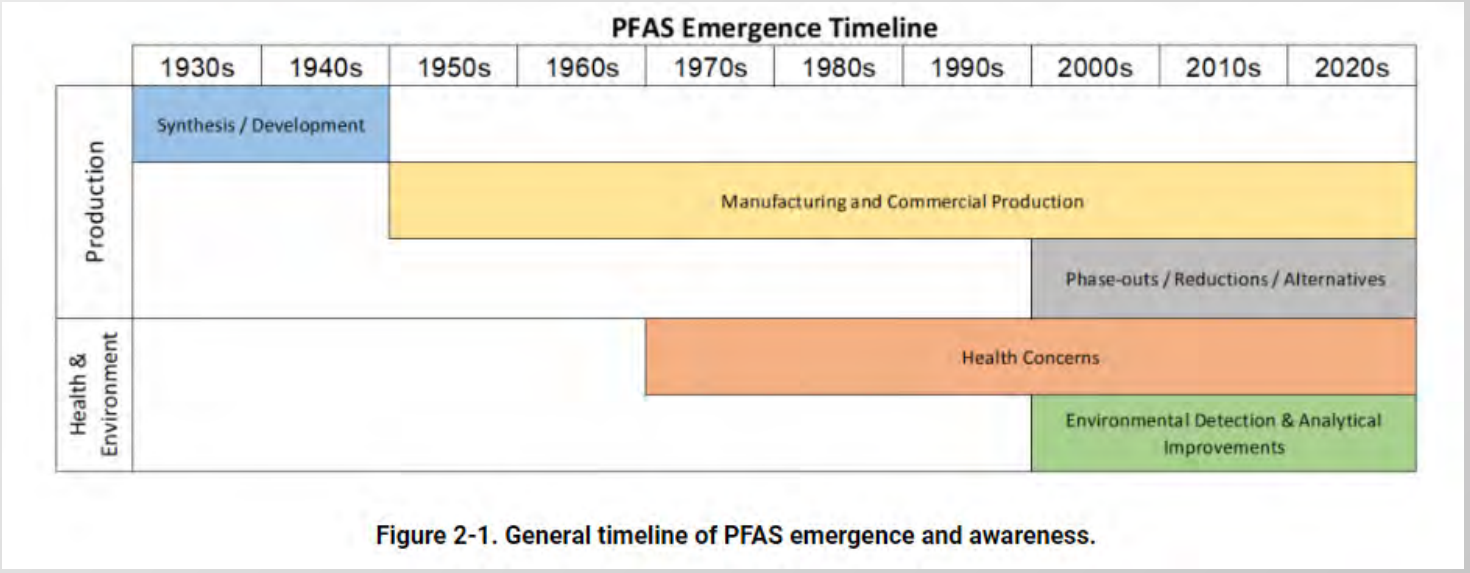
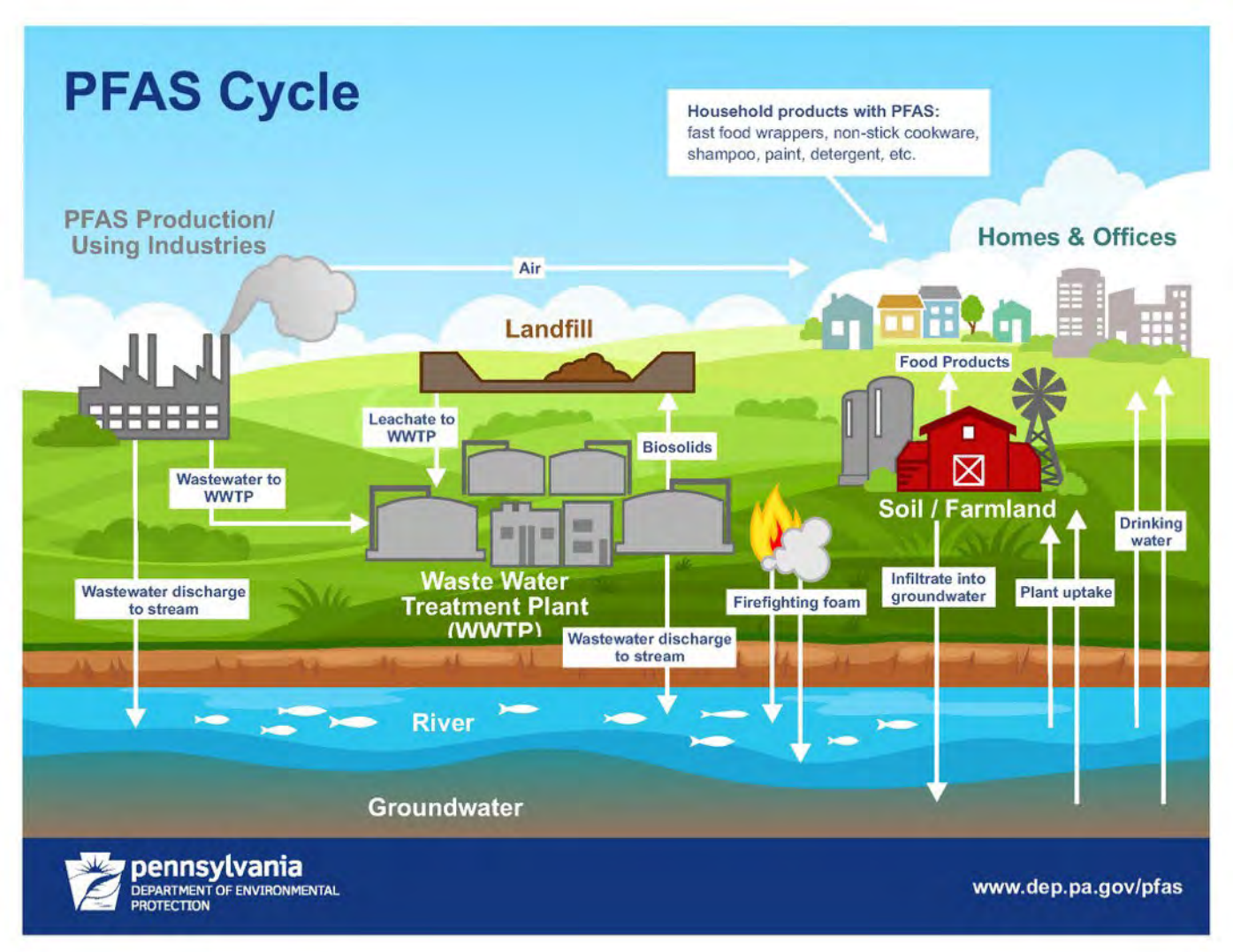


Figure 2-1. General timeline of PFAS emergence and awareness.

Figure source: ITRC, 2022

PFAS – Where Do We Find It?

- Wastewater treatment plants
- Waste disposal facilities
- Airports
- Bulk fuel terminals & refineries
- Paper mills
- Carpet manufacturing
- Textile and leather processors
- Metal plating facilities
- Industrial surfactants
- Military facilities
- Class B fluorine-containing aqueous film-forming foams (AFFF)
- Personal care products (e.g., cosmetics, shampoos, lotions)
- Sunscreen and insect repellants
- Food packaging
- Car washes
- Wet laundry
- Medical products (e.g., contact lenses, body implants)



West Plains Area – PFAS Identification and Studies

- May 2017 – PFAS identified in drinking water for the city of Airway Heights due to historical use of aqueous film-forming foam (AFFF) at Fairchild Airforce Base (FAFB)
- PFAS found at FAFB and multiple isolated hot spots including County Fire Districts, an elementary school, and rural housing
- Multiple aquifers affected
- On-base PFAS concentrations: 12,000 to 187,000 parts per trillion (ppt)
- Off-base: non-detect (ND) to 5,700 ppt

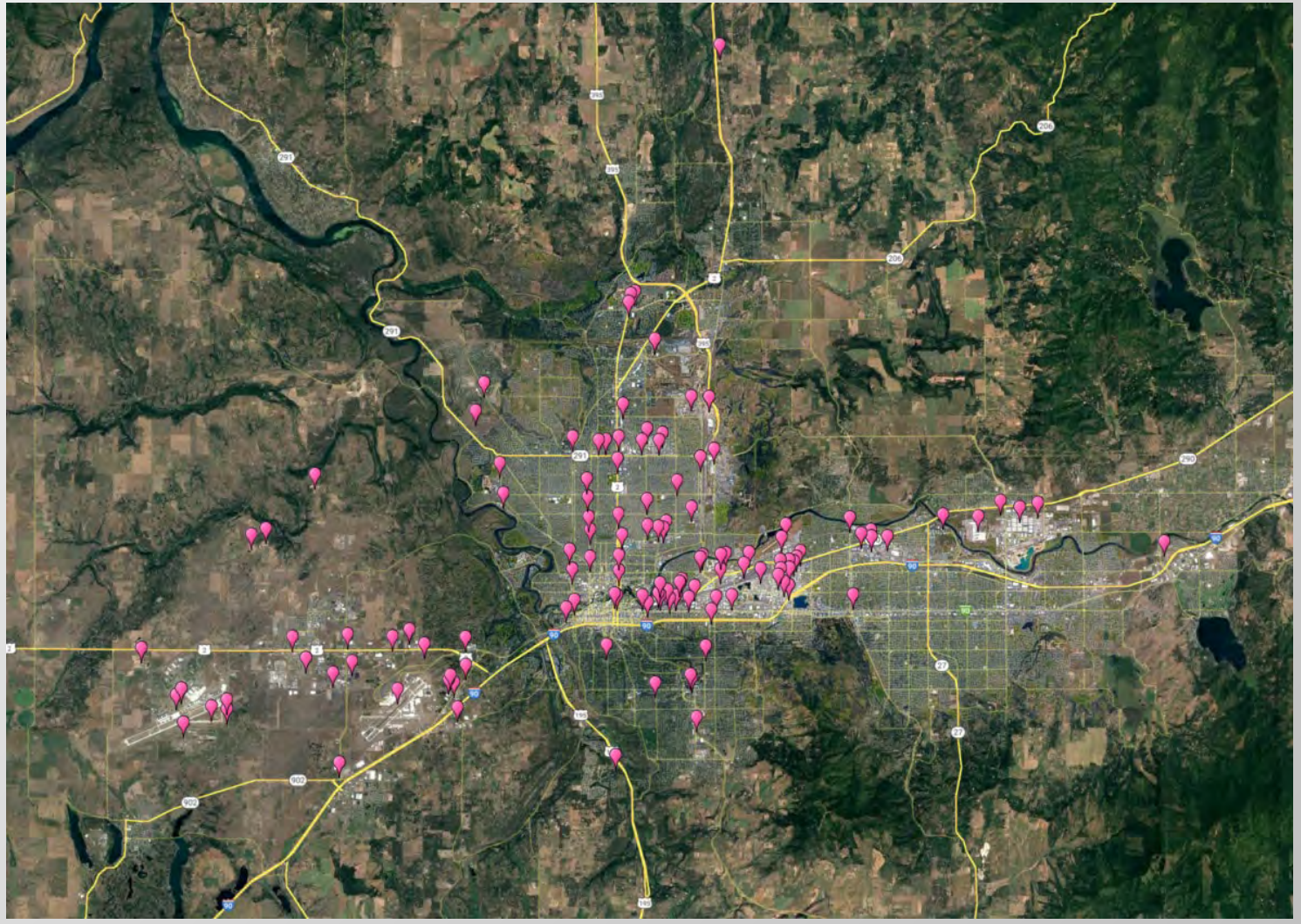
Table 1 - PFAS Sampling Results Outside of FAFB Study Area

	WADOH State Action Levels (ng/L)	Palisades Residence (ng/L)	Great Northern Elementary School (ng/L)	Fire District 10 Station 5 (ng/L)
Perfluorobutanesulfonic acid - PFBS	345			86.3
Perfluoroheptanoic acid - PFHpA	--			336
Perfluorohexanesulfonic acid - PFHxS	65	6.4	74	638
Perfluorononanoic aid - PFNA	9			1,010
Perfluorooctanesulfonic acid - PFOS	15		115	1,930
Perfluorooctanoic acid - PFOA	10	9.6	12.6	360

Potential Sources of PFAS – West Plains And Beyond

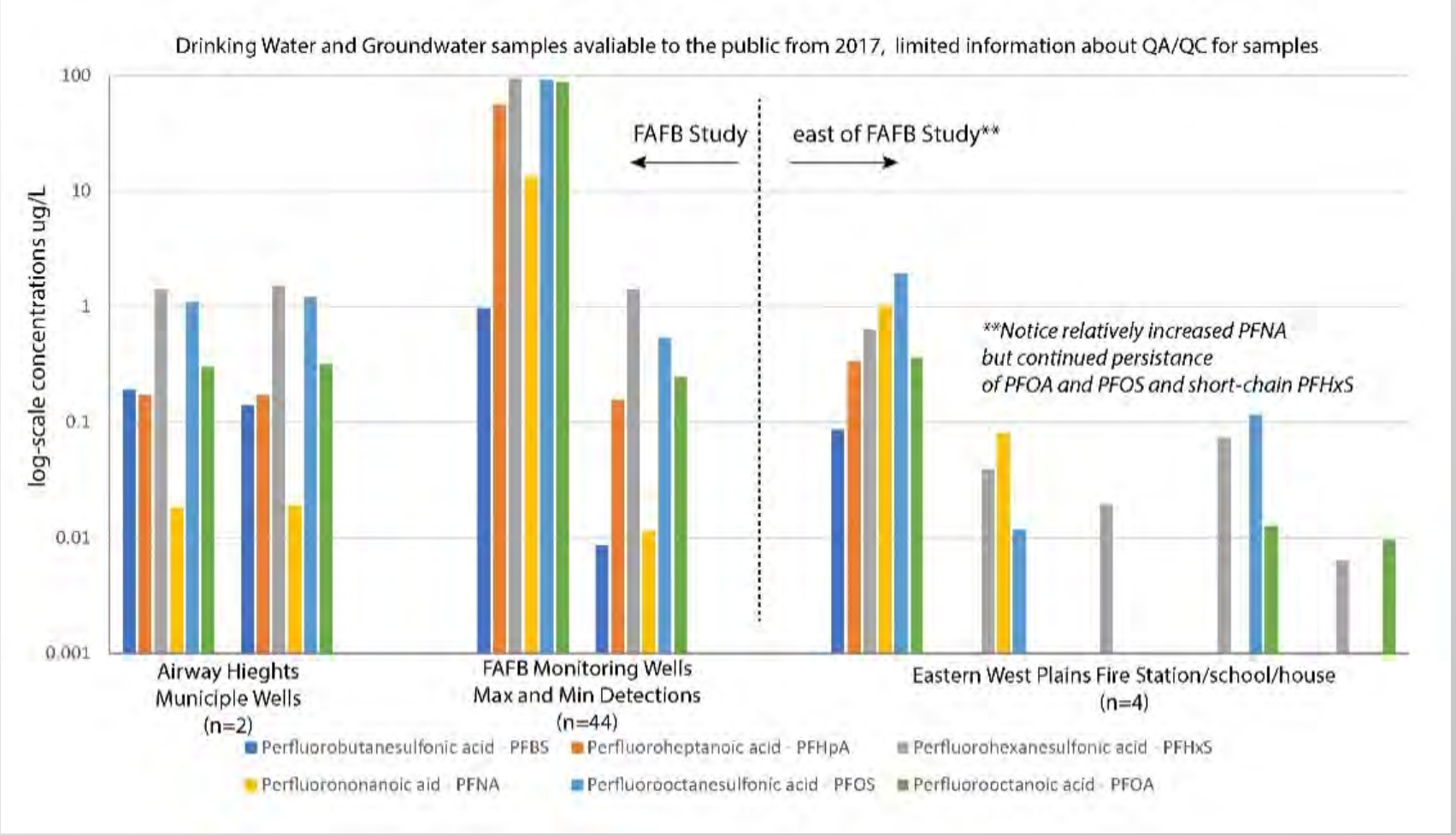
Includes the following potential sources (non-comprehensive):

- Landfills
- Airports
- Military Facilities
- Industrial and Commercial Facilities (that may have used/produced/stored PFAS-containing products)
- Refineries and Bulk Fuel Terminals
- Sewage Treatment and Water Reclamation Facilities
- Fire Department Training Areas and Fire Stations
- Car Washes



West Plains Area – PFAS Identification and Studies

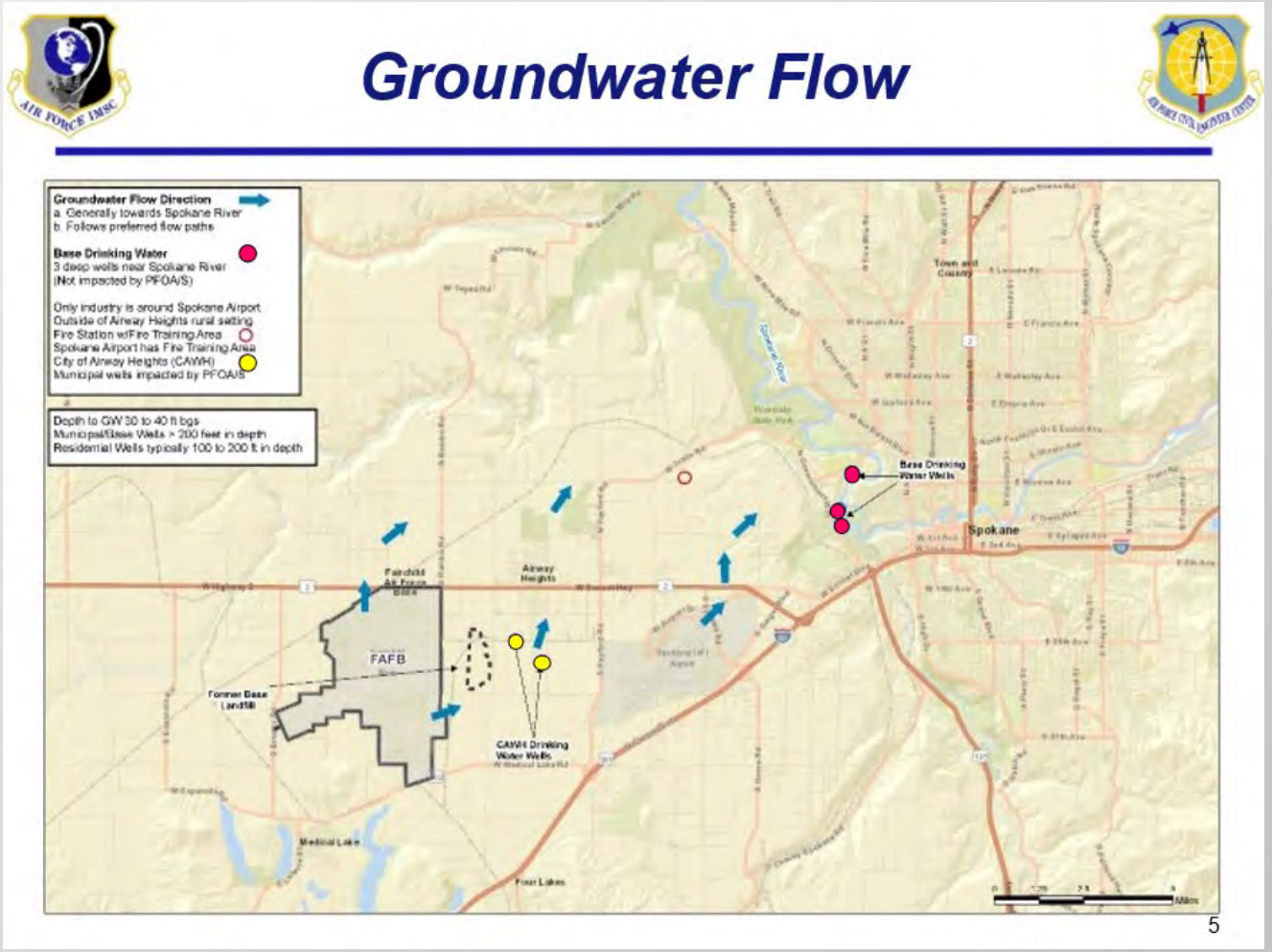
- Different PFAS ‘signatures’ observed in collected data.
- Data in parts per billion (ppb), i.e., 3 orders of magnitude higher than ppt
- Data suggests multiple different sources of PFAS impacts, or environmental factors have degraded certain PFAS



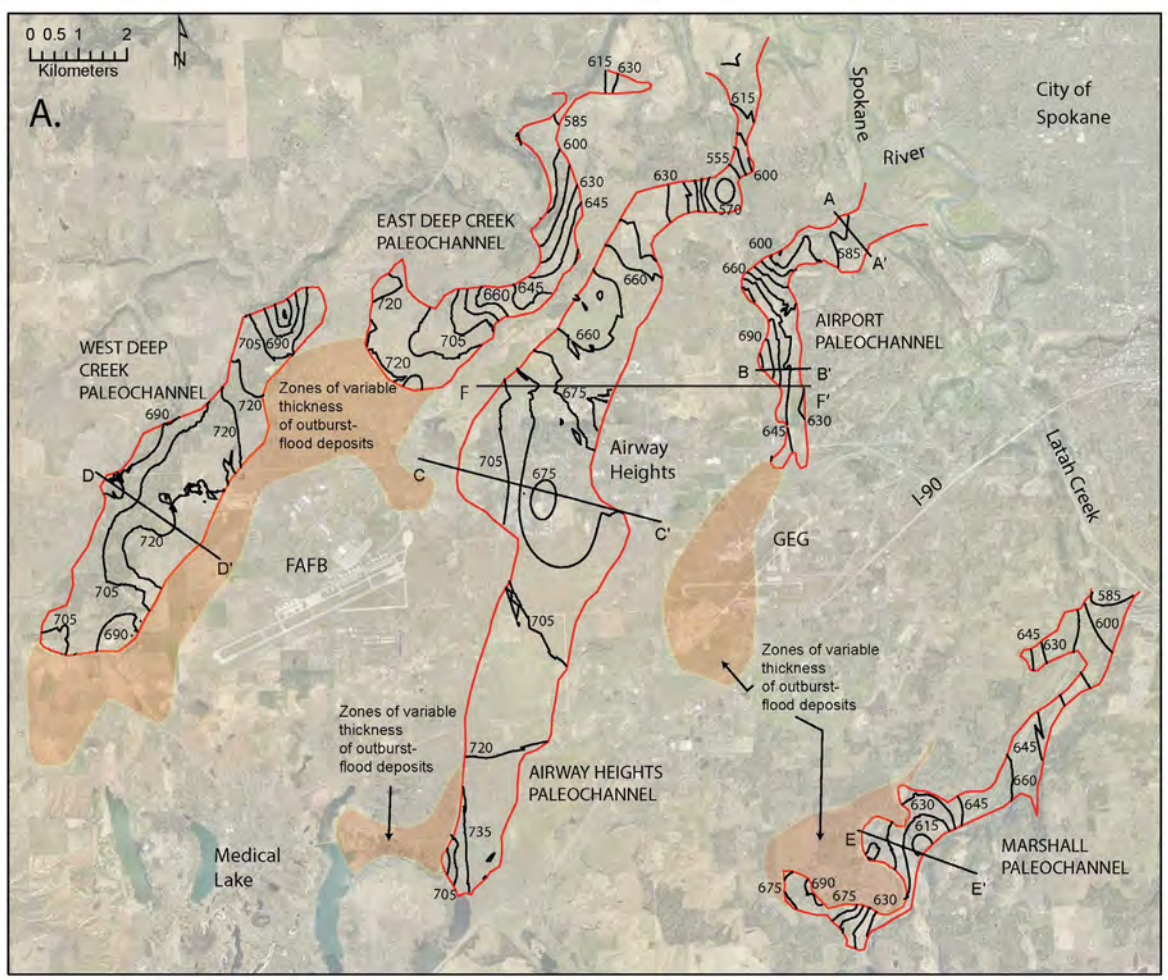
Toulou and Pritchard, 2023

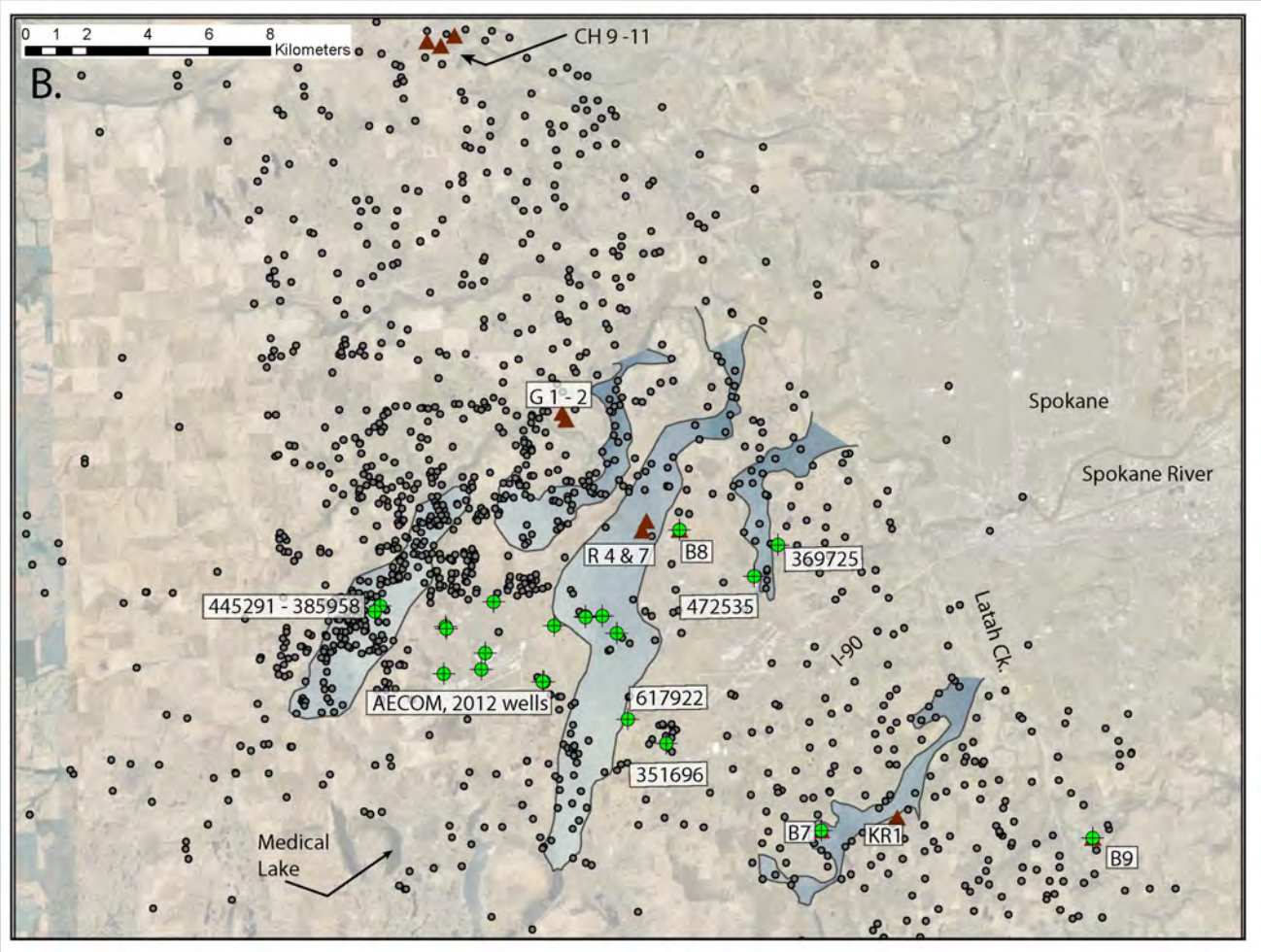
Fairchild AFB – At A Glance

- Sampled 422 private drinking water wells
- Detected PFAS in 106 private wells above the former EPA health advisory level of 70 ppt
- Detected PFAS in 2 of 4 municipal wells above the former EPA health advisory level of 70 ppt
- Has ~90 residential filtration systems in place
- Has 7 residences connected to the municipal water supply
- Has ~20 homes receiving bottled water
- Has 10+ homes in the pre-design stage for filtration
- Nearly 100 homes being monitored for PFAS presence below the former EPA health advisory level of 70 ppt



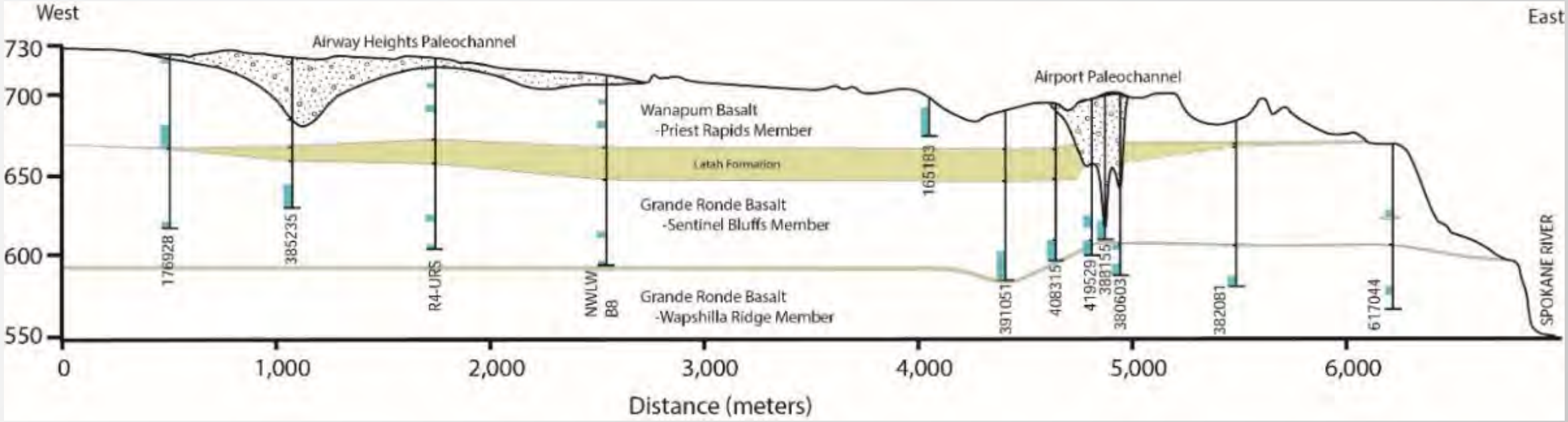
West Plains Area – Geology





Pritchard et al, 2020

West Plains Area – Geology

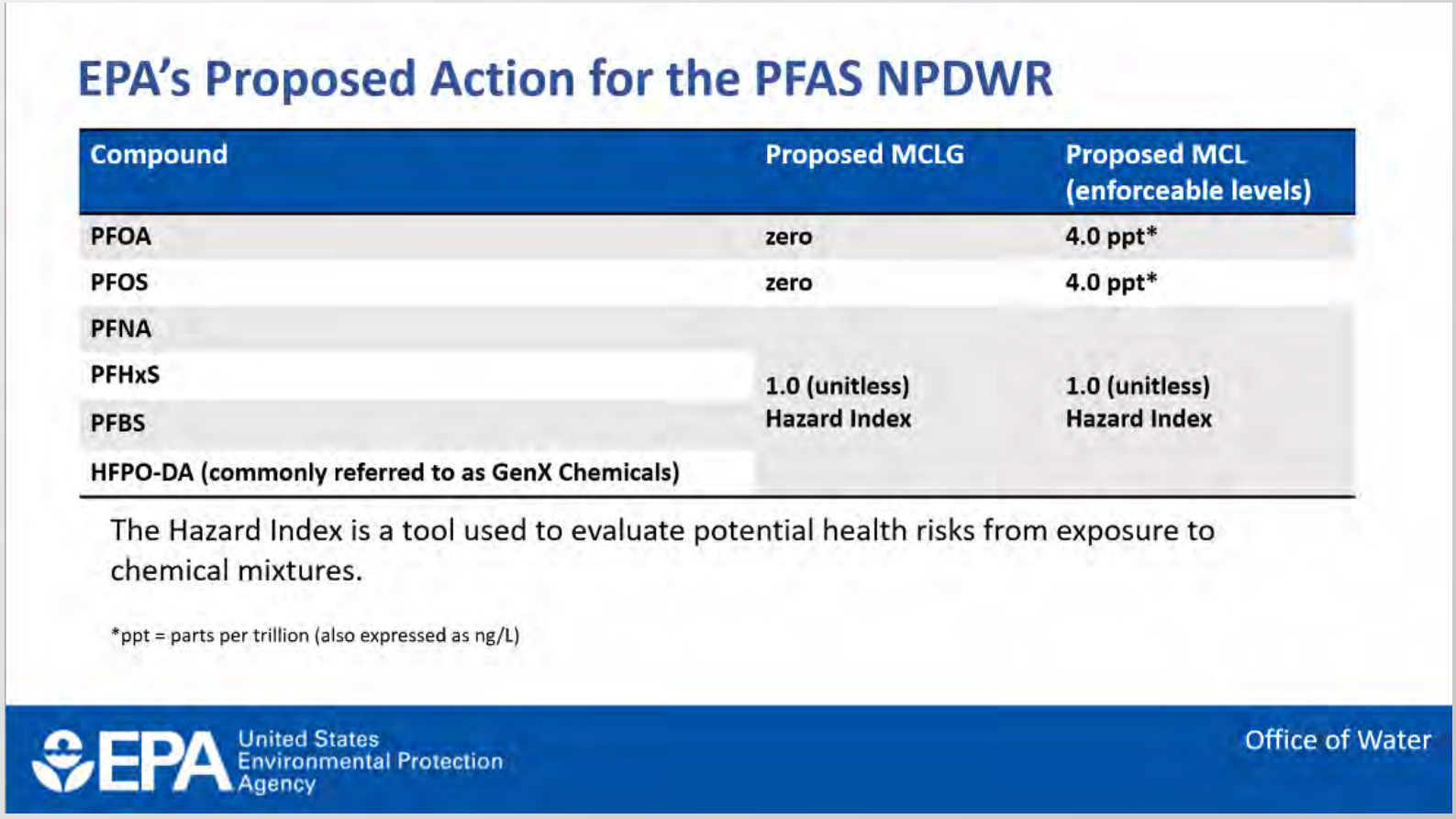


Pritchard et al, 2020

- Three aquifer systems – shallow Wanapum Basalt, paleochannels filled with sedimentary deposits, and deeper Grande Ronde Basalt
- PFAS identified in shallow Wanapum Basalt, to date
- Grande Ronde Basalt regionally confined
- Complicated fate and transport and aquifer interactions

PFAS Cleanup Concentrations – Federal

- 2016 – EPA issued lifetime drinking water health advisory of 70 ppt for PFOA and PFOS (not enforceable)
- June 2022 – EPA issued Interim Updated health advisories for PFOA (0.004 ppt) and PFOS (0.02 ppt) and final health advisories for GenX (10 ppt) and PFBS (2,000 ppt)
- March 2023 – EPA proposed maximum contaminant levels (MCLs) for 6 PFAS. Public comment period open until end of May 2023



EPA's Proposed Action for the PFAS NPDWR

Compound	Proposed MCLG	Proposed MCL (enforceable levels)
PFOA	zero	4.0 ppt*
PFOS	zero	4.0 ppt*
PFNA		
PFHxS	1.0 (unitless) Hazard Index	1.0 (unitless) Hazard Index
PFBS		
HFPO-DA (commonly referred to as GenX Chemicals)		

The Hazard Index is a tool used to evaluate potential health risks from exposure to chemical mixtures.

*ppt = parts per trillion (also expressed as ng/L)

EPA United States Environmental Protection Agency — Office of Water

PFAS Cleanup Concentrations – Washington

- July 2022 – Washington Ecology provides recommended soil and groundwater cleanup levels for 6 PFAS
- ng/L = ppt

Table 1: Recommended groundwater cleanup levels

PFAS Compound	Recommended Groundwater Cleanup Level	EPA Health Advisory Level
PFOA	10 ng/L	0.004 ng/L
PFOS	15 ng/L	0.02 ng/L
PFNA	9 ng/L	None
PFHxS	65 ng/L	None
PFBS	345 ng/L	2,000 ng/L
HFPO-DA (GenX)	24 ng/L	10 ng/L

Table 2: Recommended soil cleanup levels protective of groundwater

PFAS Compounds	Vadose Zone	Saturated Zone
PFOA	6.3E-05 mg/kg	4.0E-06 mg/kg
PFOS	1.7E-04 mg/kg	9.9E-06 mg/kg
PFNA	8.0E-05 mg/kg	4.8E-06 mg/kg
PFHxS	4.1E-04 mg/kg	2.6E-05 mg/kg
PFBS	1.8E-03 mg/kg	1.2E-04 mg/kg
HFPO-DA (GenX)	1.0E-04 mg/kg	7.2E-06 mg/kg

Table 3: Recommended soil direct contact cleanup levels

PFAS Compounds	Method B	Method C
PFOA	0.24 mg/kg	11 mg/kg
PFOS	0.24 mg/kg	11 mg/kg
PFNA	0.2 mg/kg	8.8 mg/kg
PFHxS	0.78 mg/kg	34 mg/kg
PFBS	24 mg/kg	1,100 mg/kg
HFPO-DA (GenX)	0.24 mg/kg	11 mg/kg

Cleanup Concentration Comparison

Drinking Water EPA MCLs – Common Contaminants With Lowest MCLs

Lead – 15,000 ng/L	Mercury – 2,000 ng/L	Benzene – 5,000 ng/L
Benzo(a)pyrene – 200 ng/L	Dioxin (2,3,7,8-TCDD) – 0.03 ng/L	PCBs – 500 ng/L
PCE and TCE – 5,000 ng/L	Arsenic – 10,000 ng/L	Vinyl Chloride – 2,000 ng/L

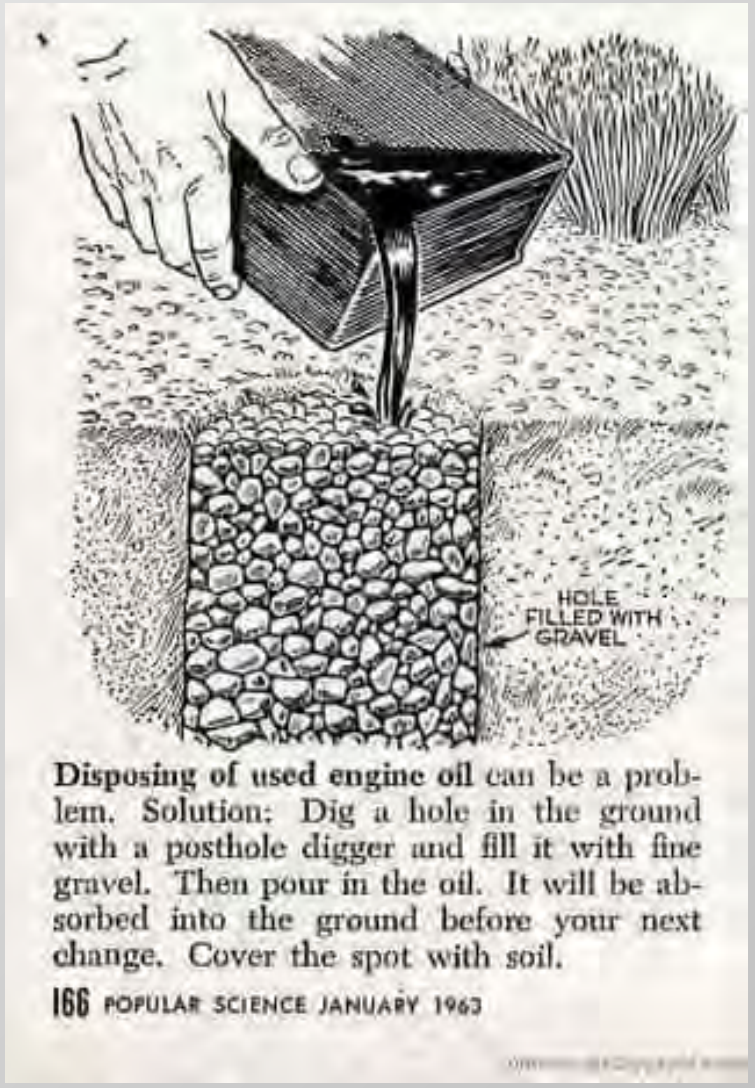
PFAS Proposed Drinking Water MCLs

PFOA – 4 ng/L

PFOS – 4 ng/L

Current Challenges in PFAS Remediation

- Unique properties require innovative remediation technologies
- Performance and operating costs depend on many factors, including:
  - Concentration and type of PFAS
  - General water quality parameters
  - Co-contaminants
- Activated Carbon – most commonly used full-scale treatment
  - Granular (GAC)
  - Colloidal
  - Powder
- Ion Exchange – second most commonly used full-scale treatment
  - Resins
- Can be high maintenance costs due to usage capacities, breakthrough times, and change-out frequency



Thank You!

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